RAPID Gate Three
Strategic Resource Option – Hampshire Water Transfer and Water Recycling Project

Supporting Annex 2: Solution Design

July 2024

Contents

2. Solution Design

2.1 Solution Description

As described in Chapter 2: Solution Design, the Hampshire Water Transfer and Water Recycling Project (HWTWRP) is a major part of Southern Water's (SW) Water for Life – Hampshire (WfLH) programme[1]. WfLH has been created address the water shortages Hampshire faces by investing in new water sources for the region whilst protecting the health of the county's chalk streams by reducing how much water is abstracted.

At Gate Two, the HWTWRP, known as Option B.4, was taken forward for further investigation (Figure 2-1). This consisted of:

- A WRP producing 15 Ml/d located near Budds Farm WTW with associated transfer pipelines between Budds Farm WTW, the WRP site, Havant Thicket Reservoir (HTR) and Otterbourne WSW to provide a maximum deployable output (DO) of 75 Ml/d.

This solution is dependent upon HTR and cannot deliver until the reservoir has been constructed and filled.

Figure 2-1 - Schematic of the transfer routes for Option B4 from the Gate Two Submission

This Gate Three submission presents a revised version of the solution, which reflect the updated regional requirements that have been identified. This is set out in Chapter 2: Solution Design.

For the HWTWRP to be able to supply water, it must interact with the key Portsmouth Water's (PW) HTR as part of a total engineering solution. There are several key components progressing around HTR that need to be integrated to ensure onward supply of water to both SW and PW customers:

- Water Recycling Plant (WRP) – Construction of a WRP located near Budds Farm Wastewater Treatment Works (WTW) that can supply a maximum capacity of 60 Ml/d;
- Transfer from the WRP site to HTR – As demonstrated in Chapter 2: Solution Design, two tunnel options are being considered to ensure the transfer of a maximum capacity of 60 Ml/d from the WRP site to HTR can be achieved;
- HTR - This is an 8700 Ml capacity reservoir being constructed by PW as a storage lake. As part of the HWTWRP, the sources for HTR will be a combination of the Havant Thicket catchment, the Bedhampton and Havant Springs (BHS), and the transfer from the WRP;
- Transfer to Hampshire - A pipeline from HTR will gravitate blended water to the HLPS at WRP. There are two tunnel options being considered for this part of the pipeline route, as set out in Chapter 2: Solution Design. The water is then pumped from the HLPS to SW Otterbourne Water Supply Works (WSW) through an underground pipeline. Otterbourne WSW then supplies SW's Hampshire Water Resource Zone (WRZs);
- Transfer to PW - A pipeline from HTR to PW's Farlington Water WSW; and
- Transfer to Sussex – A pipeline from HTR to SW's Pulborough WSW which supplies their Sussex North (SNZ) water resource zone.

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[1] Water for Life – Hampshire

2.2 Background and Objectives

The need for the HWTWRP was originally identified in SW's WRMP19[2] with the HWTWRP being incorporated into WRMP19 by SW's Annual Review in December 2021. The HWTWRP is selected in SW's upcoming revised draft WRMP24 and WRSE's revised draft Regional Plan in all future planning scenarios. These plans have been developed in line with all applicable regulatory policies, requirements and objectives set out by the EA for England in the National Framework for Water Resources[3].

There has been significant change since WRMP19 with a number of key drivers and changes, including:

- The National Framework, published in 2020;
- The introduction of the concept of best value planning;
- Adoption of an Adaptive Planning approach; and
- The Water Resources Planning Guideline 2023.

The Water Resource Management Plan (England) Direction 2022, issued in April 2022, and the accompanying government expectations for water resources planning, set out key expectations for WRMP24. This included the alignment with the WRSE revised draft Regional Plan[4] covering the periods 2023-25 and 2025-75, presenting them separately. SW have set out key policy areas in which they seek to address through the revised draft WRMP24 that has been prepared.

For several planning cycles, SW have been involved in developing regional plans as part of the WRSE group[5]. The Regional Plan development has required detailed and complex technical work, building on work undertaken by member companies for previous WRMP's as well as implementing new methods and datasets to form the Regional Plan. Preparation of the Regional Plan has been a multi-stage process undertaken over several years.

In January 2022, an emerging water resources Regional Plan was published by the WRSE for a period of public consultation. This emerging plan presented a cost-efficient plan, with the best value planning not yet completed. The feedback received from the consultation taken into account by WRSE for its preparation of its draft Regional Plan.

The WRSE draft Regional Plan was published in November 2022 following the completion of the best value planning processes for public consultation. The best value plan identified the detailed demand management and new water resources developments that would be required to be delivered in response to the significant scale of water resources challenges facing the South East. The draft Regional Plan explained how the proposals are capable of being adapted to a wide range of futures, with new investment in the early part of the plan period capable of adapting to any of a range of potential futures that might arise. Many of the consultation responses that were received related to the new infrastructure resource developments proposed. WRSE and member companies commissioned additional customer research on the proposals to gain further insight into how customers view and value the proposals.

A further revised draft Regional Plan that incorporates the changes identified through the consultation process, was published for information in August 2023[4]. This publication was used to support the separate statutory processes being undertaken by the WRSE member companies as they prepare their individual WRMPs. Following on from consultation on the draft WRMP's in late 2022 and early 2023, the member companies have prepared statements on how the draft WRMP's have changed as a result of the consultation process along with revised drafts.

2.2.1 Water Resource Management Plans

SW have developed the WRMP24 in line with the WRPG[6], ensuring compliance with statutory obligations and in accordance with relevant government policy and environmental legislation can be achieved. This plan ensures the links to a wide range of other plans and programmes that are being delivered or are to be delivered with SW and the wider South East region (Figure 2-2).

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[2] Southern Water's Water Resources Management Plan 2019
[3] National Framework for Water Resources
[4] WRSE Revised Draft Regional Plan August 2023
[5] Our members | WRSE - Water Resource South East
[6] Water resources planning guideline April 2023

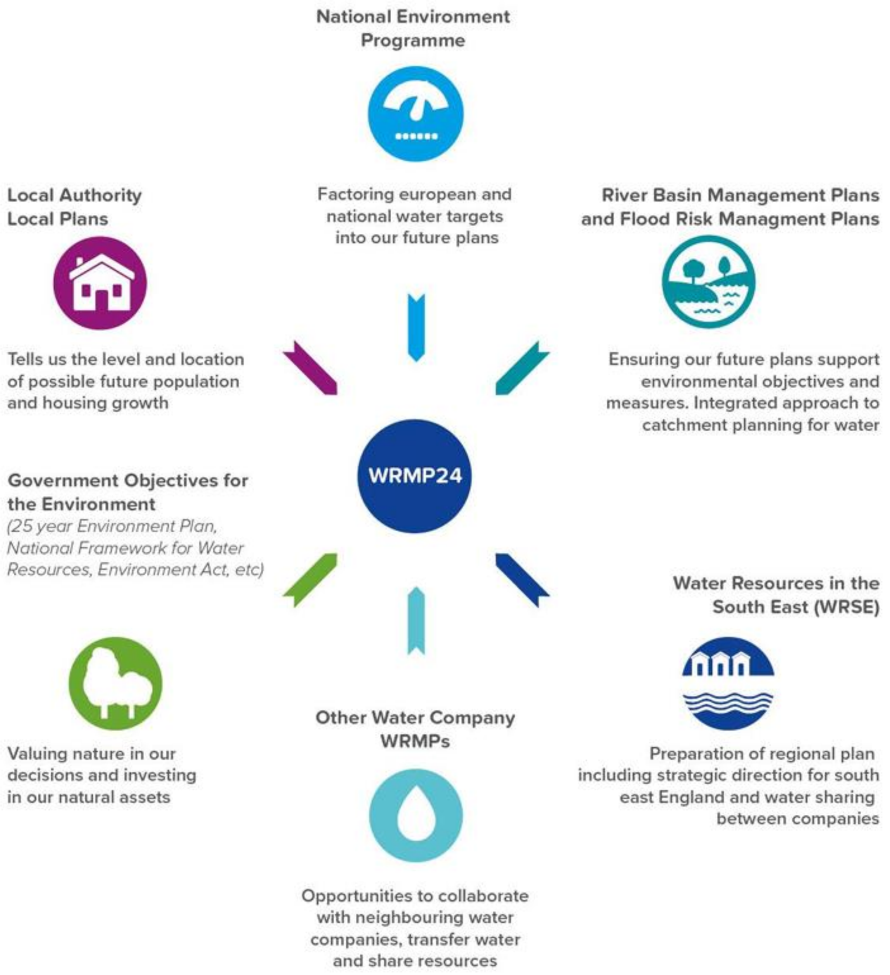

Figure 2-2 - Links between WRMP24 and other plans and programmes.

The EA and NE have set out their expectations on the need to deliver ambitious reductions in abstractions to protect the environment. SW have included a range of scenarios in the WRMP that seek to meet the current and future needs of the environment.

2.2.1 Best Value Planning Approach

When preparing its plans, WRSE has constructed two types of plans:

- Least Cost - this only considers the cost of the plan; and
- Best Value – this considers costs, and other metrics as defined below.

The best value planning approach is explained in the WRSE Best Value Planning Method Statement[7]. This provides the process, approach and development of the best value planning that has been used to determine the options selected that are selected in the WRMP24 and WRSE revised draft Regional Plan, which includes the HWTWRP as presented in the submission.

Water companies and some third parties submitted options to WRSE to consider in the Regional Plan[8]. This included existing options and new options, identified via the engagement process. In total more than 4000 options were appraised.

WRSE member water companies identified and provided data, for the regional supply, demand and transfer options not included in the baseline, whether existing, under construction or new. These options could be:

- Option elements (resource, conveyance);
- Option phases (modular increases in resource DO); or
- Option stages (planning, development, construction, and operation).

These options have been set out and appraised through the WRSE regional planning processes. The options selected and the process which has been used to determine the options put forward can be identified in WRSE revised draft Regional Plan and supporting documents[9]. Further detail as to the best value planning approach and the benefits of the HWTWRP can be found in Chapter 8: Solution Costs and Benefits.

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[7] WRSE Developing our 'Best Value' multi-sector regional resilience plan February 2021

[8] WRSE Revised Draft Regional Plan August 2023 (Section 7.2 page 79)

[9] WRSE Revised Draft Regional Plan and Supporting Documents

2.2.2 The Role of the HWTWRP in the WRSE revised draft Regional Plan

The South East of England will enter a deficit scenario unless demand is reduced, and additional resource schemes are developed. This shortfall could occur as early as 2030 in 1-in-500-year drought, or as late as 2050 under average climatic conditions[10]. All the regions within the South East have been considered for a surplus or deficit of water as part of the regional planning process. Where opportunities to share resource between regions have been identified they have been incorporated into the Regional Plan as options. The locations of key supply schemes have been identified in the WRSE revised draft Regional Plan for the period 2025 to 2035 (Figure 2-3). These options are currently determined as least regret options required under any of the future scenario's tests and will allow the ability for adaptation to any of the future pathways beyond 2035. The HWTWRP and transfers with HTR schemes have been included as part of this plan.

Most of the options put forward for development in the planning periods between 2035 and 2075 have been proposed for completion in the period up to 2040 and 2050, this will allow the Regional Plan to achieve its increased drought resilience by 2040, and its environmental destination by 2050.

From 2035 onwards there is a greater level of uncertainty in the model outputs, therefore, to mitigate this a greater number of options, with additional DO capacity, will be required to ensure the Regional Plan remains on track to meet its objectives, especially under the more challenging future scenarios. These key schemes and locations have been identified in the revised draft Regional Plan in the period 2035-2075 (Figure 2-4). The HWTWRP has been selected in all future scenarios.

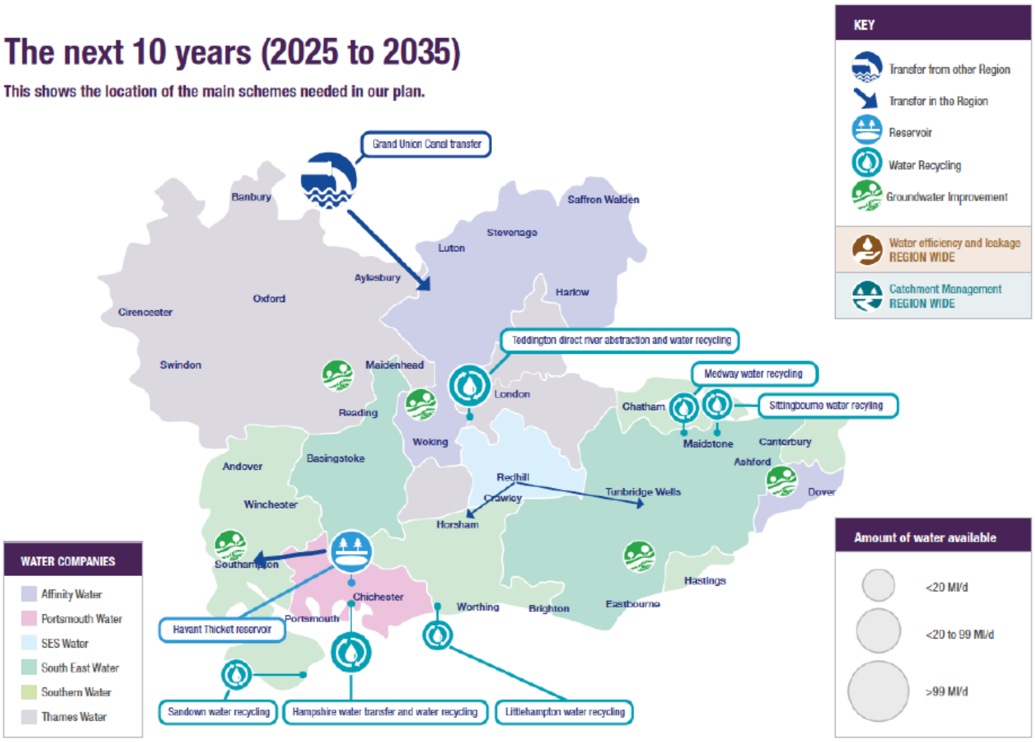

Figure 2-3 - Proposals for 2025 to 2035 – locations of key schemes[11].

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[10] WRSE Revised Draft Regional Plan August 2023 (Section 9.2, page 89)

[11] WRSE Revised Draft Regional Plan August 2023 (section 9.1 page 91)

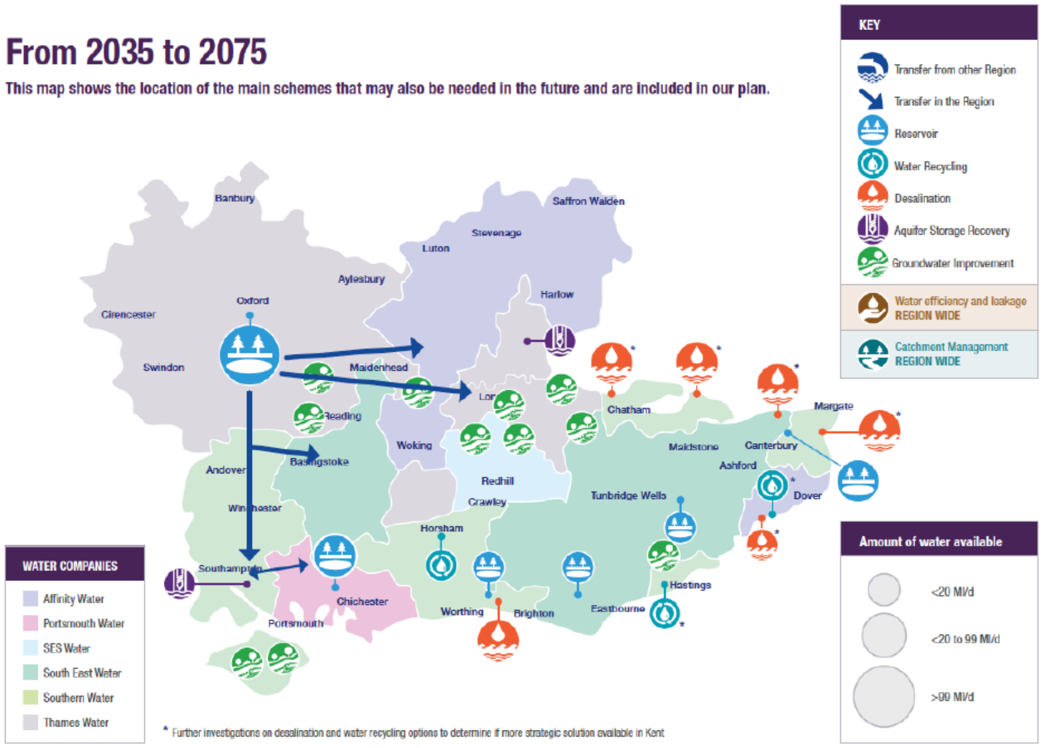

Figure 2-4 - Proposals for 2035 to 2075 – locations of key schemes[12].

The Regional Plan has identified the need for both new reservoirs schemes and schemes that will increase the size of the existing reservoirs[13]. There are limited locations across the South East where reservoir can be built due to water availability, geology, and social and environmental factors. HTR is a WRMP19 scheme which has planning permission, and its construction is underway. It will be able to provide an average of 21 Ml/d through a direct transfer to Hampshire South East Water Resource Zone (WRZ) initially, and then more when combined with the recycled wastewater from the HWTWRP[14]. It is a critical solution for ensuring water security in the South East for generations to come.

The six member companies of WRSE already share some of the region's water supplies through pipelines that link their supply areas. There are also pipelines that link the companies water resource zones which enable them to move water around their own supply areas. There are also imports into the region from companies outside of the WRSE area[15]. The Regional Plan has identified new transfers to increase how much water can be moved around the region. As new sources of water are developed, they will be shared between companies helping to increase the resilience of the regions water supplies. As part of this network the Regional Plan identifies some new strategic transfers are required, all of which are being investigated through the RAPID gated process[16][17].

2.2.3 Solution Scalability and Interaction and Phasing with Other SROs – AMP9

Due to the timeline of the deficits in the Western and Central areas, the HWTWRP will be progressed and implemented as soon as possible (2034-35). This will require the HWTWRP to be delivered in a single phase producing the maximum capacity of 90 Ml/d DO, including delivering the WRP to its maximum capacity of 60 Ml/d, rather than a phased approach to construction that is scaled up to the maximum output.

The proposed transfers between water companies in AMP8 and AMP9 with the anticipated additional DO from the HWTWRP and HTR have been identified (Figure 2-5)[18].

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[12] WRSE Revised Draft Regional Plan August 2023 (Figure 9.2, page 93)
[13] WRSE Revised Draft Regional Plan August 2023 (Section 12.20 page 114)
[14] WRSE Revised Draft Regional Plan August 2023 (Section 12.21, page 114)
[15] WRSE Revised Draft Regional Plan August 2023 (Sections 13.1 – 13.3, page 124)
[16] Regulators Alliance for Progressing Infrastructure Development (RAPID)
[17] WRSE Revised Draft Regional Plan August 2023 (Section 13.6, page 124)
[18] Portsmouth Water Revised Draft WRMP24 Appendix 1C – Southern Water and Portsmouth Water Common Understanding

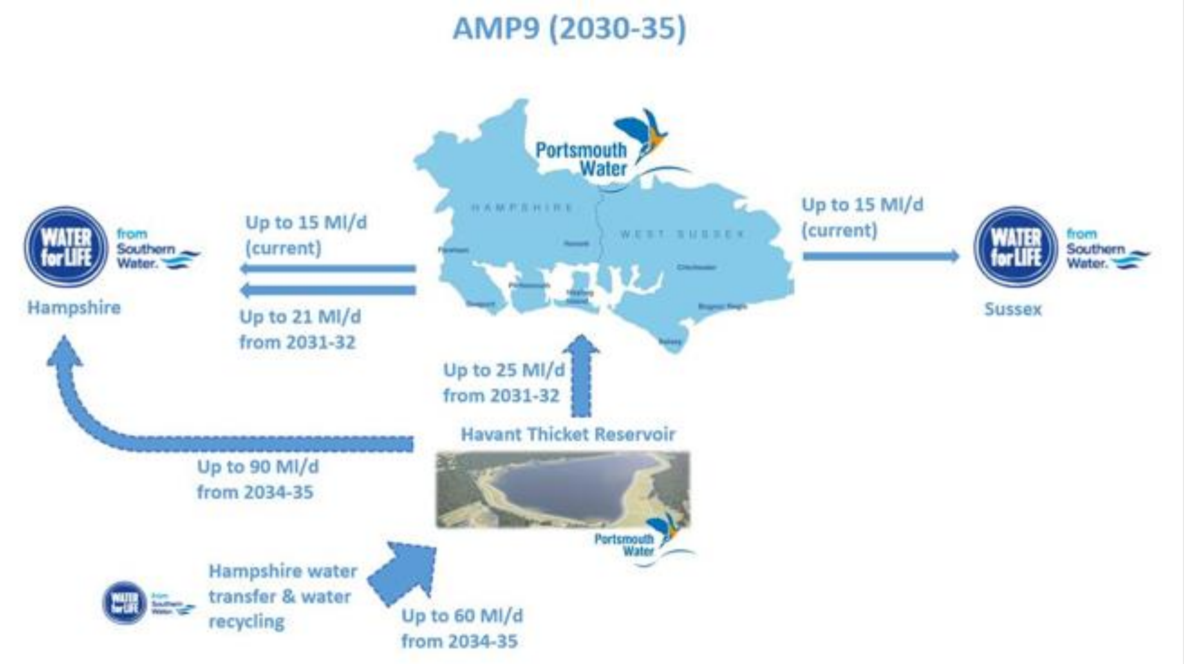

Figure 2-5 - Planned transfers between PW and SW following the completion of HTR and the HWTWRP

There are, however, options to scale the wider solution and the transfers once interactions with the SRO project within the wider region become available from AMP10.

2.2.4 Interaction and Phasing with Other SROs – AMP10 and Beyond

From 2039-40 there are two additional SRO projects which can interact with the HWTWRP and HTR. These are:

- The South East Strategic Reservoir (SESRO) - a new reservoir located near Abingdon, that offers storage and a resilient supply of raw water to the River Thames, currently planned to be available after 2040;
- The Thames to Southern Transfer (T2ST) - a transfer from the SESRO into the Hampshire WRZs, currently planned to be available after 2040.

These SRO projects are planned to work together to transfer water into the Hampshire WRZs (Figure 2-6). SW, PW and the WRSE have modelled multiple future scenarios to account for various variables described in adaptive planning (see Chapter 2: Solution Design). These additional SROs will interact with the HWTWRP and HTR system in the reported pathway, Situation 4. The benefit that would be provided by these schemes impacts the planned future transfers between SW and PW once SESRO and T2ST are operational.

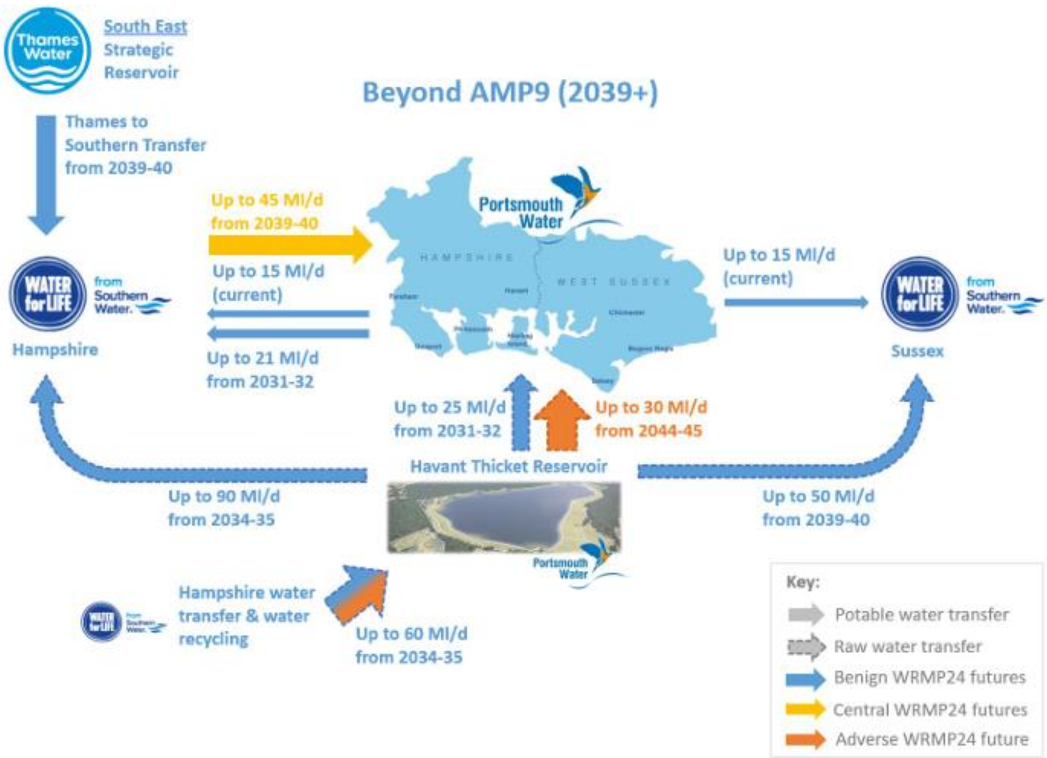

Figure 2-6 - Planned transfers between SW and PW including the SESRO and T2ST under multiple WRMP future scenarios.

2.2.5 Conjunctive Use Benefit

SW and PW have collaboratively produced an annex[18], to set out the common understanding of several bulk supply transfers between the two companies which have been used in the baseline forecasts and final WRMP's. This details the existing imports and exports between the company water resource zones and includes details of HTR and associated bulk supply transfer to Otterbourne WSW.

HTR

PW's draft WRMP24 included HTR, identifying its first use in 2029-30. This would enable a new 21 Ml/d treated bulk supply to SW's Hampshire South East Water Resource Zone (WRZ) in the event of drought.

This has since been adjusted to 2031-32 in PW's revised draft WRMP24[19] due to delays with the delivery of the reservoir and an opportunity to future proof the pipeline tunnel between BHS and HTR that would, if approved, accommodate part of the HWTWRP.

The WRSE investment model has been updated to include this delay within the baseline supply demand forecast. The deployable output (including the conjunctive use benefits) taken by PW from HTR vary across the different adaptive planning situations and drought scenarios.

The HWTWRP, HTR and Transfer to Otterbourne WSW

The HWTWRP is dependent upon HTR, and HTR must first be completed to ensure the HWTWRP can operate. SW's draft WRMP24 included the HWTWRP, identifying its first use of the scheme in 2030-31. Since the draft WRMP24 a detailed evaluation of the risks involved in delivery has taken place which has led to the scheme being first available in 2034-35 as set out in Chapter 6: Programme and Planning.

In the first five years of operation, the HWTWRP provides between 20 Ml/d and 30 Ml/d within a normal year/typical year scenario. From 2039-40 the utilisation of the WRP increases to 60 Ml/d in most years under the reported pathway, Situation 4.

The utilisation of the water transfer to Otterbourne WSW is greatest and more variable within a normal year/typical year scenario, as identified within the different adaptive planning situations and drought scenarios modelled. This is largely driven by SW's environmental destination and the impacts to supply as a result of abstraction reductions.

HTR to Sussex North Raw Water Transfer

SW's upcoming revised draft WRMP24 has included a new transfer from HTR via Pulborough WSW to its Sussex North WRZ, supported by DO from the WRP.

The transfer is utilised across most scenarios (normal year though to severe drought), although it is not needed in the summer critical period scenario. Utilisation commences in 2039-40 and varies significantly depending on the

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[19] Portsmouth Water Revised Draft WRMP24

adaptive planning situation. This transfer has been included with the SW's upcoming revised draft WRMP24 however is out of scope for the SRO.

SW to PW Import and Export

PW's draft WRMP24 included a new treated import from SW's HSE WRZ. The import is utilised again from the revised draft WRMP24 but around ten years earlier in 2039-2040.

The utilisation of the treated import to PW is utilised in most scenarios (normal year through to severe drought annual average scenarios) under the reported pathway (Situation 4), although it is not needed in the summer critical period scenario.

The import to PW from 2039-40 is enabled by the implementation of key WRSE regional schemes, these are:

- The HWTWRP;
- Thames Water's South East Strategic Reservoir Option (SESRO); and
- Thames to Southern Transfer (T2ST).

The earliest year in which SESRO can be implemented is 2039-40, but once delivered it unlocks the new transfer to SW's Hampshire WRZ, which alongside the HWTWRP creates a surplus of water that can be transferred to PW.

It is recognised that with the contractual 21 Ml/d export from PW to SW under the HTR there is a degree of re-circulation of water when considering this alongside the new import from SW to PW. The contractual arrangements of this transfer will be considered further in WRMP29.

2.3 The Preferred Solution Option

2.3.1 Option Evolution

The timing of investment and utilisation of the solution have continued to be refined during Gate Three. SW and PW have utilised the high-level Water Resources South East (WRSE) RSS model to develop and represent the Western area and the PW supply areas. The results of the Pywr modelling have been used to inform the WRSE investment model, which in turn was used to inform the revised draft Regional Plan and SW's and PW's draft WRMP24.

Further development of this model has allowed the more granular Pywr model to better represent the detailed networks, river, and groundwater constraints. This has resulted in the following project changes:

WRP

To accommodate the need to achieve a 1-in-500-year drought scenario and meet update supply demand deficit that would be the result of an adverse environmental destination. Three potential new scenarios 20 Ml/d, 40 Ml/d and 60 Ml/d were considered. The modelling outcomes of these scenarios have shown that the maximum capability of 60 Ml/d at the WRP would now be required to ensure the future demand can be achieved.

Transfer from HTR to Otterbourne WSW

Further modelling on the transfer from HTR to Otterbourne WSW, has led to an improved understanding of the peak capacity (see Chapter 2: Solution Design), which has now been increased to 90 Ml/d.

Changes to Timeframes

As the scope for the solution has continued to mature, testing of the delivery schedule has been conducted, including using Quantitative Risk Analysis (QSRA) which has enabled greater understanding of the project. The revised "construction ready" and "operational ready" dates are presented in Chapter 6: Programme and Planning.

This solution cannot deliver until HTR has been constructed and filled. The construction of HTR was initially expected to begin in spring 2024, however there have since been changes regarding the delivery, that seek to reduce the long-term disruption for local residents and minimise the overall environmental impact of the solution when delivered alongside the HWTWRP. The revised completion date for HTR can be found in Chapter 6: Programme and Planning.

The revision of these dates will mean that there will be a delay to the introduction of some of SWs' abstraction reductions that support the environmental destination targets in parts of the Western and Central areas.

2.4 The WRP and High Lift Pumping Station (HLPS)

As described, the HWTWRP requires the production capacity of the WRP to increase from 15 Ml/d to 60 Ml/d. At Gate Two, the design targeted a minimum recycled water output of 7.5 Ml/d. This has since been revised at Gate Three, to facilitate greater process turndown, with a minimum production flow of around 10 Ml/d. This revised process design will enable the operator to adjust recycled water production in increments of 10 Ml/d between the minimum and maximum flow conditions as required.

There is no change to the proposed treatment train for the WRP as reported at Gate Two. The multi-barrier treatment process shall include micro/ultrafiltration (MF/UF), reverse osmosis (RO), an ultraviolet light advanced oxidation process (UV-AOP), granular activated carbon (GAC) adsorption, and remineralisation.

The WRP process configuration specified for the Gate Three Submission is illustrated as a process flow diagram (Figure 2-7). Key design changes have occurred since Gate Two and Gate Three, reflecting the revisions and update of the design as development has continued (Table 2-1). These changes have been reviewed by independent subject matter experts in the UK to validate and provide confidence in the mass balance and process unit sizing/configuration which has been prepared for the Gate Three design.

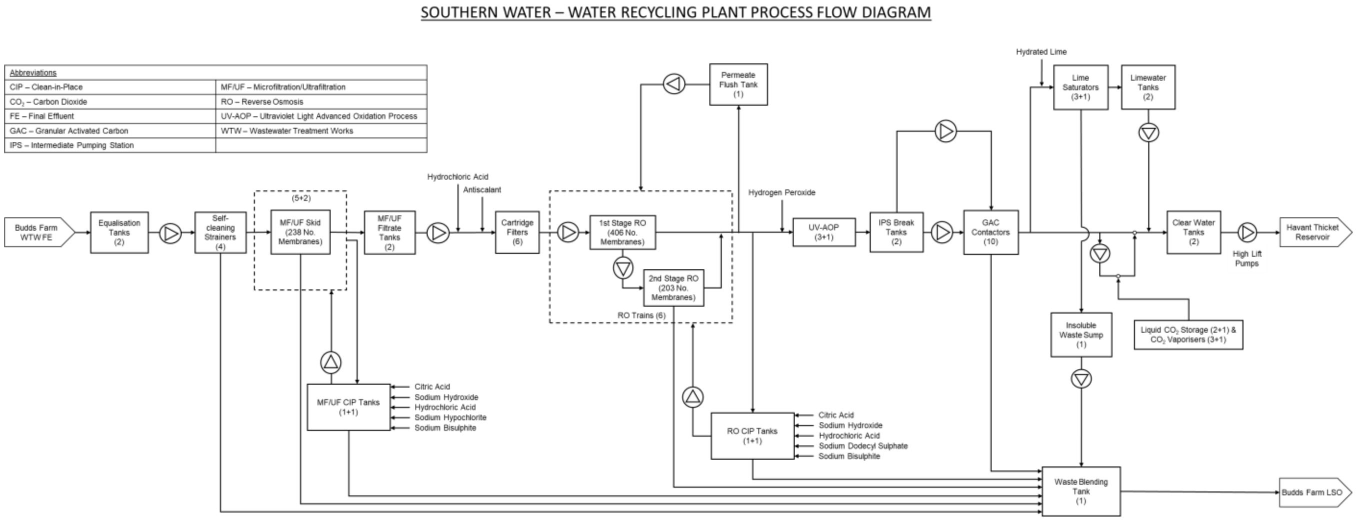


Figure 2-7 - Process flow diagram for the Gate Three WRP design

The design presented for Gate Three offers' opportunities for offsite fabrication of the following modular treatment units at each treatment stage:

- Strainers, Cartridge Filter Housings, MF/UF Skids, RO Trains, and UV Reactors – suppliers typically adopt standardised modular units, fabricated at a centralised facility for subsequent dispatch and installation on site. Larger MF/UF and RO units could be dispatched in sections, requiring some on-site assembly;
- GAC Contactors – the diameter of the GAC contactors was constrained to enable off-site fabrication and transport to site by road; and
- Chemical Storage and CIP Tanks – with the possible exception of lime silos, all chemical storage tanks are sized for offsite fabrication and transport to site by road; this includes the vacuum insulated liquid CO_2 storage tanks which are sized for international shipping.

The revised 60 Ml/d WRP design capacity is forecasted to be the maximum flow achievable using only the final effluent from Budds Farm WTW under drought conditions. If the need for further recycled water production in Hampshire arises, this would require the transfer of final effluent from another WTW, or for a second WRP to be deployed local to this WTW. This possibility was discussed at Gate Two through the potential use of Peel Common WTW.

Table 2-1 – Key Design changes for WRP since Gate Two

Process Area	Design Parameter	Units	Gate Two Specification	Gate Three Specification	Comments
General	Final Effluent to WRP	Ml/d	19.5	81.6	The maximum recycled water output required from the WRP was increased from 15 Ml/d to 60 Ml/d, reflecting a change in the level of service from 1-in-200-year to 1-in-500-year drought operation across SW's and PW's asset base.
	Maximum WRP Output	Ml/d	15	60	Change in recycled water production capacity and turndown capability for the WRP to reflect the change in strategy for the HWTWRP at Gate Three.
	Minimum WRP Output	Ml/d	7.5	10	
	WRP Process recovery	%	77%	74%	Reduction in overall process recovery is based on the change in design recovery for the RO to reduce complexity of the process units to reduce overall operating risk.

Feed Equalisation Tank	No. of Tanks	#	1	2	Change in number if tanks to facilitate cleaning without interruption in final effluent supply to the WRP. It is assumed cleaning will be undertaken outside of drought conditions to maintain maximum available equalisation volume during full flow operation of the plant.
	Volume	Ml	0.9	26.5	Equalisation volume increased as the increase in final effluent demand from 19.5 Ml/d to 81.6 Ml/d has substantially increased the projected water availability deficits associated with diurnal flow variations and cumulative flow deficits from sustained periods of low flow.
Self-cleaning Strainers	No. Units	#	2 duty, 1 standby	4 duty	The number of self-cleaning strainers and the individual unit sizing was increased to reflect the increased process throughput. Strainer sizing at Gate Three is on an N-1 basis, ensuring redundancy is incorporated in the design, but with all units subject to continuous operation.
MF/UF	No. of Skids	#	2 duty, 2 standby	7 duty	The total number of MF/UF skids was increased from 4 to 7 to reflect the increased process throughput. The Gate Two design assumed 2 duty and 2 standby units. The skids in the Gate Three design were sized on an N-2 basis using average and peak membrane flux values specified by a supplier quote at Gate Two. This approach required a change from 250 membranes per skid to 238.
	Membranes per Unit	#	250	238	
	Cleaning Chemicals	-	Sodium hypochlorite Citric Acid Sodium bisulphite Sodium hydroxide	Sodium hypochlorite Citric Acid Sodium bisulphite Sodium hydroxide Hydrochloric acid	Hydrochloric acid added to cleaning regime for use neutralising sodium hydroxide. This was identified as the preferred approach to neutralisation (versus citric acid) due to the existing hydrochloric acid demand for the process, plus the elimination of additional Biochemical Oxygen Demand (BOD)/Chemical Oxygen Demand (COD)/Total Organic Carbon (TOC) which would be added to the blended waste stream by the use of additional citric acid.
	Average Membrane Flux	$l/m^2.h$	32	45	Gate Two design based on the peak membrane flux specified in a supplier quote; the number of skids and membranes per skid in the Gate Three design were defined to align with the average and peak flux values specified by the same quote.
	Peak Membrane Flux	$l/m^2.h$	62	62	
	Estimated Average Process Recovery	%	95	96	The Gate Two design adopted a fixed high-level assumption of 95% recovery; the recovery in the Gate Three design was calculated based on the cleaning regime specified in the mass balance and process sizing (referenced to available supplier literature).
Cartridge Filters	No. Units	#	2 duty, 1 standby	6 duty	The number of cartridge filter vessels and the individual vessel sizing was increased to reflect the increased process throughput. Sizing at Gate Three is on an N-1 basis, ensuring redundancy is incorporated in the design, but with all units subject to continuous operation.

RO	No. of Trains	#	2 duty, 1 standby	6 duty	RO trains are designed to operate with a fixed flow and recovery. The Gate Two design used 2 duty trains, each with an output of approximately 7.5 Ml/d. Following the change in design flow in Gate Three, 6 duty trains, each producing around 10 Ml/d are required. The standby train included in the Gate Two design has been removed in Gate Three with the expectation that a suitable inventory of critical spares would be maintained to quick restore operation in the event a train fails. Given the high turndown requirement (minimum flow of 10 Ml/d) specified at Gate Three, the additional operational complexity/risk associated with the standby unit was deemed to outweigh the risk of partial process outage with its removal.
	No. of Stages	#	3	2	The complexity of the RO trains was reduced between Gate Two and Gate Three by the removal of the third stage, simplifying operation and control for these units. This change required the design recovery to be reduced from 82% to 78% and the number of membrane elements in each pressure vessel to be increased from 6 to 7. These changes were validated using RO modelling software to demonstrate compliance with supplier specifications for internal hydraulics and membrane fouling risk.
	Elements per Vessel	#	6	7	
	Design Flux	l/m^2.h	18	19	
	Design Recovery	%	82	78	
	Number of Vessels (stage 1/stage 2/stage 3)	#	44/22/12	58/29	Standard staging ratio for a 3-stage system of 4:2:1 adopted at Gate Two. Changed to the ratio for a 2-stage system (2:1) at Gate Three. This was validated using RO modelling software to demonstrate compliance with supplier specifications for internal hydraulics and membrane fouling risk.
	RO Feed Conditioning Chemicals	-	Hydrochloric Acid Antiscalant	Hydrochloric Acid Antiscalant	No change.
	Cleaning Chemicals	-	Citric acid Hydrochloric acid Sodium hydroxide Proprietary RO cleaner	Citric acid Hydrochloric acid Sodium hydroxide Sodium dodecylsulphate	The Gate Two design retained a placeholder for an additional cleaning chemical, assumed to be a proprietary product which could be specified by an RO membrane supplier at a later stage of development. Sodium dodecylsulphate was identified as a likely additional cleaning chemical requirement based on available literature from a large RO membrane supplier.
UV Units	No. of Reactors	#	1 duty, 1 standby	3 duty, 1 standby	Additional duty units to accommodate higher process flow.
	Dosed Chemical Oxidant	-	Hydrogen Peroxide	Hydrogen Peroxide	No change.
	Peak UV Dose	mJ/cm^2	900	900	No change.
GAC	Type	-	Pressure vessel	Pressure vessel	No change. Pressure vessel sizing constrained on the assumption of off-site fabrication and delivery to site via road transport.

	No. of Contactors	#	5 duty, 1 standby	10 duty	Increase in number of units due to increase in flow through the works. The Gate Three GAC contactor sizing is based on N-1. There effectively remains a standby unit, but it will be in operation whenever available, so is presented as a duty unit for the purpose of this summary.
	Minimum Empty Bed Contact Time	min	10	10	The empty bed contact time remains unchanged from Gate Two to Three. Specified for removal of trace organic decomposition products and to quench any residual hydrogen peroxide from the UV-AOP.
Remineralisation	Remineralisation Chemicals	-	Powdered Lime Carbon Dioxide Sodium Hydroxide	Powdered Lime Carbon Dioxide	With more detailed assessment of remineralisation requirements, it was concluded that the desired final water quality could be achieved without the addition of sodium hydroxide.
	No. of Lime Saturators	#	Not specified	3 duty, 1 standby	The remineralisation regime was not specified at Gate Two. Recycled water quality projections have since been prepared for various degrees of remineralisation including the extremes of minimal remineralisation to stabilise the water (as indicated by a suite of corrosion indices) and remineralisation to target the existing sources at Otterbourne WSW (i.e., maximum). The process was sized to accommodate the maximum regime; however, an intermediate scenario has been carried forward in water quality modelling. This is expected to balance water quality & environmental risks with the operational complexity, cost, and carbon impact.
	Lime Saturator Diameter	M	Not specified	13.2	
	Maximum Hydraulic Loading Rate	m^3/m^2.h	Not specified	1.0	
	No. of Limewater Tanks	#	Not specified	2 duty	Limewater storage specified to facilitate ramp up of the process in approximately 10 Ml/d flow increments whilst also returning a lime saturator to service.
	Tank Working Volume	m^3	Not specified	116	

2.4.1 Site Layout

Between the Gate Two and Gate Three the site layout has been developed taking account of:

- The increase in production capacity of the WRP to from 15 Ml/d to 60 Ml/d, which gives rise to an increased plant footprint;
- An assessment of existing and new geo-environmental data for the site; and
- The surrounding landscape.

This has been developed as an illustrative layout (Figure 2-8) to inform the maximum parameters of the WRP site that has been used to inform the Preliminary Environmental Information Report as part of the EIA process consulted on as part of the Statutory Consultation in the summer of 2024.

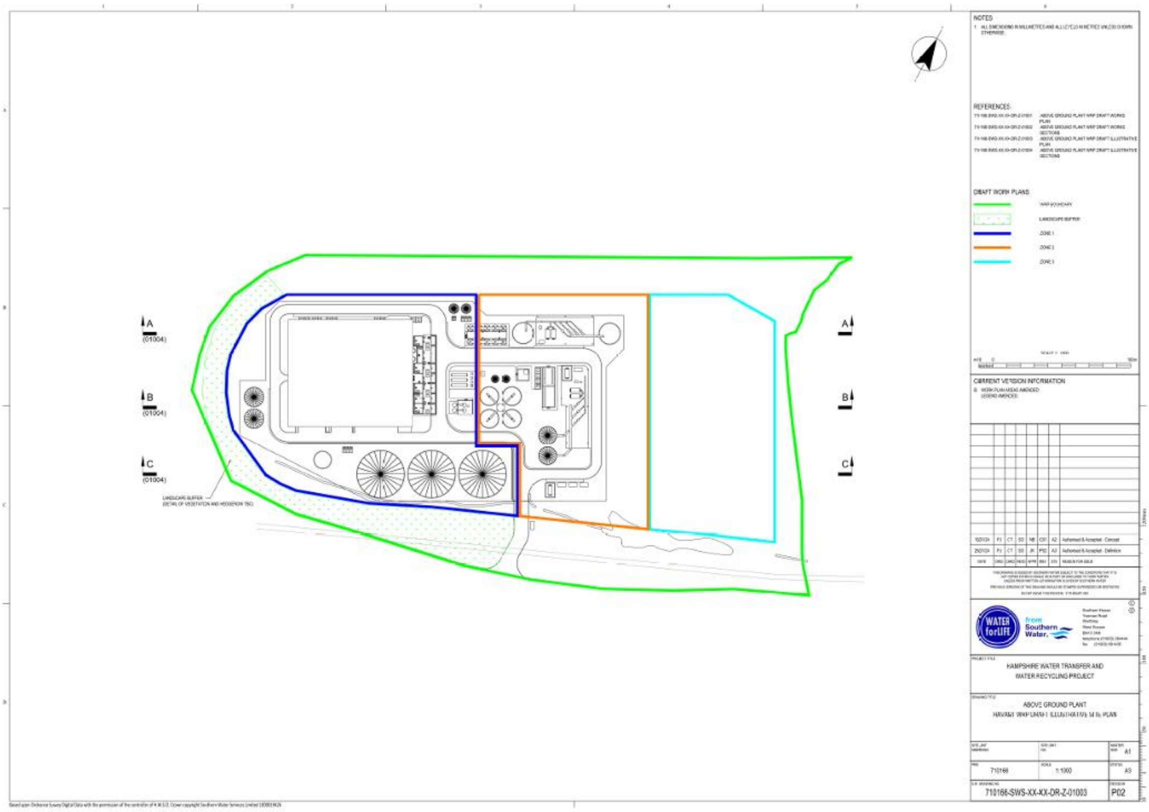


Figure 2-8 - Illustrative layout of WRP

2.4.2 Geoenvironmental Considerations

The WRP site comprises part of the wider closed and restored former landfill (Brockhampton West). It is located immediately west of the Hermitage Stream and immediately north of Langstone Harbour (SSSI, SPA, SAC, Ramsar site etc.).

The ground investigation undertaken indicates that the waste appears to have been deposited in two main areas:

- The eastern “cell” a mounded landform contains generally more domestic waste, that is between 6.8 m and 15.2 m thick;
- The western “cell” generally level and lower lying contains generally more commercial / industrial waste, that is between 4.7 m and 9.0 m thick.

At the current stage of design, the aim is to locate the WRP and associated infrastructure predominantly within the western “cell” where the existing ground levels and topography are preferable.

- This minimises (as far as reasonably practicable) the requirement for excavation, off-site disposal and treatment of the waste, and the sustainability impacts / expense that accompany them;
- There will inevitably be some disposal required, e.g., pile and service trench arisings, however this will be minimised by design; and
- A piling mat can be installed quickly and easily following an initial site strip, breaking the pathway for the human health hazards.

There is an active contaminant linkage at the site - the migration of contaminated leachate into the adjacent groundwater and surface water (ecological receptors). This is the expected behaviour of a dilute and disperse landfill. Source treatment / removal is neither sustainable nor economically viable. The construction of the HWTWRP is expected to achieve overall betterment by minimising infiltration through the waste body and so reducing the rate of leachate generation.

2.4.3 Site Entrances, Roads and Screening

As indicated on Figure 2-8, the current site layout in the illustrative design utilises existing site entrances, which are located away from road junctions and this approach will minimise ecological and biodiversity impact.

The site is edged by trees and woodland, particularly on the North and West. The design locates the works and security fence away from the edge of the site to minimise, as far as practicable, the potential loss of habitat, retain the benefit of screening within the landscape, and give the opportunity for enhancement of screening and biodiversity through additional planting. The outdoor equipment with industrial appearance is located to the centre, so further screened behind the main building and larger tanks. With planting for screening around the site boundary, the backdrop to Langstone harbour should not be significantly impacted.

Road layout within the site takes account of chemical deliveries, operational and maintenance staff and visitors who would use potential education and/or community engagement facilities.

Space on the West side of the site is allocated for a construction compound and potentially a solar power installation that would provide some renewable energy without the need for piled foundations or significant intrusive works in that portion of the former landfill. This would not be visible from external viewpoints.

2.4.4 Surface Water Drainage

Across the programme, the principles of Sustainable Urban Drainage Systems (SuDS) have been applied in the development of design (Figure 2-9). For the Water Recycling Pant site, the approach to surface water drainage has been refined to align with the intent to minimise infiltration and therefore leachate with would provide further biodiversity enhancement.

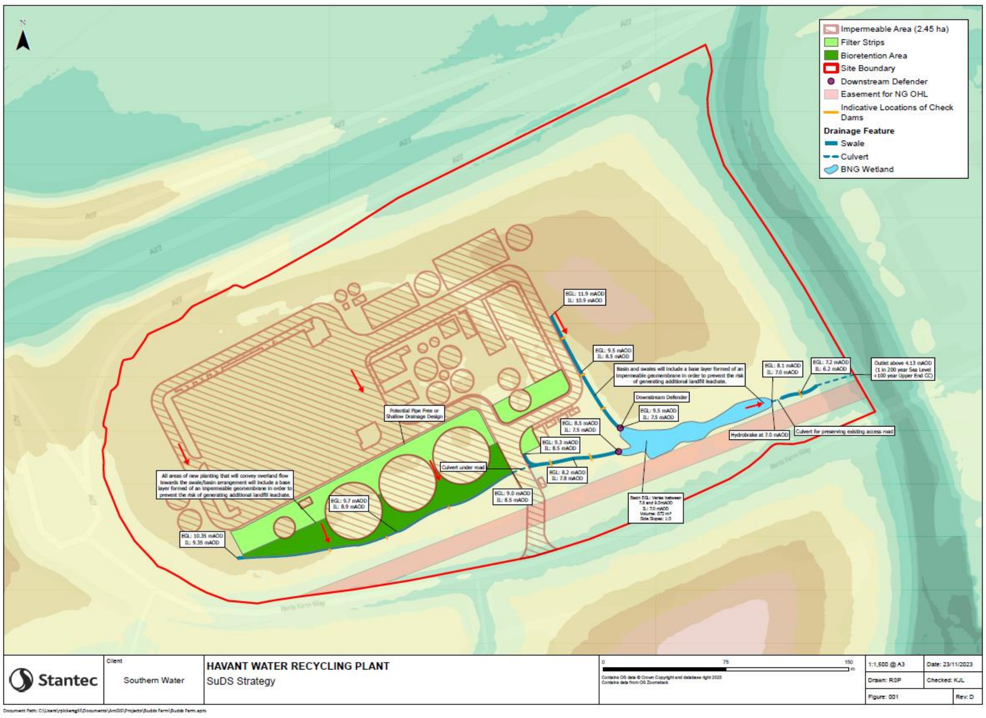


Figure 2-9 - WRP SuDS assessment.

2.4.5 Plant and Equipment

The process design has been updated for Gate Three (Figure 2-7). This shows the number of main process units in the current design. The key supporting plant and equipment have been reassessed accordingly and are summarised in Table 2-1.

2.4.6 Main Process Stream, Storage Tanks and Break Tanks

The design includes buffer storage of final effluent. This will allow constant feed to the MF and RO units without impact from either the normal diurnal variations during dry weather or the potential shortfall over a number of days during less extreme drought. For the PEIR and the current design, there will be 7.5 hours of storage at 60 Ml/d recycled water production. The storage provided will be under continual review in line with the latest available data up until the planned design freeze ahead of DCO application. The storage is arranged in three tanks, so that one or two can be out of service when the plant is operated to deliver less than 60 Ml/d. They are set on a lower finished ground level than the main process building.

The MF tanks are sized to supply clean backwash water to the Microfiltration plant, and are installed as a pair of two tanks, giving redundancy for maintenance. The tanks supplying the GAC relift pumping station are sized sufficient to supply clean backwash water to the GAC adsorbers when required.

2.4.7 Main Process Pumps

Initial sizing for the pumps in the main process stream has been assessed, to cover the range of duties from 10 Ml/d to 60 Ml/d of recycled water production. This has resulted in the selection of 4 pumps (Duty / Assist / Assist / Standby) for each of:

- Final Effluent Transfer (to the flow equalisation buffer tanks);
- MF Feed Pumps;
- RO Transfer Pumps;
- GAC Relift Pumps; and
- Raw Water Pumping Station (to HTR).

2.4.8 Process Unit Location

MF, RO and UV-AOP plants will be located within the main building on the site along with associated filters, strainers, clean-in-place equipment and services.

The GAC adsorption vessels are located outdoors as is the remineralisation plant, which used Carbon Dioxide and Lime.

2.4.9 Final Effluent Transfer

The Final Effluent transfer main from Budds Farm WTW to the WRP will run beneath the Hermitage Stream (along with the reject waste line that will pass reject/waste flow to Eastney LSO through an existing tunnel).

At Gate Two the outlet of the transfer main was anticipated to be in the South East corner of the WRP site but has now been relocated to the South West area. The mains were anticipated to be installed using horizontal directional drill technique however, further investigation is being conducted to identify the most suitable trenchless technique to be employed. This will include the identification of a preferred location of the associated pumping station as the is opportunity at either at Budds Farm WTW (West of the Final Effluent channel), or at the WRP site.

2.4.10 Electrical Distribution

A new electrical supply will be required at the WRP site and the current illustrative design includes a dual supply, that is to provide the necessary resilience for recycled water production in the event of an exceptional outage.

The High Voltage Distribution designed for the site (Figure 2-10) includes:

- a ring main to distribute power to:
    - Three motor control centres in the main process building, fed by transformers adjacent to the building, serving the main processes and their associated feed pumps and services;
    - One motor control centre to serve the RWPS;
- a second ring main for:
    - the HLPS Motor Control Centre (MCC), which will need to operate independently of the WRP and in the current design has a connection for a standby generator.

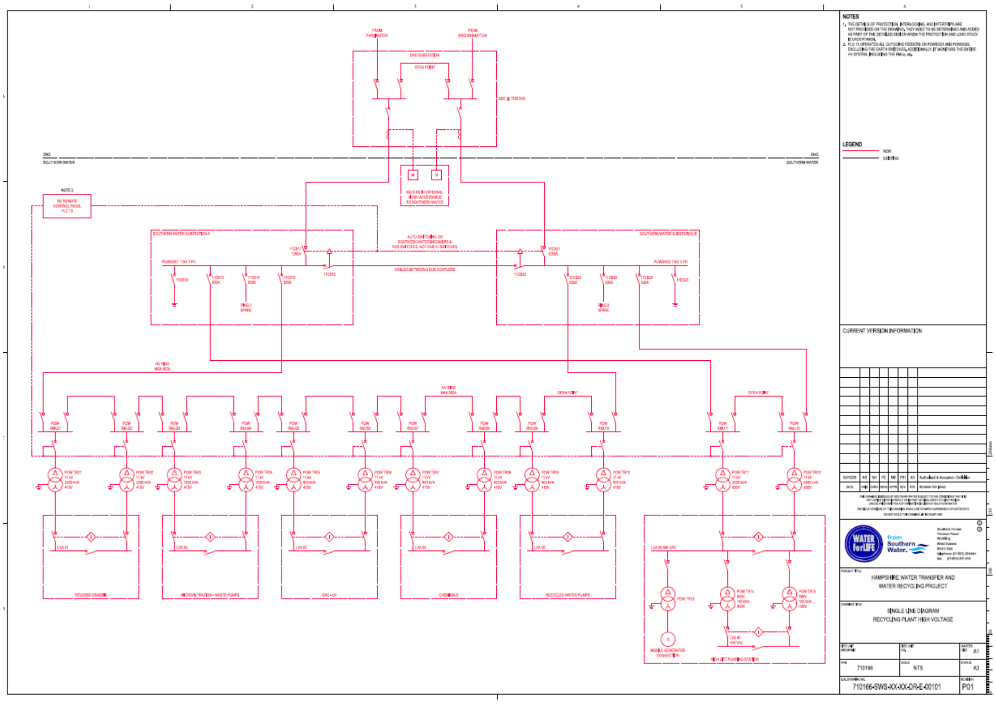


Figure 2-10 - HV Distribution for WRP Site

2.4.11 WRP Site - Security and Emergency Measures (SEMD)

SEMD information has been redacted for security reasons prior to publication.

The following security measures have been identified at the WRP site based on an initial assessment undertaken by AQT Global and agreed with SW:

- *Loss Prevention Certification Board (LPCB) Security Rating (SR) 3 rated fence to (a height of 2.4 metres) enclose the entire site and set out the extent of SWs property;*
- *LPCB SR 3 rated kiosk to enclose the pumps;*
- *All locking mechanisms to the fence line to meet BSEN 5 standard; and*
- *Analytical CCTV with line-crossing (early warning functionality to provide both an 'early' and 'verified' alarm to the perimeter fence in 'M1'.*

2.5 Transfer Between WRP Site and HTR

2.5.1 System Design

At Gate Two, the SW transfer from WRP to HTR and PW transfer BHS to HTR were identified two separate tunnel options. The proposed pipeline configuration for the WRP to HTR transfer would be achieved through a single tunnel, whilst PW had proposed a predominantly open cut route through Havant, which would enable the transfer from BHS to HTR, with an inlet and outline pipeline into HTR being housed within a central control building (Figure 2-11). In addition, the HLPS was located at the HTR site, with a direct transfer from HTR to Otterbourne WSW.

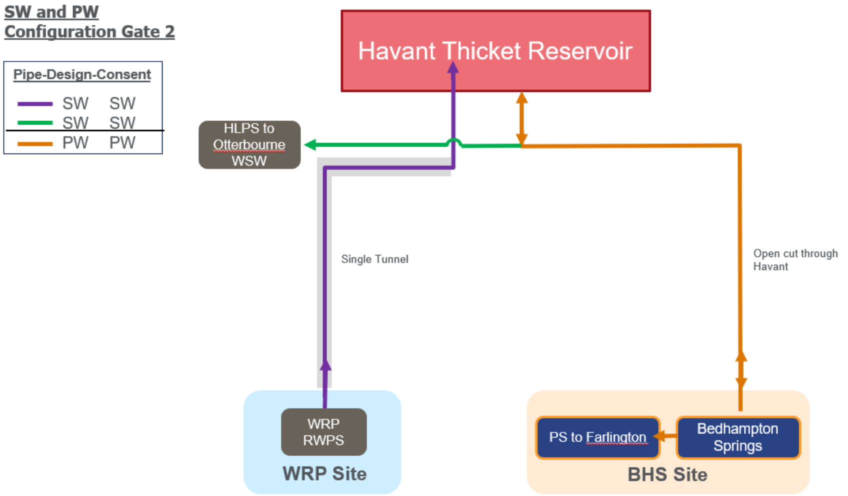


Figure 2-11 - Proposed system design of WRP and BHS at Gate Two

Further scheme development and optimisation of the HWTWRP system design, has resulted in the HLPS being moved from HTR to the WRP site. By relocating the HLPS, the transfer system to Otterbourne WSW can utilise gravity whilst co-locating the HLPS with other key assets will reduce environmental and residential impacts. This has provided opportunity for significantly reduce operational costs and provide a more efficient solution.

Similarly, PW have proposed a new micro tunnel solution through Havant for the transfer from BHS to HTR. While this has been driven by a desire to reduce impacts on the environment and the residents of Havant, it has opened up an opportunity to align the needs of the HTR and HWTWR projects.

This has led to the development of the Preferred and Backup Tunnel Options as set out in Chapter 2: Solution Design. Flows would be pumped from the WRP site either via a connection to PW pipework at BHS (Preferred Tunnel Option) or directly to HTR (Backup Tunnel Option). The Preferred Tunnel Option that would transfer from BHS to HTR, would be delivered by PW subject to the necessary planning permission.

These options been developed to optimise the system configuration, enabling significant cost savings and provide an opportunity to reduce the overall carbon emissions of the HWTWRP.

2.5.2 Preferred Tunnel Option

The option under consideration is for a combined tunnel from BHS to HTR. Therefore, the SW pipeline will only need to transfer flows between the WRP site and BHS. This option comprises of 3 main elements:

- SW to construct 0.6km connection from WRP site to BHS. The connection will be a trenchless construction using a micro tunnel with both inlet and outlet pipelines from the WRP site to near to BHS. The pipelines will then be laid above ground through the BHS site;
- PW to construct twin micro tunnels from BHS site to Staunton Country Park near to HTR. The inlet and outlet pipelines from HTR will be within separate tunnels; and
- PW to construct inlet and outlet pipes to HTR using open-cut construction methods.

The transfer from the WRP site to BHS has two key crossings: the A27 and Hermitage Stream (Figure 2-12). The last section of the pipeline, which is through the Source Protection Zone (SPZ), from the tunnel shaft into and through the BHS site, will then be partially laid above ground and connect into the PW assets at BHS.

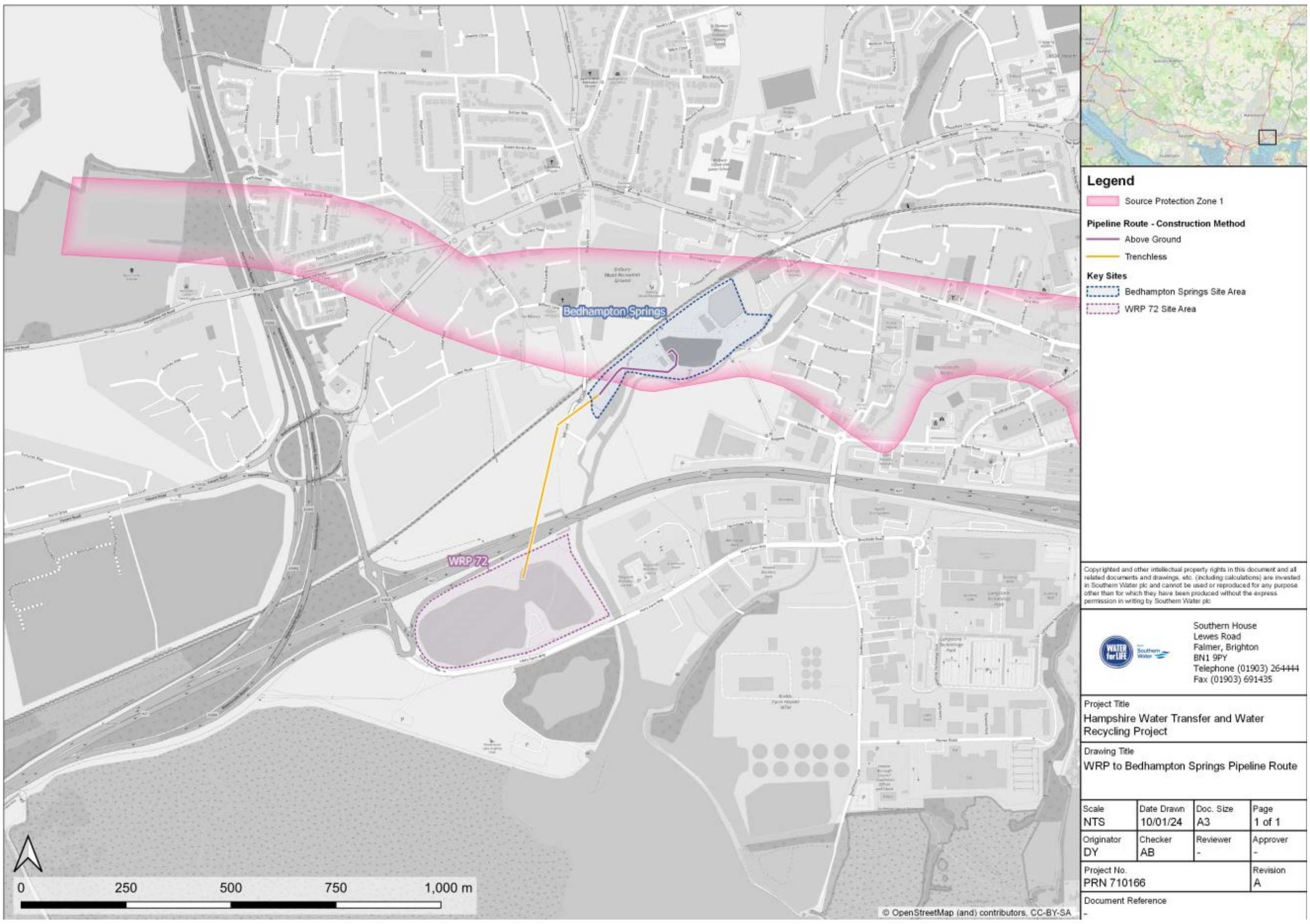


Figure 2-12 - Proposed route for preferred tunnel option (Draft)

The proposed pipeline for the preferred tunnel option is to be constructed using a variety of technique to minimise environmental impact and maintain affordability in the technique chosen (Table 2-2).

*Table 2-2 - Pipeline details between WRP Site and HTR for SW/PW combined option. *Pipe across the BHS site to be laid above ground*

Pipeline section	LPA	Key Crossings	Pipeline diameter (mm)	Open Cut Length (m)	Trenchless Length (m)	AGP
RWPS to BHS	Havant Borough Council	A27 High Pressure Gas Main Hermitage Stream SPZ	800	100 150*	497	RWPS
HTR to HLPS			1050	100 150*	497	None

2.5.3 Backup Tunnel Option

This option proposes largely separate SW and PW assets split into 4 different elements:

- SW would construct a trenchless tunnel from the WRP site to a reception shaft at Staunton Country Park. This would be a single tunnel that contains both inlet and outlet pipelines between the WRP site and the reception shaft;
- An open cut inlet pipeline would be constructed to transfers flows from the SW tunnelled inlet pipeline at the reception shaft to a discharge location within HTR;
- PW would construct a separate single micro tunnel from BHS to Staunton Country Park to accommodate a single bi-directional pipeline, which would then be open cut to connect into the reservoir via the control building and culvert. This pipeline could either fill HTR from BHS or transfer water out of the reservoir to BHS;
- PW would then install within Staunton Country Park connections from its single pipeline to a) the SW inlet pipeline and b) the SW outlet pipeline;
- The SW inlet pipeline would hereafter combine flows from the WRP and BHS. providing capacity for up to 100 Ml/d (60 Ml/d from WRP and 40 Ml/d from BHS), and acting as the sole inlet pipe into the reservoir;

- The PW outlet pipeline from HTR would enables transfers from HTR either via the SW outlet pipeline to the HLPS, or via the PW single pipeline to BHS when not being used to fill HTR with spring water (Figure 2-13).

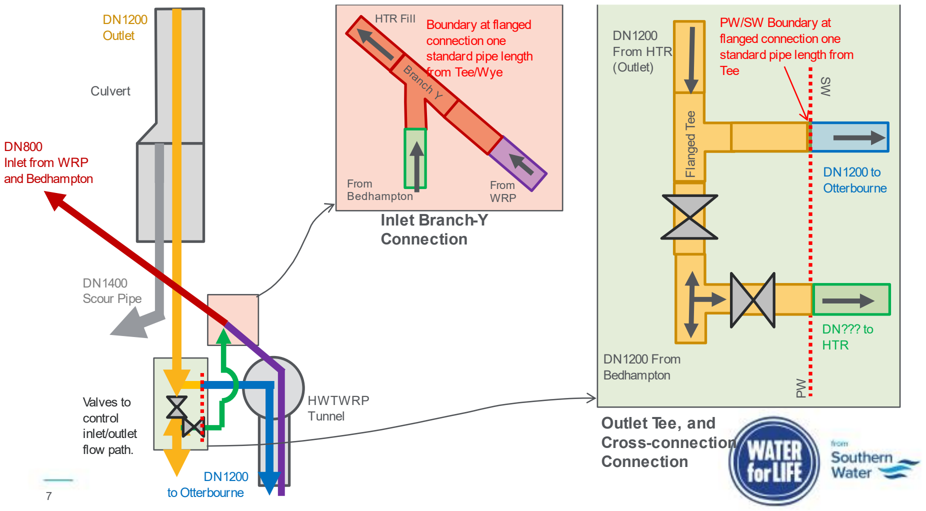


Figure 2-13 - Draft Site Layout of interaction of SW and PW connection near to HTR

There are several key crossings including the A27, West Coastway Railway Line and PW pipeline for the inlet and outlet for HTR across the proposed pipeline route (Figure 2-14). However, as the tunnel will be over 20m deep, there is unlikely to be any significant interaction with these. The tunnel route passes through a SPZ and close to PW abstraction locations at BHS.

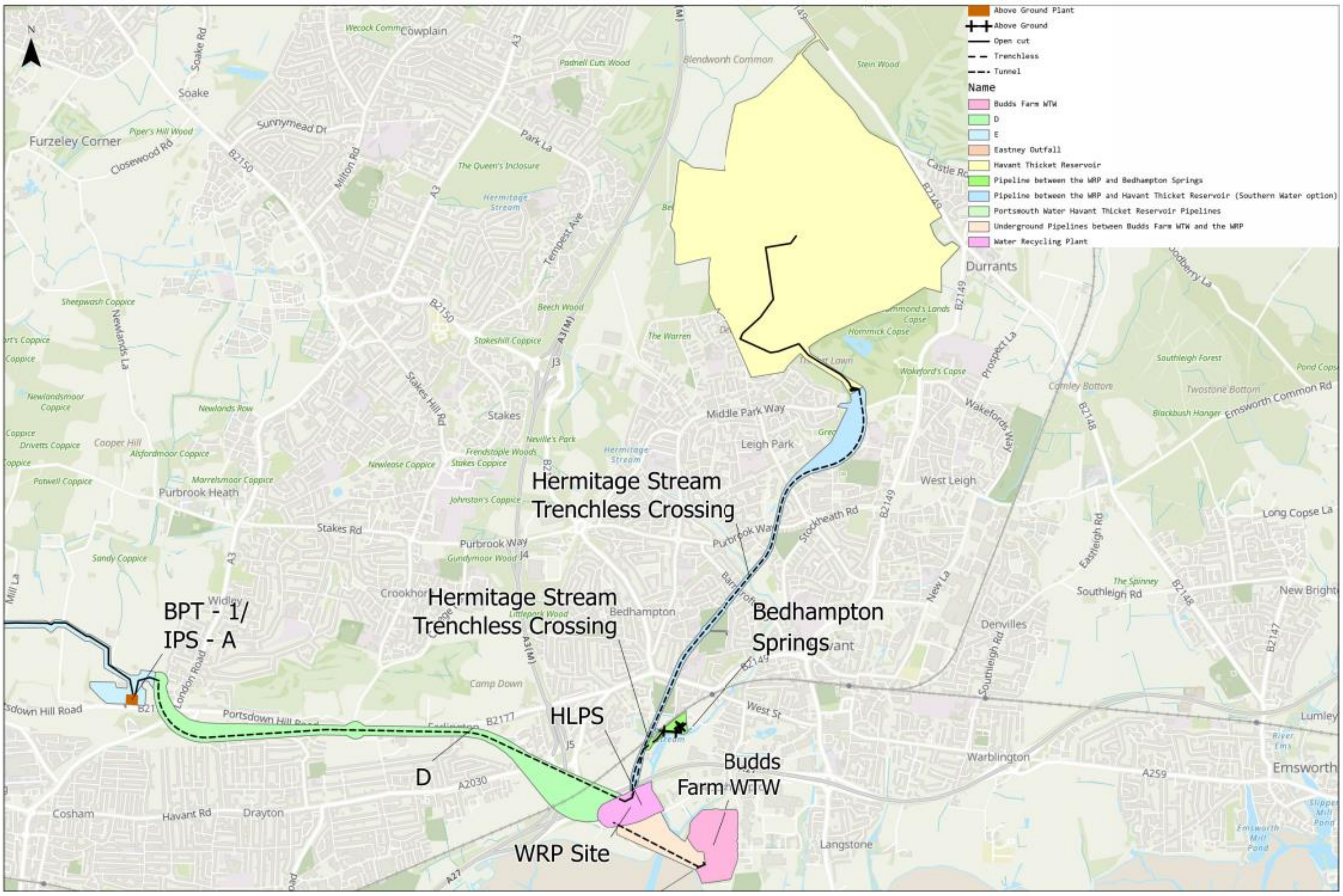


Figure 2-14 - Backup tunnel option pipeline route

The proposed pipeline for the backup tunnel option is to be constructed using a variety of techniques to minimise environmental impact and maintain affordability in the technique chosen (Table 2-3).

Table 2-3 - Pipeline details between WRP Site and HTR for Backup tunnel option

Pipeline section	Local Planning Authority	Key Crossings	Pipeline diameter (mm)	Open Cut Length (m)	Trenchless Length (m)	AGP
RWPS to HTR	Havant Borough Council	A27 HP Gas Mains West Coastway Railway Line SPZ PW proposed inlet /outlet pipeline	800	2086	3695	RWPS
HTR to HLPS			1050	40	3695	None

2.6 Transfer for HTR to HLPS

The transfer of flows from HTR to the HLPS at the WRP site will utilise the selected tunnel option as described in section 2.5. Due to the topographical variation of HTR with the WRP site, flows can gravitate down to the HLPS.

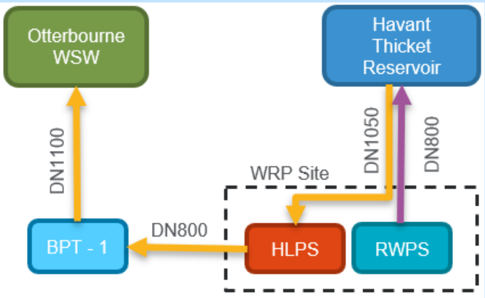
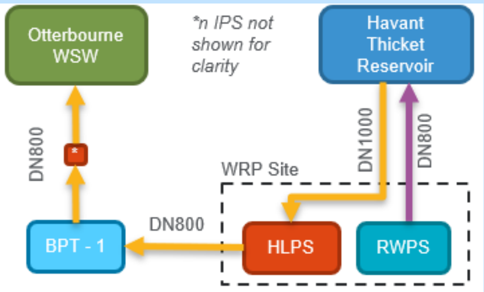
2.7 HLPS to Otterbourne WSW

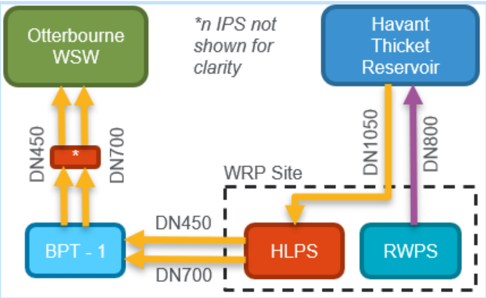
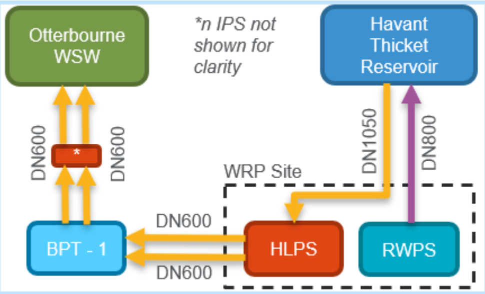
2.7.1 Minimum Flow for Transfer HTR to Otterbourne WSW

Following the confirmation of the reduction in transfer time from 72 to 24 hours and the increase in max flow from 75 to 90 Ml/d (as discussed in Chapter 2: Solution Design), many transfer options were considered however were unable to meet the water age criterion without significant cost implications. This included treatment options that could reduce water age risks; however it was recognised that the most cost-effective solution would be to increase the minimum flow to 20 Ml/d until further water quality assessments could be complete.

A hydraulic optioneering report was undertaken to select the preferred system design following these changes. The output of this report has been independently reviewed by Arcadis, SW Principal Hydraulic Engineer and has been reviewed by SW technical leads. This presented four system design options for consideration (Table 2-4).

Table 2-4 - Proposed system configurations for HTR to Otterbourne WSW

Option	Description	System Configuration
1	**'Single large pipe, gravity option'** Single transfer pipeline, from BPT - 1 to Otterbourne WSW and single DN800 from the first IPS to BPT - 1. All flows from 20 Ml/d to 90 Ml/d by gravity. Water age exceeds 24 hours at BAU flows and additional treatment may be required.	
2	**'Single small pipe, pumped option'** Single DN800 transfer pipeline, from BPT - 1 to Otterbourne WSW and single DN800 from the first PS to BPT - 1. Satisfies the 24-hour water age threshold for all flows between 20 Ml/d to 90 Ml/d, up to 30 Ml/d can gravitate from BPT - 1. Higher flows will require intermediate pumping.	

3	**‘Asymmetric dual pipe option’** Asymmetric DN450 and DN700 pipes running in parallel from the 1st IPS via BPT - 1 to Otterbourne WSW. The DN450 takes BAU flows to satisfy the 24-hour water age threshold, while the DN700 is employed to assist for higher flows up to 90 Ml/d. Pumping is required for all flows.	
4	**‘Symmetric dual pipe option’** Symmetric DN600 pipes running in parallel from the 1st PS via BPT - 1 to Otterbourne WSW in a duty/assist configuration. Satisfies the 24-hour water age threshold for all flows between 20 Ml/d to 90 Ml/d, 20 Ml/d can gravitate from BPT - 1.	

Upon review of the system design options considered, the following conclusions were made:

- Option 1 is hydraulically and operationally feasible, but it does not satisfy the 24-hour water age threshold;
- Option 2 is hydraulically and operationally feasible and meets the 24-hour water age threshold; and
- The operational and control regime of options 3 and 4 are complex and the requirement to bring a pipeline in a state of cold commission into full design service on an annual basis renders these options unfeasible.

At this stage of design, Option 2 is considered the preferred option based on meeting key design criteria, most cost and carbon efficient at BAU flow and providing the most flexibility to the CAP. A high-level overview of the proposed system design has been developed to illustrate the key asset components of the transfer (Figure 2-15).

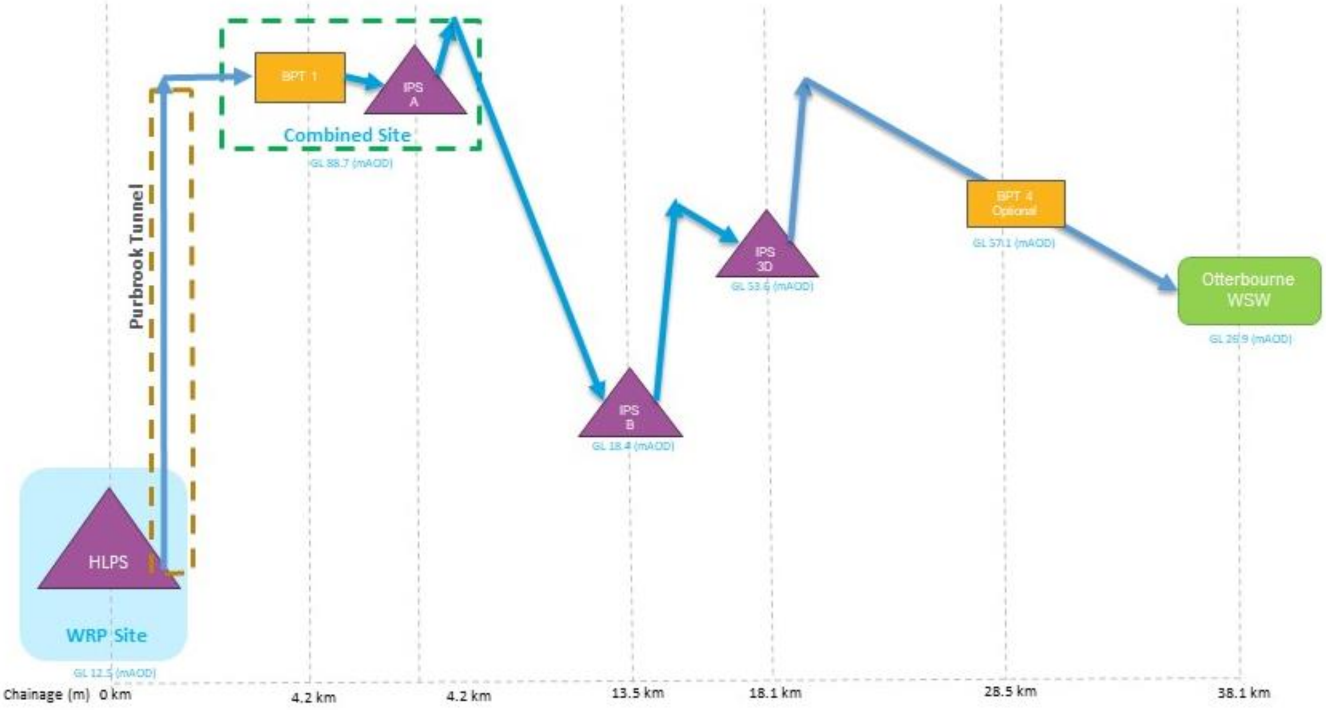


Figure 2-15 - HTR to Otterbourne WSW transfer schematic

Additional investigation will be conducted to further refine and understand the proposed system design. Additional considerations will be made to include the following key aspect:

- Higher system pressures;

- Water age threshold;
- Whole Life costs, taking into account the frequency of a range of drought return periods;
- Scenarios where flows may vary based on demand at Otterbourne WSW and supply variability from the HTR and WRP; and
- Discharge capabilities required at Otterbourne WSW or along the pipeline route.

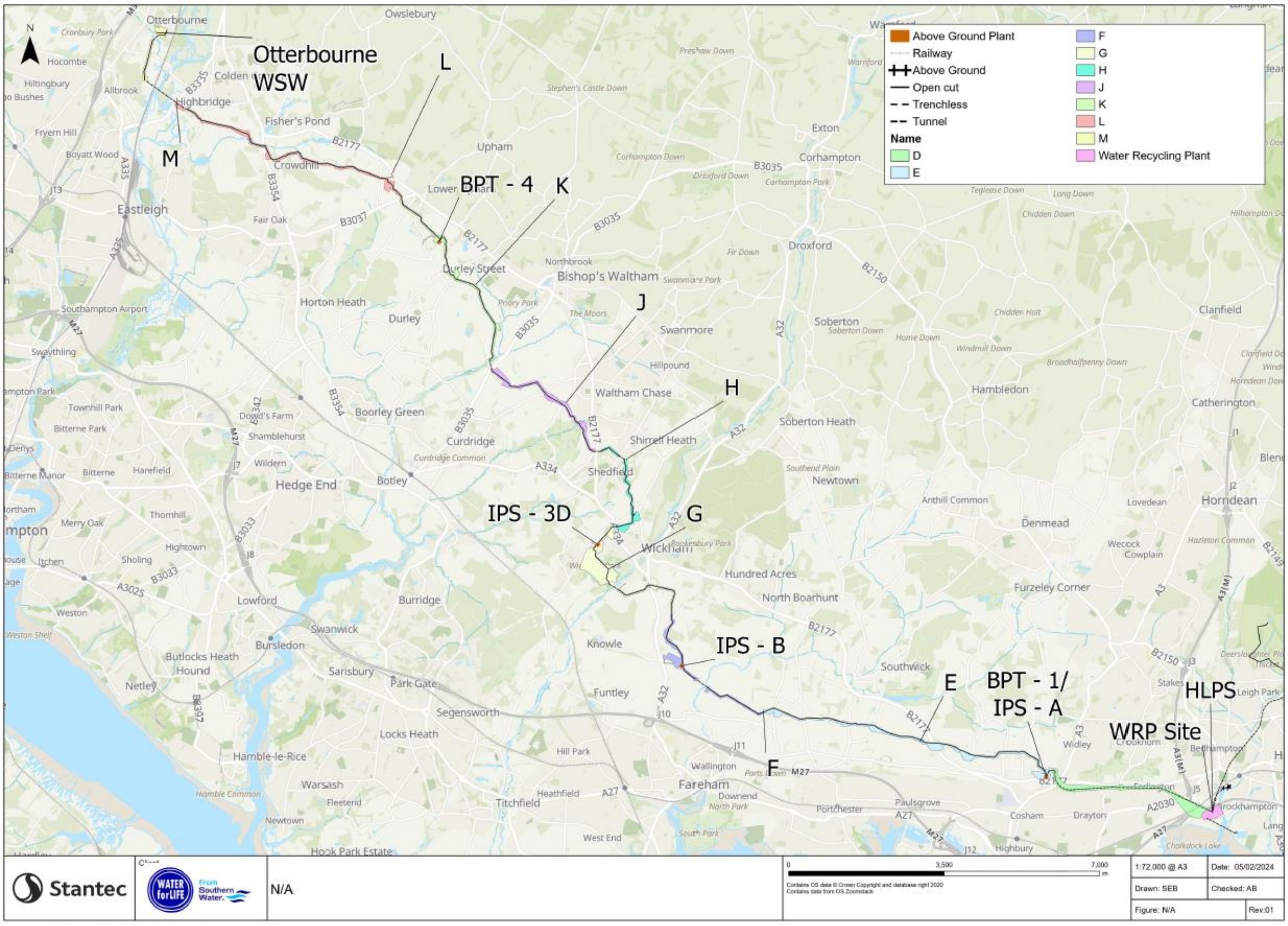


Figure 2-16 - Proposed pipeline route between HLPS and Otterbourne WSW

In this arrangement, the selected system design requires 3 Intermediate Pumping Stations (IPS) and a single Break Pressure Tank (BPT-1). There is also the potential for a second (BPT-4) between IPS-3D and Otterbourne WSW to mitigate potential surge issues and reduce OPEX costs as the downstream pipeline will be operate under gravity rather than pumping.

The IPS's are only required for the higher flow volumes and therefore will not always be utilised. At BAU flows none of the IPS's are required and flows can gravitate to Otterbourne WSW from BPT-1.

The pipeline transfer between the HLPS and Otterbourne WSW has been assessed in 10 sections for micro sighting of the route. The sections were set based on Local Planning Authority boundaries and key crossings, such as railway line, major roads, rivers and streams etc. (Figure 2-16).

2.7.2 Section D

Section D extends from the HLPS at the WRP Site to the ridge of Portsdown Hill (Figure 2-17). Due to the complexity of the route and number of critical crossings the pipeline is proposed to be housed within a segmental tunnel, 3.9km long with an Internal Diameter (ID) of 3.5m, passing underneath Drayton and follow part of the alignment of Portsmouth Road (B2177). It is anticipated that the tunnel shaft at WRP site would be a maximum depth of approximately 40m and the tunnel shaft at the ridge of Portsdown Hill would be at a maximum depth of approximately 80m.

An allowance has been made to provide a temporary intermediate tunnel shaft for construction, if required. This would be located south of Portsdown Hill Road (B2177) and west of Gillman Road. It is anticipated to be at a maximum depth of approximately 80m below ground level;

The tunnelled part of Section D crosses major utilities including High Pressure (HP) gas mains, PW's proposed Farlington to Nelson pipeline (F2N) and Acquind Interconnector (a proposed DCO high voltage electricity cable) and under several 'A' roads. However, due to the depth of the tunnel any impact on these is expected to be minor.

2.7.3 Section E

Section E begins at the ridge of Portsdown Hill (Figure 2-17) and extends to the boundary between Winchester City Council and Fareham Borough Council located west of Boarhunt, identified by IPS-B (Figure 2-18).

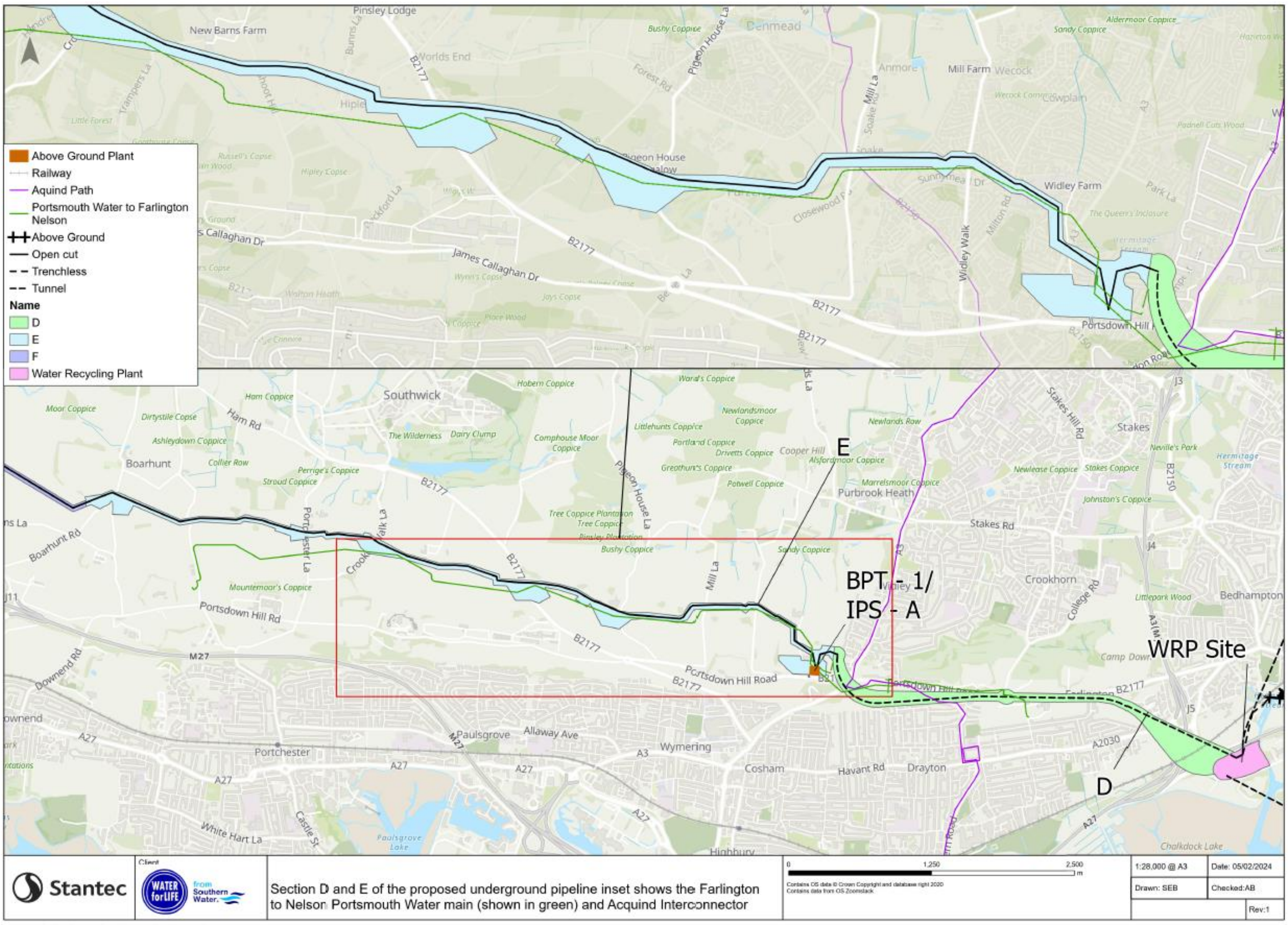


Figure 2-17 - Section D and Section E of the HLPS to Otterbourne WSW transfer. Inset shows interactions with Farlington WSW to Nelson PW main (shown in Green) and Acquind Interconnector (shown in Purple).

The key crossing in this section is PW's proposed Farlington to Nelson pipeline. Collaboration with PW is ongoing to coordinate ongoing site investigation and pipeline alignment.

Section D and E is planned to move through the boundaries of multiple LPAs and cross several key crossings. These have been identified as part of the ongoing development process and the appropriate engagement and mitigation activities to address these challenges is being incorporated into the design (Table 2-5).

Table 2-5 - Details of sections D and E

Pipeline section	LPA	Key Crossings	Pipeline diameter (mm)	Open Cut Length (m)	Trenchless Length (m)	AGP
D	Havant Borough Council Portsmouth City Council Winchester City Council	A27 West Coastway Railway Line A3(M) A2030 Havant Road 2no. HP Gas Mains 2no. Intermediate Pressure (IP) Gas Mains F2N Water Main Acquind Interconnector (Planned High Voltage Direct Current cable) A3 London Road	800	63	3875	HLPS
E	Winchester City Council	F2N Water Main 2no.HP Gas Mains	800	7285	0	IPS-A/ BPT-1

	Portsmouth City Council					

2.7.4 Section F

Section F comprises of the proposed pipeline route from the boundary between Winchester City Council and Fareham Borough Council located west of Boarhunt and IPS-B to the boundary between Fareham Borough Council and Winchester City Council north of Crockerhill (Figure 2-18). Section F has one key trenchless crossing of the River Wallington.

2.7.5 Section G

Section G comprises the section from the boundary between Fareham Borough Council and Winchester City Council north of Crockerhill to Winchester Road (A334) north-west of Wickham (Figure 2-18). Section G has a single trenchless crossing of the River Meon.

2.7.6 Section H

Section H comprises the section from Winchester Road (A334) north-west of Wickham to Winchester Road (B2177) north of Shedfield (Figure 2-18).

2.7.7 Section J

Section J comprises the section from Wickham Road (B2177) north of Shedfield to Botley Road (B3035) south of Treefield Farm (Figure 2-18).

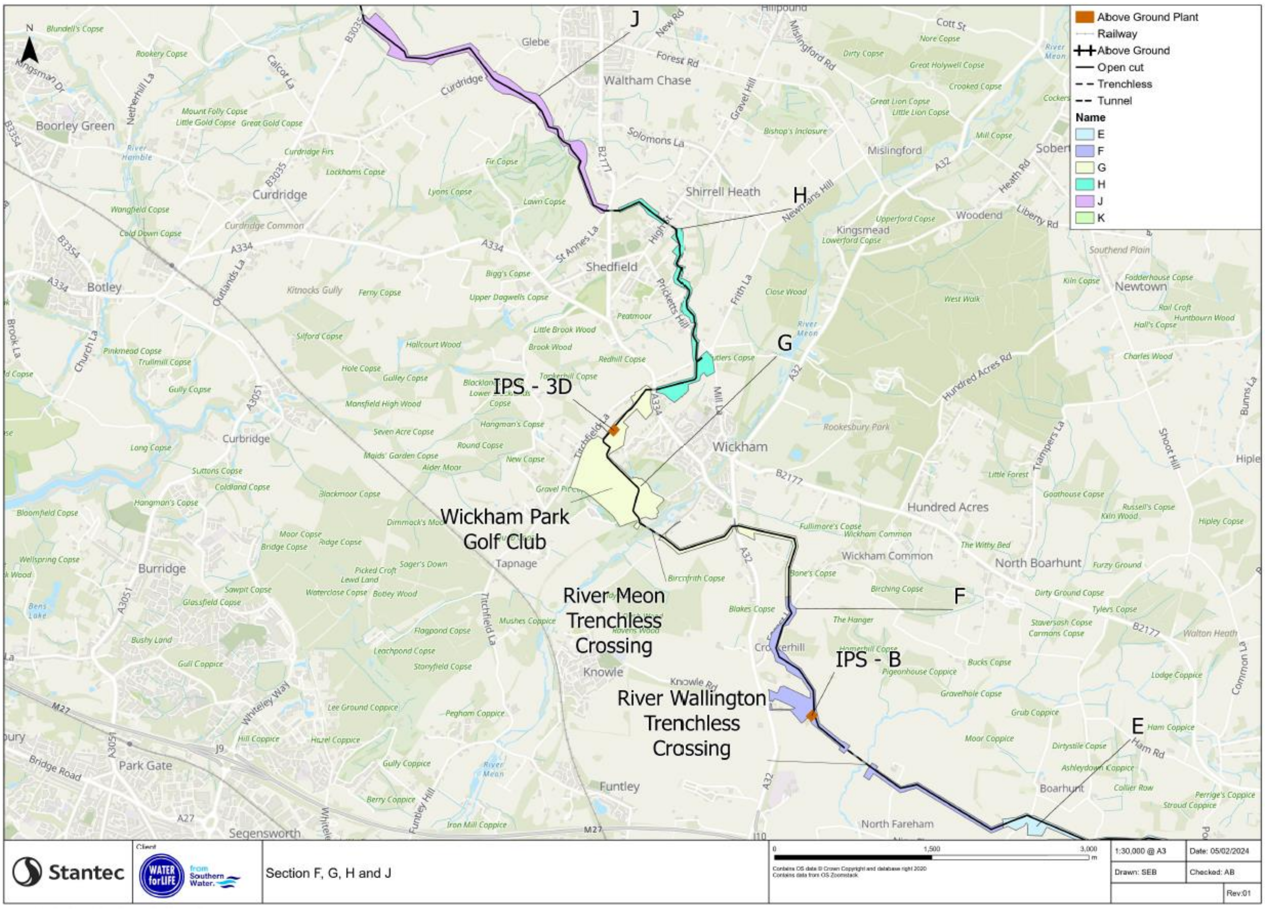


Figure 2-18 - Sections F, G, H and J of the HLPS to Otterbourne WSW transfer.

Section F, G, H and J will pass through the boundaries of multiple LPAs and pass over several key crossings, such as existing infrastructure and rivers (Table 2-6). These have been identified as part of the ongoing scheme development process and the appropriate engagement and mitigation activities to address these challenges is being incorporated into the design.

Table 2-6 – Details of sections F, G, H and J

Pipeline section	LPA	Key Crossings	Pipeline diameter (mm)	Open Cut Length (m)	Trenchless Length (m)	AGP
F	Fareham Borough Council	River Wallington	800	3223	270	IPS-B
G	Winchester City Council	A32 Hoad's Hill OH 400kV EHV electricity cable. River Meon Wickham Park Golf Club A334 Winchester Road	800	3255	390	IPS-3
H	Winchester City Council	High Street B2177 Winchester Road	800	2410	270	None
J	Winchester City Council	None	800	3270	90	None

2.7.8 Section K

Section K comprises the section from Botley Road (B3035) south of Treefield Farm to the boundary between Winchester City Council and Fareham Borough Council east of Ashbourne Stables.

The key crossings in Section K are the River Hamble and Exolum and Southampton to London Esso oil pipelines. For the crossing of the River Hamble, a micro tunnel with a minimum 2.5m depth below bed level is proposed, with shafts located either side of the river outside of flood zones 1 and 2.

2.7.9 Section L

Section L starts at the boundary between Winchester City Council and Fareham Borough Council east of Ashbourne Stables to Highbridge Road (B3335). There are 2 main rivers that run through Section L (Bow Lake and a tributary of the River Itchen) which make up the key crossings. Both of these crossings are proposed to be constructed using a micro tunnel. At the end of Section L, the micro tunnel underneath the tributary of the River Itchen will also extend into Section M (Figure 2-19).

2.7.10 Section M

Section M comprises the section from Highbridge Road (B3335) and connect into Otterbourne WSW. There are three key crossings; the River Itchen and associated Special Area of Conservation (SAC) and Site of Specific Scientific Interest (SSSI), the South West Main Line and a tributary of the River Itchen near to Kiln Lane.

The crossing of the River Itchen and the South West Railway Line will be crossed in a single 1.05km micro tunnel. The micro tunnel would be between the east of Highbridge Road (B3335) and east of Otterbourne Park Wood. It is anticipated that both tunnel shafts would be at a depth of approximately 20m. Trenchless construction would have to be utilised under a watercourse that is an upstream tributary of the River Itchen. At this watercourse, the pipeline would be a minimum of 2.5m below the bed level.

The Otterbourne WSW connection, will discharge into an inlet balancing tank, downstream of a pressure sustaining valve, with the pipeline terminating at the boundary of the WSW with an isolation valve and blank flange. The downstream works and any further upgrades to Otterbourne WSW to facilitate the HWTWRP will be undertaken as separate projects and are not part of the HWTWRP scope.

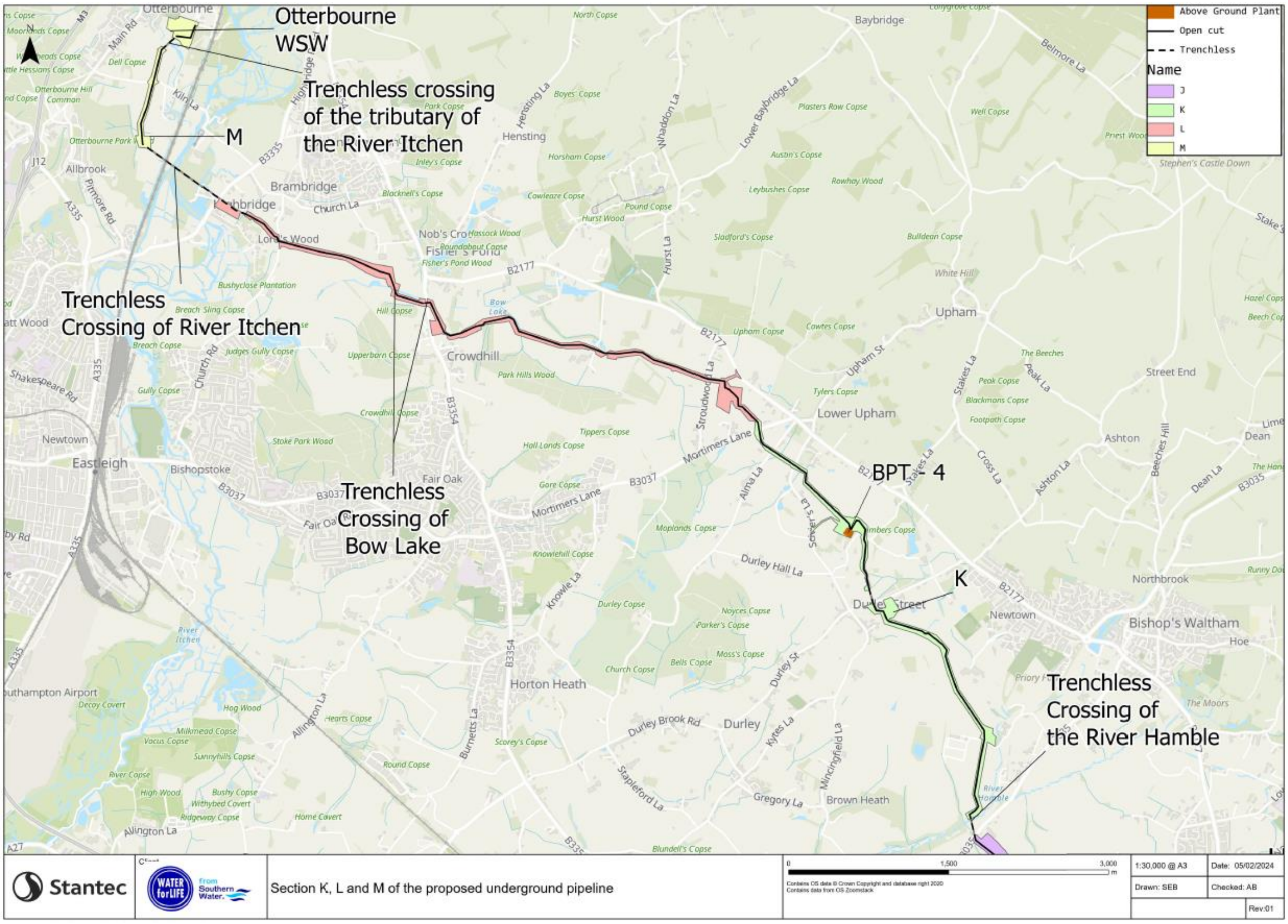


Figure 2-19 - Section K, L and M of the HLPS to Otterbourne WSW transfer

Section K, L and M is planned to move through the boundaries of multiple Local Planning Authorities (LPA) and cross several key crossings. These have been identified as part of the ongoing development process and the appropriate engagement and mitigation activities to address these challenges is being incorporated into the design (Table 2-7).

Table 2-7 – Details of section K, L and M

Pipeline section	LPA	Key Crossings	Pipeline diameter (mm)	Open Cut Length (m)	Trenchless Length (m)	AGP
K	Winchester City Council	River Hamble Esso Oil Pipeline Southampton to London Esso Pipeline IP Gas Main Overhead 400kV HV electricity cable. Exolum Oil Pipeline	800	4805	365	BPT-4
L	Eastleigh Borough Council Winchester City Council	2no. Overhead 400kV HV electricity cable Bow Lake Tributary of the River Itchen	800	5545	420	None
M	Winchester City Council	River Itchen South West Main Line railway	800	1170	1065	None

2.8 Pipeline Interfaces

2.8.1 Environmentally Sensitive Crossings

Following crossing sensitivity analysis, including watercourse crossings and other environmentally sensitive areas, locations where mitigation such as trenchless construction / reduced working width have been identified.

Trenchless crossings have been shown on the figures for each section and along with reduced working widths have informed the impact assessments presented in the PEIR that was part of the summer 2024 Statutory Consultation.

2.8.2 Statutory Undertakers and Utilities

Interfaces with Statutory Undertakers and utility providers along the proposed pipeline route have been identified and engagement is ongoing to agree crossing locations, construction methodology and any required protective measures.

2.8.3 Source Protection Zones (SPZ)

A Hydraulic Impact Assessment (HIA) report is being undertaken and includes assessment of the potential risks to water quality (during construction) and flow associated with the trenchless solutions proposed through SPZ's located close to abstraction sites at Otterbourne WSW and BHS site.

Engagement with the respective environmental managers, hydrogeologists, water quality and production teams at SW and PW and the EA is ongoing to agree assessment requirements and ensure mitigation measures (risk assessments, safe control of operations, contingency measures, monitoring etc) are incorporated into the HIA that forms part of the Environmental Statement.

2.8.4 Open Cut Crossings

A draft drawing of the proposed open cut crossings has been developed (Figure 2-20).

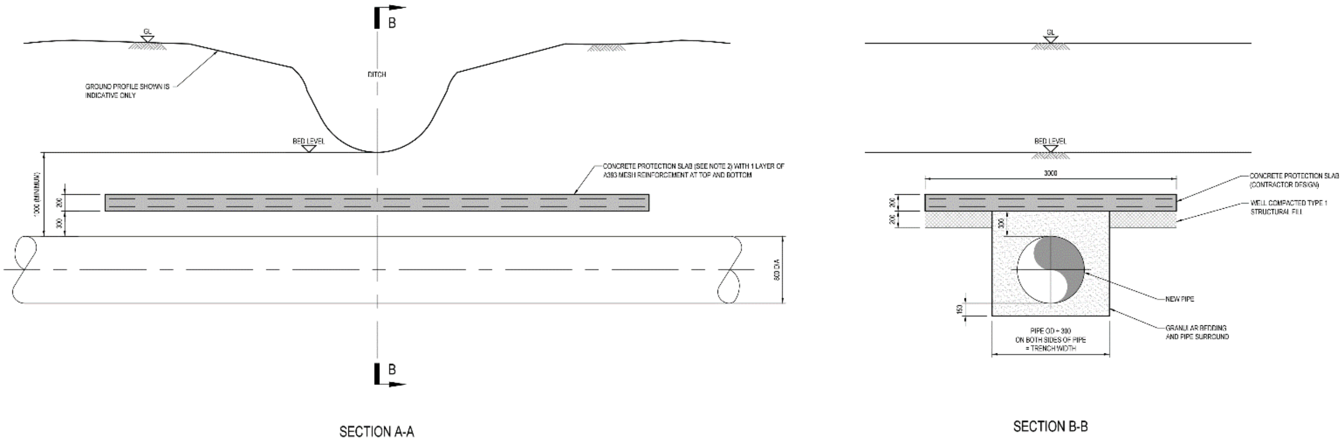


Figure 2-20 - Draft Typical Detail Drawing of a ditch crossing

2.9 Trenchless Crossings

2.9.1 Segmental Tunnels utilising Tunnel Boring Machine (TBM)

This construction method allows crossings that are over 1km to be at greater depths than is possible with other methods and therefore minimises the impact on communities by reducing the need for intermediate shafts Depending on the length of the trenchless section intermediate shafts may be required during construction and will be filled in and sealed following completion.

This method is proposed for the following sections:

- Pipelines between WRP site and HTR (Backup Tunnel Option); and
- Section D of the HTR to Otterbourne WSW pipeline (Figure 2-17).

Initial settlement calculations and contour drawings to 1mm settlement zone have been completed to ensure values are within permissible limits for key crossings (i.e. Network Rail, 5mm max). Further detailed assessment will identify if there is any impact on sensitive structures in the zone of influence and ensure mitigation measures are included in the detailed design.

2.9.2 Micro Tunnels

For shorter trenchless crossing such as under roads or main rivers, micro tunnelling will be utilised. There are two types of micro tunnel crossing proposed in this project, the first is for longer crossings that are required to avoid multiple key crossings which are 0.5km long or greater and 15m+ deep. These are similar to the TBM crossing described above but due to the length and pipe diameter do not require a TBM to construct.

This includes:

- Trenchless crossing of River Itchen and railway lines in Section M (Figure 2-19);
- Preferred Tunnel Option between the WRP site and BHS.

2.10 Above Ground Plant (AGP)

Illustrative site layouts have been produced for the AGP required along the route as presented at the summer 2022 Non-Statutory Consultation. These layouts will be updated to include site specific requirements in line with the design principles as part of DCO application. The site-specific designs will also include any required SUDs features, landscaping or Biodiversity Net Gain (BNG). Land parcel have been sized to provide flexibility, but requirements may change to meet site specific requirements (Table 2-8).

Table 2-8 AGP Site Information

AGP Site	Section	AGP Land Parcel (m^2)	Current Illustrative Design land take within site security fencing (m^2)
IPS-A/ BPT-1	E	5580	4180
IPS-B	F	5580	3344
IPS-3D	G	5580	3344
BPT-4	K	4340	4320

2.10.1 General Requirements

The general requirements that have been considered when developing the illustrative design for each above ground plant are set out in Table 2-9.

Table 2-9 - General requirements for the AGP

Requirement	Consideration
Site Entrance Roads / access	For each of the proposed sites, new access roads will be required to the site. Draft proposals are being prepared for consultation with local highways authority and New Roads and Street Works Act (NRSWA) officers.
Welfare Facilities	Sites will be unmanned so it is assumed no permanent welfare facilities will be required and portable facilities will be installed at the site for any extended period of works.
Lighting Requirements	The site lighting will consist of internal lighting within kiosk and buildings which will all be LED to provide the best whole life cost. Illuminance levels shall be in accordance with the Lighting Strategy.
Telemetry	Telemetry Outstation at the IPS or BPT station with separate offsite communications providing alarms to the RCC.
Noise Strategy	Preliminary noise assessments have been undertaken and where sensitive receptors at proposed sites are identified, noise mitigation measures will be specified to negate / reduce noise levels to an acceptable level.
Power Requirements	Preliminary power requirements have been assessed and Distribution Network Operator (DNO) quotes obtained for the proposed locations.
Intermediate Pumping Stations without a Break Pressure Tank	Intermediate Pumping Stations are required along the route to overcome the head losses at the higher flow rates along the DN800 pipeline.

2.10.2 AGP - Security and Emergency Measures Directive (SEMD)

SEMD information has been redacted for security reasons prior to publication.

The following security measures have been identified at the IPS and HLPS sites based on an initial assessment undertaken by AQT Global and agreed with SW:

- *For sites without a Break Pressure Tank (BPT) - LPCB SR 2 rated fence to (a height of 2.4 metres) enclose the entire site and set out the extent of SWs property;*
- *For sites with a BPT - LPCB SR 3 rated fence to (a height of 2.4 metres) enclose the entire site and set out the extent of SWs property;*
- *LPCB SR 3 rated kiosk to enclose the pumps;*
- *All locking mechanisms to the fence line to meet BSEN 5 standard; and*
- *Analytical CCTV with line-crossing (early warning functionality to provide both an ‘early’ and ‘verified’ alarm to the perimeter fence in ‘M1’.*

The following security measures are required at the BPT site:

- *LPCB SR 3 rated fence to (a height of 2.4 metres) enclose the entire site and set out the extent of SW's property;*
- *All locking mechanisms to the fence line to meet BSEN 5 standard; and*
- *Analytical CCTV with line-crossing (early warning functionality to provide both an 'early' and 'verified' alarm to the perimeter fence in 'M1'.*

2.10.3 Civil Design

The illustrative layouts of the AGP have been developed to include the following elements (Figure 2-21):

- Pumphouse with 4 pumps (details of these pumps are included in the Section 2.10.5);
- Generators and fuel storage – for emergency/ standby power generation;
- MCC Kiosk;
- Surge Vessels;
- Sampling Unit;
- Flow Meter;
  - Site access road and parking;
  - Security gate and perimeter fencing.

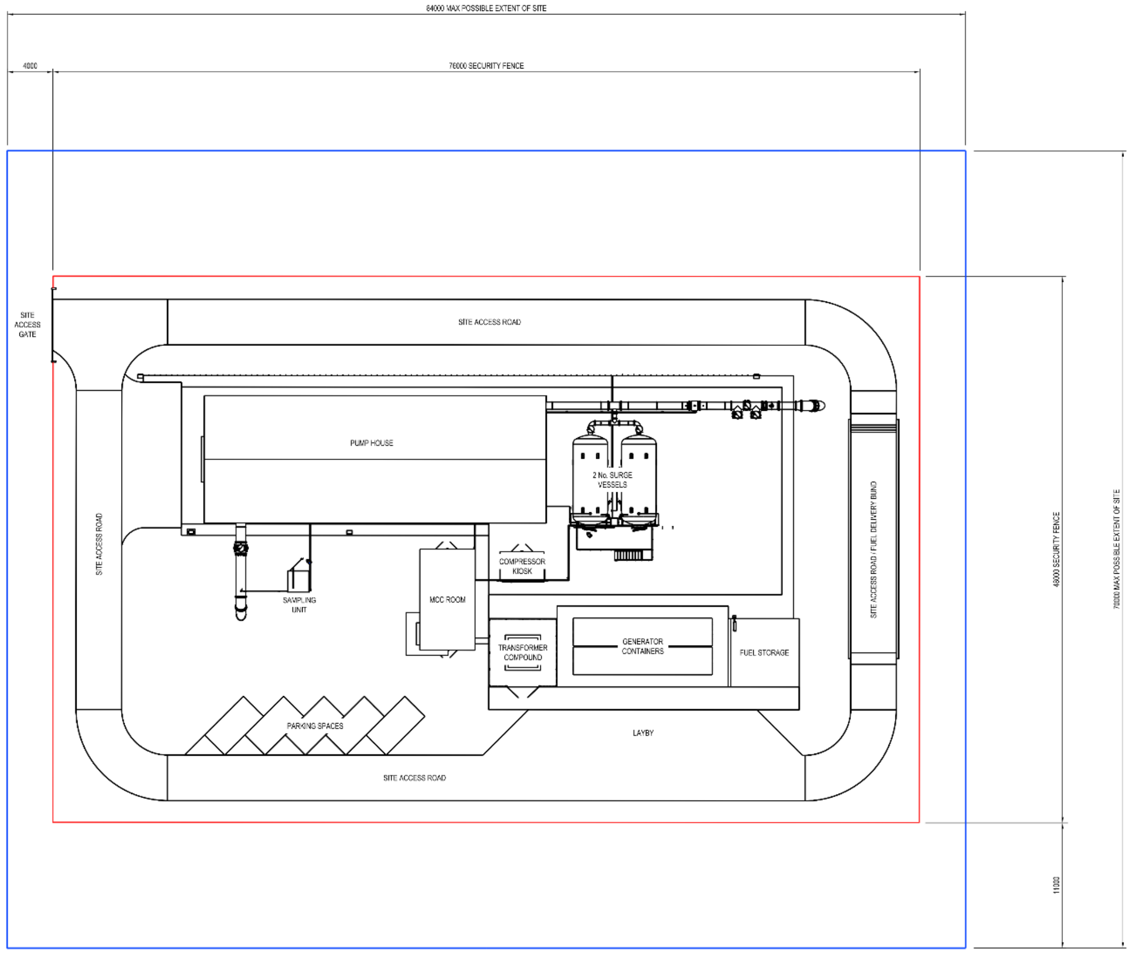


Figure 2-21 - Proposed draft illustrative layout of IPS

2.10.4 Intermediate Pumping Station with a Break Pressure Tank

In the hydraulic design, IPS-A also requires a BPT to be located nearby. The design has been amended to accommodate a BPT, altering the layout of key components (Figure 2-22). Within this land parcel, the following elements have been included in the sites:

- Pumphouse with 4 pumps (details of these pumps are included in the Section 2.10.5);
- Generators and fuel storage – for emergency/ standby power generation. A separate length of pipe through pumphouse without a pump will also be required to bypass the pumps for BAU flows when the pumps are not required;
- Break Pressure Tank – Dual cell tank with each cell to provide 500m3 of storage which is 15 minutes flow at 45 Ml/d. During droughts where flows need to be higher than 45 Ml/d any planned maintenance should be carried out prior to the drought period;
- Generators and fuel storage – for emergency/ standby power generation;

- MCC Kiosk;
- Surge Vessels;
- Sampling Unit;
- Flow Meter;
- Site access road and parking; and
- Security gate and perimeter fencing.

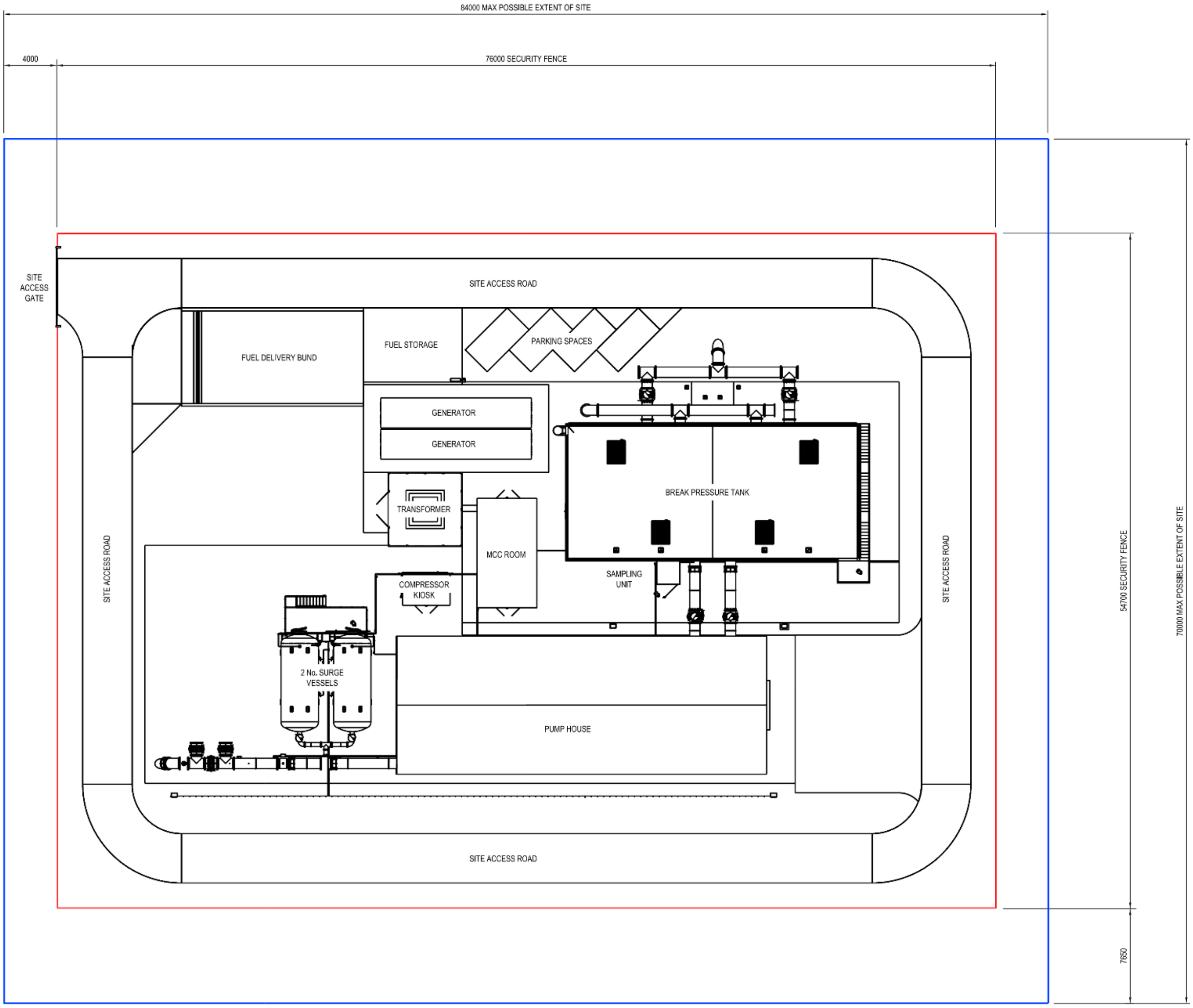


Figure 2-22 - Proposed Draft Illustrative Layout of IPS with a BPT

2.10.5 Mechanical

For the illustrative designs the following assumptions have been made related to the mechanical design:

- The design of the IPS's mechanical plant and equipment comprises of pumps arranged in a duty, assist and standby arrangement within a common suction and common discharge pipe manifold. The layout of the pumps and pipe work is arranged at a thirty degree off set to offer an optimum footprint and friction loss;
- A bypass pipeline will be required to allow lower duty flows to be gravitated without recourse to electromechanical pumping. This may be included in the IPS site for the combined IPS-BPT but for the other sites is not shown as the bypass will bypass the entire IPS;
- Amazon filter points are included in the illustrative designs to enable the rapid deployment of tertiary in line treatment if and when required; and
- Ancillary plant including compressor and back up diesel generators will be located within their own acoustically lined kiosks.

Table 2-10 - Pump design requirements at Gate Three design

Pump Selection	Assumed Pump Arrangement	Max Flow Duty Head (m)	Pump Motor Rating per Pump (kW)	Pump Station Max Power draw (kW)	Pump Drives

IPS-A/ BPT-1 Split Case Axial (SCA)	D/A/A/S	10	75	188	VSD
IPS-B SCA	D/A/A/S	70	450	954	VSD
IPS-3D SCA	D/A/A/S	60	450	818	VSD

2.10.6 Electrical

For the illustrative designs of the AGPs, the following assumptions have been made related to the electrical design:

- The power supply to the pumping station will consist of a single supply at 11kV at 1500kVA and a separate standby containerised generator rated at 1700kVA. There will be a Low Voltage (LV) switchboard with mains and generator incomers, motor starters, feeders and Instrument, Control and Automation section. Transformer Substation containing 1500kVA. 11kV to 400V Step down transformer for the pumps, building services, instrumentation and controls;
- The generator will require a 20m3 bulk fuel tank;
- The PLC will be required provide control and monitoring of the pumps plus supervisory function of all plant in the pumping station. HMI provided with PLC which will have visibility of the entire pumping station. PLC will have a UPS providing autonomy of 4 hours; and
- It is proposed that the PLC and HMI will be connected through Managed Ethernet Switches and routers for providing network security for connection to external communications network for in cooperation into WRP SCADA system. Pumping stations, BPT and WRP SCADA will be integrated together. All integrated SCADA at WRP will be connected back to Otterbourne WSW. There will be a link to PW for their Plant Status which interfaces with SW.

2.10.7 Break Pressure Tank (BPT-4)

As well as the Break Pressure Tank at IPS-A, an individual tank has also been included to mitigate potential surge issues and reduce overall pumping costs between IPS-3D and Otterbourne WSW (Figure 2-23).

2.10.8 Civil

- The illustrative design of this BPT has been based on the typical layout of a service reservoir using a concrete tank with an embankment around it to provide visual screen and reuse as much material on site as possible (Figure 2-23). Between the bunding and the tank will be an access path to allow for condition of the tank to be monitored and any required maintenance carried out;
- The illustrative design of this tank has been sized to provide a working volume equivalent to 15 minutes of peak flow (90 Ml/d) within each of the two cells, totalling approximately 2,000m^3. Therefore, each cell will be 20m long by 10m wide by 5.5m high to provide this storage and will partially be located below ground to further reduce the visual impact.

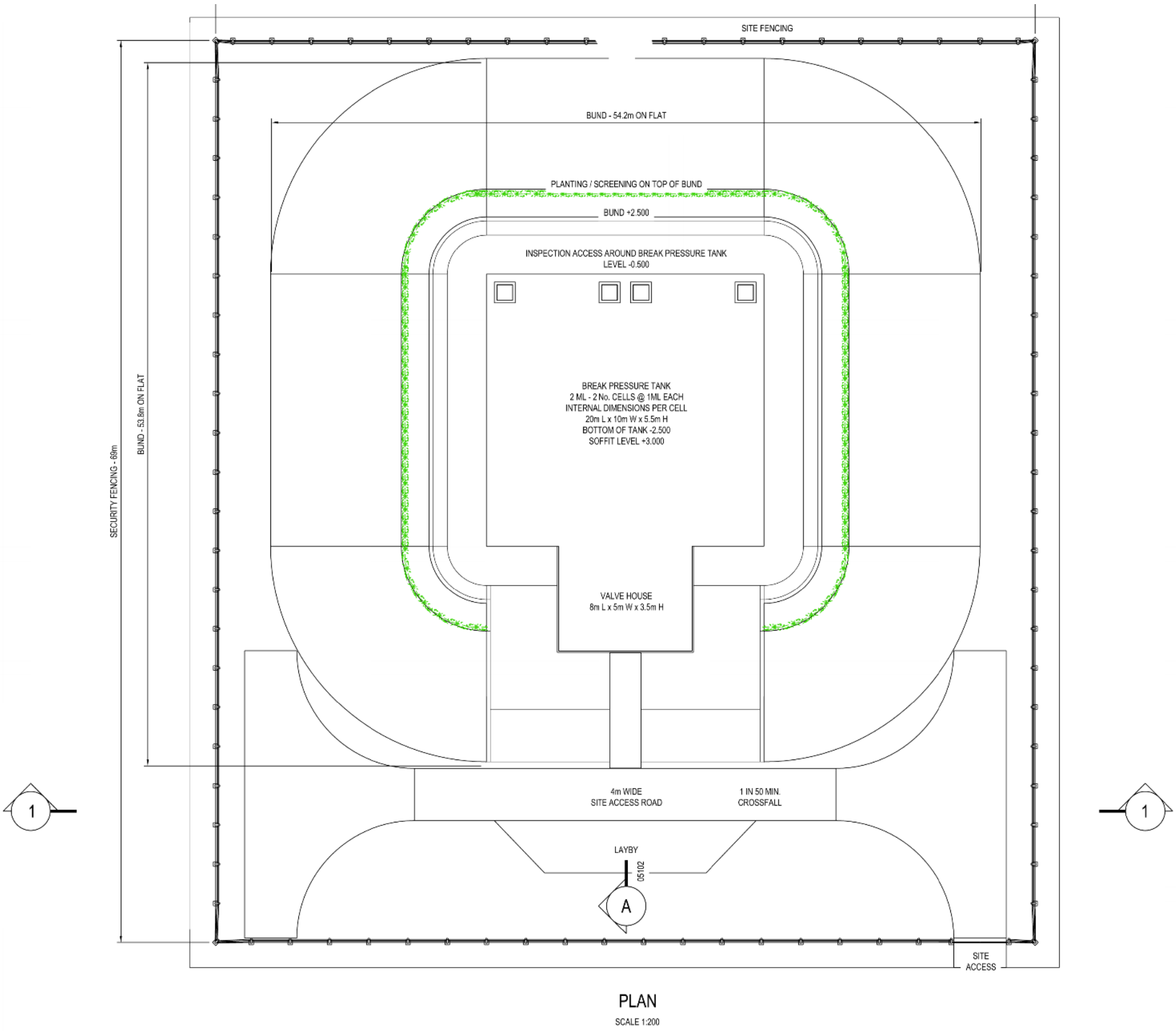


Figure 2-23 - Proposed Draft Illustrative Layout of BPT-4

2.10.9 Mechanical

For the illustrative designs the following assumptions have been made related to the mechanical design:

- The break pressure tank includes isolation valves on the inlet and outlet of each of the 2 no. storage compartments. Flow away from the BPT would be controlled via a control valve at Otterbourne WSW. The water level within the water storage compartments would also be maintained at all times when the BPT cell is in operation; and
- Access into the tank should be through submarine access doors.

2.10.10 Electrical

For the illustrative designs the following assumptions have been made related to the electrical design:

- Power supply to the BPT 4 Station will consist of a single DNO supply at 11kV at 1500kVA and a separate standby containerised generator rated at 1700kVA. There will be an LV switchboard with mains and generator incomers, motor starters, feeders and ICA section. Transformer Substation containing 1500kVA. 11kV to 400V Step down transformer for the building services, instrumentation and controls;
- The PLC will provide control and monitoring of the pumps plus supervisory function of all plant in the BPT station. HMI provided with PLC which will have visibility of the entire BPT station. PLC will have a UPS providing autonomy of 4 hours; and
- The PLC and HMI will be connected through Managed Ethernet Switches and routers for providing network security for connection to external communications network for in cooperation into WRP SCADA system. BPT and WRP SCADA will be integrated together. All integrated SCADA at WRP will be connected back to Otterbourne WSW. There will be a link to PW for their Plant Status which interfaces with SW.

2.10.11 Ongoing Desktop and Site Investigation to Inform Design

Geotechnical and Geo-Environmental Investigation

An extensive programme of Geotechnical and Geo-Environmental Investigation and monitoring is ongoing to inform design and information is being gathered at key locations such as trenchless crossings, AGP sites, sources of potential contamination and along the pipeline route to inform the various environmental assessments. This includes:

- Geotechnical and Geo-Environmental Detailed Desk Top Study; and
- Geotechnical and Geo-Environmental Site Investigation, including boreholes; trial pits; hand dug pits; geophysical surveys; infiltration testing; watercourse bathymetry.

Unexploded Ordinance (UXO)

A desk top study was undertaken to identify the risk of encountering UXO into areas of low, medium and high risk (Figure 2-24). A detailed desk top study will identify hazard zones and will detail the potential type of UXO to be encountered and at what depth. This will help inform proposed construction techniques and allow appropriate mitigation to be planned.

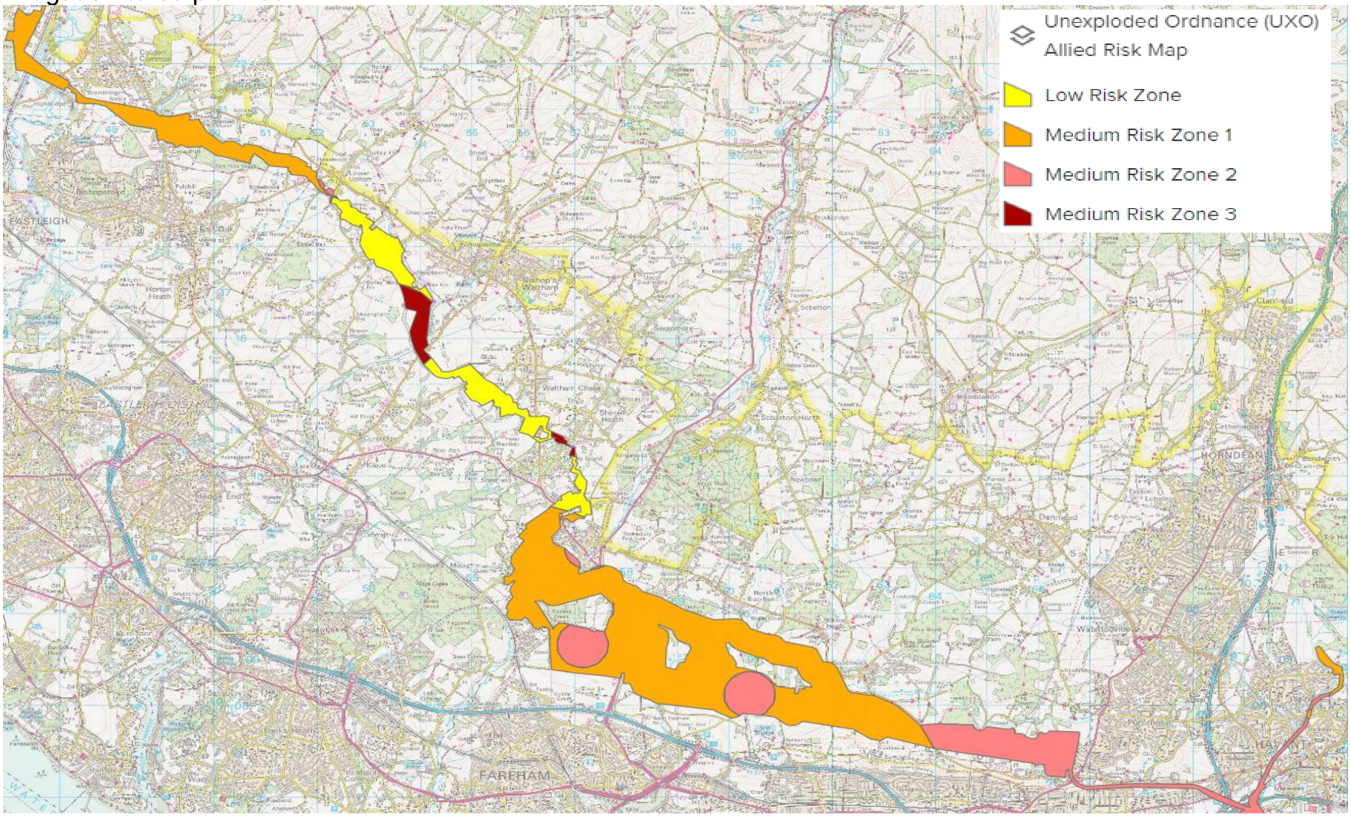


Figure 2-24 - UXO risk mapping for proposed pipeline route

2.10.12 System Control

The overall system control continues to be developed, improving the expectation and understanding of the various communication links and transfer of data (Figure 2-25)

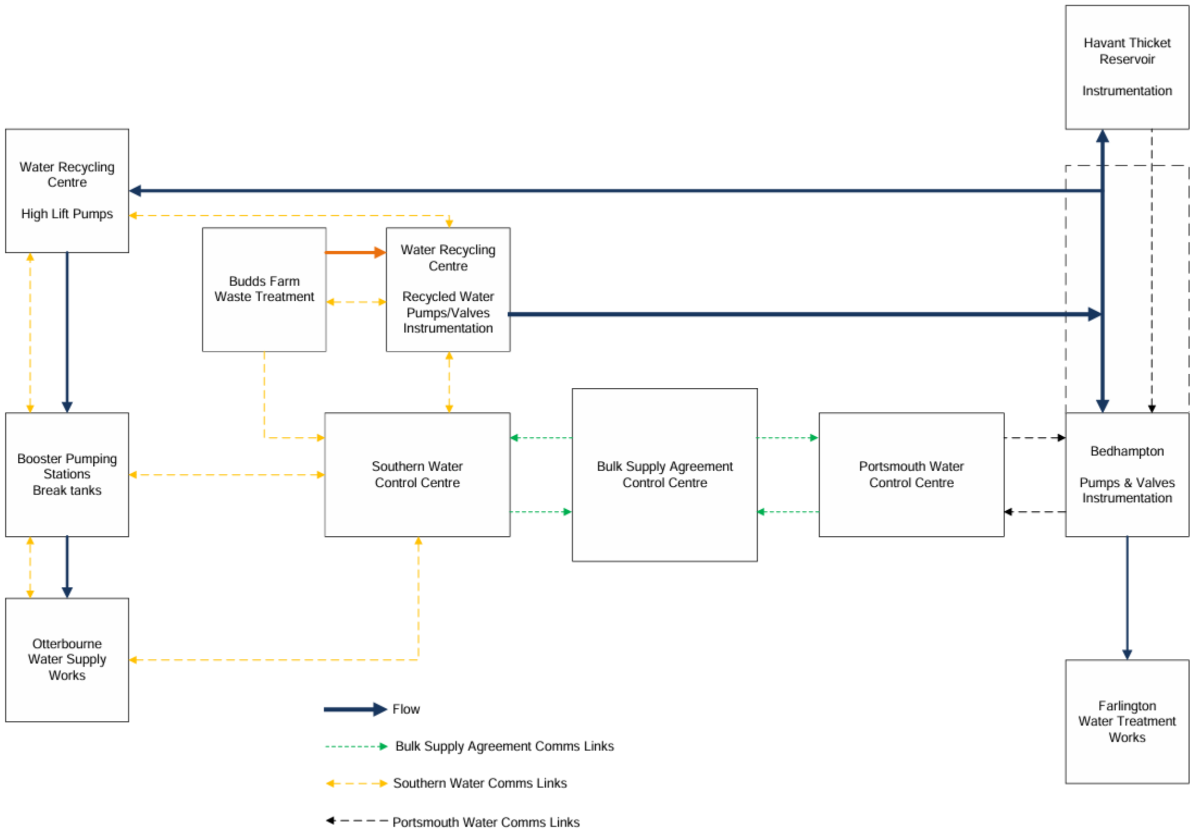


Figure 2-25 - Overview of system control development

2.10.13 Digital Twin Strategy

SW are developing a smart water and waste network as part of a holistic system thinking approach that will integrate the rich data from multiple new and existing sources and present it in a single visualisation platform. This will provide a virtual model of the physical assets across the network referred to as a digital twin. Using machine learning and artificial intelligence, clustering data sets and removing false positives, this will inform assets and operational decision-making allowing prioritisation of preventative and reactive activities. The digital twin will have live hydraulic modelling capability integrated to sensor data in the field which will be used in real-time to assess the impact of an incident or network anomaly and to provide an informed operational decision support tool.

During the life cycle of a project there are a myriad of different types of digital twins that can be developed to advance understanding of the performance of many aspects of the target entity. Selection of the development of appropriate digital twins should be made focussing on the key decisions that will be made in the lifecycle of the target entity. The purpose of the digital twin(s) is to provide information to support decision making to enable informed decision making for the best outcome.

Digital twins can be broken down into four different classifications: component, asset, system and process. Each classification of digital twin can support and benefit an organisation to achieve its business objectives:

Component Twins – these are the basic unit of digital twins and are the smallest example of a functioning component. These are intended to represent an individual part of a system or product (Table 2-11). Component digital twins are typically undertaken for a major element that has a significant impact on the performance of the physical entity to which is belongs.

Table 2-11 - Component Digital Twin

Type	Drivers	Explanation
Waste Dispersal Modelling (Mike 2D/3D)	Discharge Consents Stakeholder and Customer Engagement	Developed to understand the interaction of the waste stream from the WRP with the marine environment.

Asset Twins – the virtual representation of a physical product rather than its individual parts, their purpose is to understand how their various parts operate together within a single real-world product (Table 2-12). Asset digital twins provide visibility at the unit level.

Table 2-12 - Asset Digital Twin

Type	Drivers	Explanation

Reservoir Water Quality Modelling (AEM3D/Mike3D/CFD)	Water Safety Plans Stakeholder and Customer Engagement	Define the expected water quality envelope in the reservoir and how it evolves through the introduction of recycled water and operational and seasonal variances.
Topographical	Outline Design	Digital elevation and topographical model to inform outline design of tunnelling and critical trenchless crossings.
Geophysical	Outline Design	3D model used for managing natural resources, identifying natural hazards, and quantifying geological processes. To inform archaeological input and tunnelling design.
3D Models (Autodesk 360, Revit)	Design Development	Planning, design and construction tools

System Twins - virtual representations of systems of products working together (Table 2-13). While asset twins' model real-world products comprised of many parts, system twins model these individual products as components of a larger system. Understanding how assets interact with one another offers the opportunity to improve how they relate to one another, increasing productivity and efficiency as a result. A system digital twin provides visibility into a set of interdependent physical entities.

Table 2-13 - System Digital Twin

Type	Drivers	Explanation
WRSE Investment Model	Project Need	Financial model that represents the water resource needs of the southeastern region to ensure an affordable, resilient and sustainable water supply for the public, industry and the natural environment.
Pywr	Project Need Supply/demand balance	Modelling developed to understand the utilisation of the raw water network.
Baseline Date (MOATA/ArcGIS)	Project Development	Geospatial mapping software for baseline project information, facilitating collaboration of Engineering, consenting, environment, ecology and land access
Hydraulic Analysis (steady state Excel or Hades)	Project Development	Through the project development process, it is critical to understand the hydraulically optimum route that could be achieved through the selected corridor to inform further micro siting.

Process Twins - digital representations that provides a view into a set of activities or operations (Table 2-14). The process digital twin can be informed by a set of physical entities or system digital twins but focuses more on the process itself rather than the physical entities. They involve systems working together and can help determine the precise interactions between systems that influence overall effectiveness.

Table 2-14 - Process Digital Twin

Type	Drivers	Explanation
Mass Balance	Project Development DWSP Discharge Consents	
Treatment Process	O&M and Optimisation	Primarily a (near) real-time insight into the water quality throughout the treatment train. Consisting mainly of (process) models of the treatment stages, fed by data from a data management or process-information management system.
4D Visualisation	Construction H&S	Utilising the project 3D models to increase the safety, visibility, predictability, and productivity of the construction.

2.10.14 Maturity Level of Digital Twins

Through the project lifecycle, the maturity of a digital twin can move back and forth, dependent on the requirement of the project stage (Table 2-15). Consideration is given to the needs of the stakeholders in the creation of outputs.

To maximise value and reusability, the digital twins that are being used and will be used have been selected to align with the different stages of the project lifecycle:

Stage 1 - Planning, Consenting and Contracting

The HWTWRP has already implemented several digital twins that have informed the planning, consenting and contracting processes. These tools continue to be developed and refined as the solution progresses.

Stage 2 - Detailed Design and Construction

It is anticipated that the appointed CAP will begin the development of the baseline component digital twins. This will enable the development of a Process Twin resembling the WRP which will enable initial development of process simulation.

Stage 3 – Operation, Maintenance and Optimisation

Following the delivery of the HWTWRP, introduction of real-time sensor and analytics into the built environment will improve maintenance and operations and inform future optimisation and development of the assets and process.

Table 2-15 – Types of digital twin being implemented for the HWTWRP

Project Lifecycle	Component	Asset	System	Process
Planning, Consenting and Contracting	Dispersal Modelling	Topographical Geophysical 3D Models Reservoir WQ Modelling	MOATA Hydraulics Pywr WRSE IVM	Mass Balance
Detailed Design and Construction	Dispersal Modelling	Topographical Geophysical 3D Models Reservoir WQ Modelling 4D Modelling	MOATA Hydraulics Pywr WRSE IVM	Mass Balance Treatment Process
Operation, Maintenance and Optimisation	Dispersal Modelling	Topographical Geophysical 3D Models Reservoir WQ Modelling 4D Modelling	MOATA Hydraulics Pywr WRSE IVM	Treatment Process

2.10.15 Project Vision and Design Principles

A project vision and preliminary design principles have been developed which reflect the design approach adopted at this stage and which will be used to inform the Preliminary Environmental Impact Report (PEIR). These will continue to evolve and be tested through engagement and consultation and will be supported by more detailed site-specific principles later in the process to guide detailed design.

2.10.16 Project Vision

The project has been recognised as being a project of national significance when the Secretary of State gave a Section 35 Direction to bring it into the Planning Act 2008 regime and it will represent one of the largest investments in water resource infrastructure in the region.

SW has established a vision for the Project that will serve to underpin the overall design approach so that the project can deliver benefits to people, place and nature, having regard to the guidance in the National Infrastructure Commission's Guidance on Climate People Places Value: Design Principles for National Infrastructure[20] and the ACWG Design Principles and User guidance[21].

The project vision is as follows:

> *"We're transforming the way we source, treat and supply water across Hampshire. Creating a new, resilient and sustainable water supply will protect and enhance the county's rare and sensitive chalk streams, while maintaining supplies for our communities and the local economy."*

2.10.17 Design Principles

Acknowledging the value of good design, preliminary design principles were developed to guide scheme development to date, underpin the PEIR and inform Statutory Consultation. These outline a broad design aspiration to ensure the project design is:

- Landscape-led - responding to and enhancing local landscape character and heritage;
- Integrated - with the green and blue infrastructure network to support nature recovery on land and water; and

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[20] NIC Design Principles

[21] ACWG Water Resources: Design Principles and User Guidance

- Beneficial – delivering tangible advantages for both nature and local communities.

Any design aspiration must be set against the critical need to ensure the project meets safety, functional, maintenance and access requirements and complies with all relevant policy and legislative requirements.

The purpose of 'design principles' are to help demonstrate and guide the good design of the project having regard to the project vision – from inception to detailed design and delivery by:

- Reflecting the criteria for good design as set out in the National Policy Statement for Water Resources Infrastructure (NPSWRI)[22];
- Setting the principles that would be used to develop detailed designs for buildings, structures, pipelines and landscaping of the HWTWRP;
- Describing the primary / embedded mitigation that has been identified as part of the assessment of the likely significant environmental effects in the Environmental Impact Assessment (EIA) process; and
- Designing commitments that are reflective of stakeholder feedback during the DCO pre-application consultation process.

The form, nature and messaging of design principles will evolve throughout the DCO process to reflect their purpose at each stage and the increasing maturity of project development.

The 'end product' will be a DCO application document (the "Development Design Principles") which would be secured through the order (as part of the suite of 'control documents') with which the detailed design would need to be in accordance. As noted in NPSWRI, water resource projects are anticipated to use the DPC procurement method. This means that a number of details of the design will be reserved for subsequent determination post DCO consent. Design principles can be used to ensure that future detailed designs can deliver on the design and mitigation commitments made during the pre-application process.

The Development Design Principles document would include 'general design principles' that would apply broadly to detailed design across the project as a whole and 'site specific design principles' for each individual component of the project (such as the WRP, AGP sites and pipeline route).

The 'general design principles' and 'site specific design principles' will draw from various sources including examples of good practice and the overarching objectives and requirements of the project but most importantly (given their forward-looking purpose) from environmental assessment to reflect necessary mitigation measures to be secured through the DCO. The principles will also evolve throughout the pre application stage through consultation and engagement and on through the Examination in response to further feedback from stakeholders and the Examining Authority as well as through any project led change.

At this stage a series of Preliminary Design Principles have been developed which set out broad principles that have informed the approach to date and can be committed to at this stage and which will evolve into the final general design principles. The relationship of each principle to the four NIC design principle's broad themes has been identified (Table 2-16).

Table 2-16 - Preliminary Design Principles (November 2023)

Topic	Preliminary Design Principle	NIC theme(s)
	Site Layout and Building Design	
Land use	Minimise land take, whilst ensuring sufficient space and access for efficient construction and operation, through route and site selection and optimising site layouts.	Places
Sustainable resources and materials	Use resources sustainably across the project through strategies for natural resources and material (including material reuse on site in accordance with the waste hierarchy and use of sustainably sourced materials that meet technical requirements).	Climate Places Value
Siting and route selection	Adoption of avoidance criteria for route and site selection to avoid as far as feasible and technically possible, sensitive receptors and important designations (including residential areas, ancient woodland, national parks etc).	Places
Minimising noise and vibration impacts	Have regard to the most acceptable soundscape available, site permanent noise/vibration emitting sources away from sensitive receptors and introduce containment measures and screening where necessary.	People Places Value
Minimising carbon and emissions	Minimise carbon use and emissions throughout the project life cycle – including energy efficient and low carbon designs for buildings/new assets where feasible.	Climate Value

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[22] National Policy Statement for Water Resources Infrastructure

Sustainable water strategy	Maximise the sustainable use of water – including use of water-efficient fittings and rainwater harvesting systems to help reduce water consumption where feasible and appropriate.	Climate Places Value
Reinstatement and planning for future use	Development of a reinstatement strategy - including returning land used temporarily to its former use where appropriate and to not be left in a condition that may preclude potential future use, development or enhancement of the public realm.	People Place Value
Minimising light impacts	Minimise impacts from lighting on local amenity, dark landscapes, nature conservation and heritage locations (including impacts to the South Downs National Park Dark Skies Area and Chichester Harbour Area of Outstanding Natural Beauty).	Places
Environment		
Respecting local distinctiveness	Recognise and respect local landscape, heritage and recreational character and values and adopt a landscape-scale approach to design to maximise integration and wider environmental and social benefits beyond the boundary.	People Places Value
Environmental protection	Minimise impact on landscape, ecology, heritage and water environment (including groundwater and surface water) and seek to integrate permanent buildings into their landscape setting, with high quality design (and/or screening such as by natural features), materials and colour palette appropriate to context.	People Places Value
Retention of existing features	Existing landscape features within site boundaries will be retained where possible and beneficial and buffer zones may be provided. Existing vegetation should be retained and protected where reasonably practicable to retain visual continuity and ecological connectivity;	People Places
Appropriate planting	New tree and shrub planting will use appropriate species in keeping with the landscape whilst sourcing responsibly and considering the impacts of climate change in determining the species.	Climate Places Value
Green infrastructure enhancement	Seek to enhance green infrastructure and nature networks, with landscape planting as shown on the environment/landscape masterplans and in accordance with a reinstatement strategy.	People Places Value
Enhance biodiversity	Contribute to and enhance the natural environment by providing net gains for biodiversity. Landscape design will be compliant with the BNG strategy and seek to deliver the best outcomes for biodiversity.	Climate People Places Value
Construction methods	Utilisation of trenchless construction methods to avoid direct impacts on all main rivers (and locating compounds outside flood zones where possible).	Places
Environmental enhancement	Positively promote opportunities for project wide environmental enhancement and maximise multifunctionality to deliver Environmental Net Gain	Climate People Places Value
Climate resilience	Design for resilience to future climate change - allowing for future adaptation through the full life of the project	Climate
Sustainable drainage	Use of sustainable drainage strategies to ensure that post-development surface water run-off rates do not exceed existing rates. A hierarchical approach to drainage design will be implemented.	Climate Places Value
Safety, function and accessibility		
Operation and function	Ensuring delivery of the objectives of the project without significant operational constraint or reduction in function.	Value
Connectivity and active travel	Seek to connect to and extend walking, equestrian and cycling networks to increase access to the countryside. Include good quality walking, wheeling and cycle routes etc to enhance active transport provision.	People Value
Safety	Ensure that safety and security are overarching priorities embedded throughout design.	People Places
Consultation and engagement		

Engagement	Engage openly with local communities affected by the proposals and actively involve key stakeholders in design development.	People Value
Genuine consideration of feedback	Consider feedback carefully and respond meaningfully taking communities on the journey from inception to operation – to maximise benefits for local communities as far as possible.	People Value

These have been adopted by the Project to underpin the PEIR and were used to inform the explanation of the role of design principles through Statutory Consultation in summer 2024.

It is anticipated that the Preliminary Design Principles may evolve following Statutory Consultation, including from having regard to feedback received, to form the general design principles for submission. The more detailed site-specific design principles will be developed following Statutory Consultation.

2.10.18 Site Selection Process

A detailed description of the process for considering alternatives solutions to the HWTWRP and alternative sites for the WRP and pipeline corridors is set out at Gate Two[23] and in the Scheme Development Summary that was presented at the summer 2022 Non-Statutory Consultation for HWTWRP. This description was updated further at the Scheme Development Summary presented at the summer 2024 Statutory Consultation to take into account scheme development and consideration of alternatives since the Non-Statutory Consultation.

2.10.19 Pipeline Route and Site Development from Gate Two to the summer 2022 Non-Statutory Consultation

A number of potential pipeline routes were identified at Gate Two[23]. The starting point in developing the pipeline routes was the potential pipeline routes which comprised a number of different routes between the WRP site, HTR and Otterbourne WSW. A continual review of these potential pipeline routes has been undertaken in order to:

- Improve the hydraulic performance of the pipeline route. Additional topographical data (Environment Agency (EA) Light Detection and Ranging) was considered;
- Identify any additional potential alternative pipeline routes that would avoid or reduce impacts on key planning policy designations or constrained areas, including the South Downs National Park;
- Account for changes to land use since the routes were drawn pre-Gate Two, as a result of new development shown by updated aerial imagery;
- Consider with greater significance the potential for routes that diverge from the direct route options developed pre-Gate Two; and
- Include corridors that lead to and contain tunnelling shafts or portals, which are considered necessary where there are significant constraints for planning and construction, such as dense urban areas.

Following further review, an additional pipeline route was identified and progressed alongside the potential pipeline routes identified at Gate Two. This additional route followed a similar route to the northern section of the pipeline between Peel Common WTW and the WRP site that was part of Option B.5 presented at Gate Two.

The potential pipeline routes identified for Gate Two and the additional route identified following Gate Two have then expanded into wider pipeline corridors to allow for micro siting and refinement of the pipeline route taking account of local constraints at later stages (Figure 2-26). The pipeline corridor for each route was divided into sections so that each section to allow for the consideration of alternatives by understanding how each corridor performs compared to alternative pipeline corridor sections. The outcome of this process would be the selection of a preferred ‘chain’ of corridors.

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[23] HWTWRP RAPID Gate 2 Submission Annex 5: Options Appraisal Process

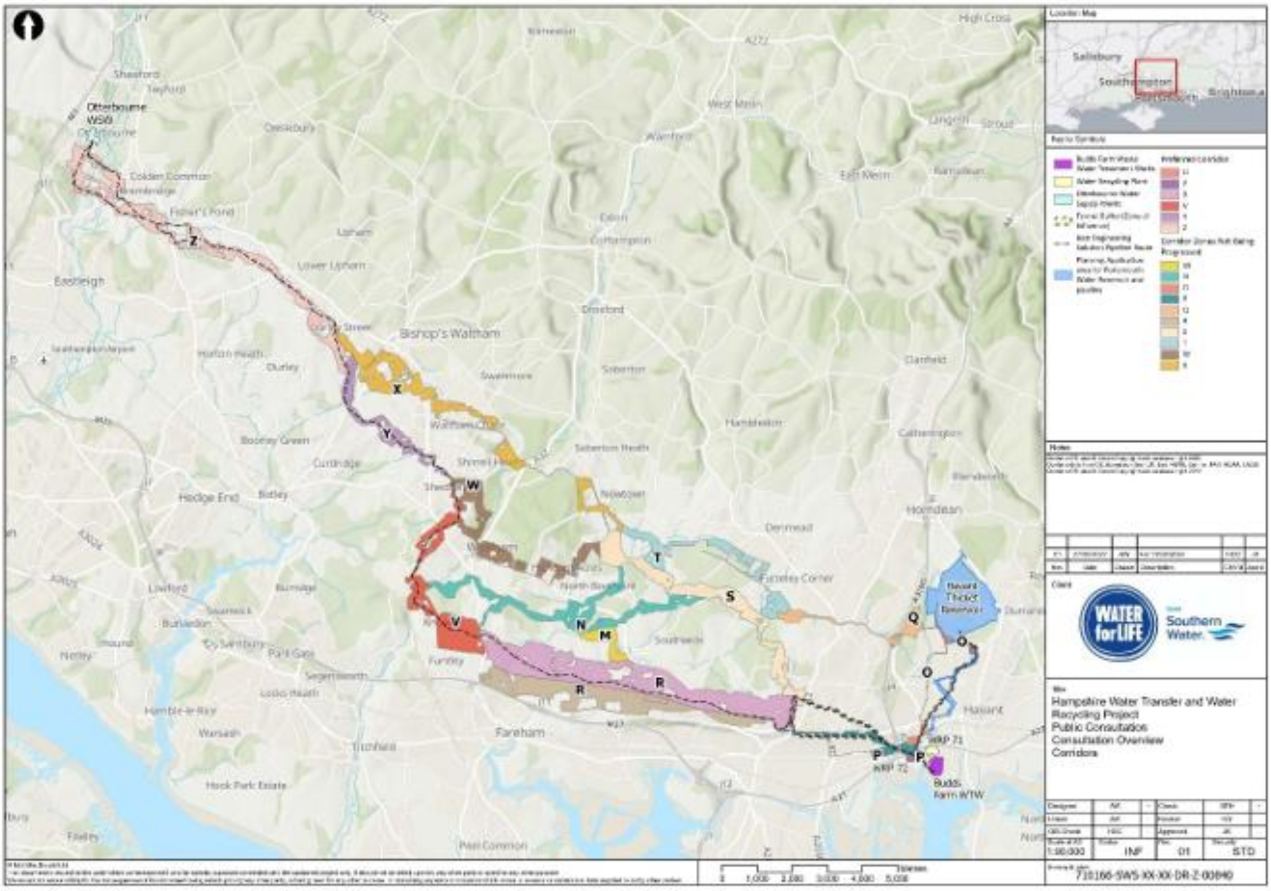

Figure 2-26 - Corridor Section Options

The pipeline corridor sections were then assessed against technical, planning and environmental criteria developed by subject matter experts and was subject to engagement with relevant technical stakeholders. The evaluation identified the potential impacts of the pipeline corridor sections pre- and post-mitigation for both the construction and operation phases. The evaluation comprised of assessments from the following subject matter experts:

- Constructability;
- Biology and nature conservation;
- Flood risk;
- Geology and soils;
- Historic environment;
- Hydraulics and engineering;
- Landscape and visual amenity;
- Socioeconomics;
- Planning;
- Special category land; and
- Water quality and resources.

The pipeline corridor sections that were considered can be found in the Book of Maps that was presented at the summer 2022 Non-Statutory Consultation. The evaluation resulted in a number of pipeline corridor sections not being progressed, and the selection of a preferred pipeline corridor which was considered to perform the best against the criteria. This preferred pipeline corridor has informed the development of the EIA Scoping Area for the HWTWRP.

A number of pipeline corridor sections were not progressed as they had a greater intersection with the South Downs National Park and the preferred corridor is located outside of the South Downs National Park where possible to reduce consenting risk associated with the National Park designation. Construction challenges were also identified in some pipeline sections, especially those within populated areas and therefore these were not progressed, or alternative routes and construction methodologies were considered. A summary of the pipeline corridor section evaluation outcomes for the preferred pipeline corridor can be found in the Scheme Development Summary presented at the summer 2022 Non-Statutory Consultation.

The preferred pipeline corridor and preferred AGP zones were consulted on at the summer 2022 Non-Statutory Consultation. A Best Engineering Solution Pipeline Route (BESPR) was also presented, which represented an indicative and hydraulically optimum pipeline route within the preferred pipeline corridor (Figure 2-27).

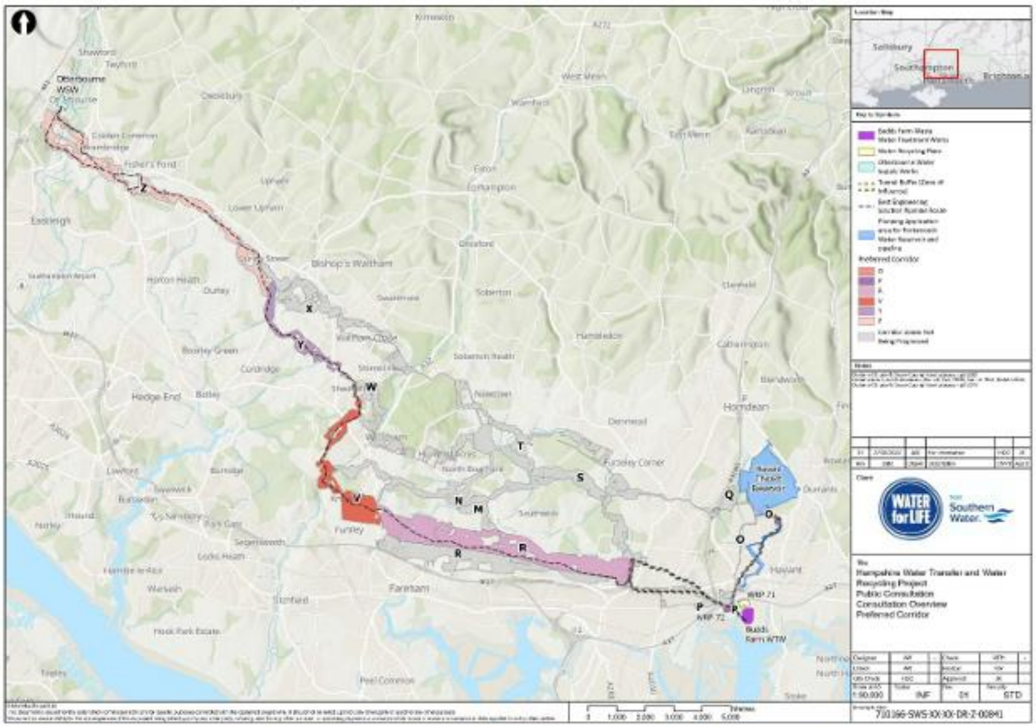

Figure 2-27 - Preferred Corridor for HLPS to Otterburne WSW

2.10.20 Pipeline Route and Site Development from the 2022 Non-Statutory Consultation to the 2024 Statutory Consultation

Following the summer 2022 Non-Statutory Consultation, further development of the pipeline and AGP was undertaken. The Scheme Development Summary presented at the summer 2024 Statutory Consultation on the HWTWRP set out a detailed description of the process and outcomes.

The approach to the development of the pipeline route and AGP was as follows:

- Development of an indicative pipeline route following key amendments to the BESPR and reduction in routeing optionality in the wider pipeline sections;
- Selection of sites for the proposed AGP within the wider zones;
- Micro siting of the indicative pipeline route to identify a preferred pipeline route; and
- Development of project boundaries (for example the Draft Order Limits) for the DCO Statutory Consultation.

The preferred pipeline corridor provided a wide area of land to allow for flexibility later in the project development process following environmental and engineering assessments as well as feedback from the summer 2022 Non-Statutory Consultation. This part of the process aimed to reduce the area of land and any options and amend the BESPR to identify an indicative pipeline route.

This stage also allowed for the BESPR to be amended in areas where environmental and engineering assessments and consultation feedback had identified constraints or matters that could be resolved by altering the route of the BESPR.

Where options were available in the preferred pipeline corridor, or where constraints were identified on the route of the BESPR, alternative routes were identified. These alternative routes used different routes to the BESPR but were still considered to be hydraulically suitable.

Once alternative routes were identified, an evaluation which compared the BESPR with the alternative route was undertaken for that location. The evaluations comprised of assessments undertaken by the following subject matter experts and considered a range of criteria and sub-criteria:

- Air quality;
- Biodiversity and nature conservation;
- Carbon and climate change;
- Geology and soils;
- Historic environment;
- Interface with other developments;

- Landscape and visual amenity;
- Noise and vibration;
- Resource and waste management;
- Socioeconomics;
- Special category land;
- Traffic and transport; and
- Water quality, resources and flood risk.

The evaluation resulted in the identification of an indicative pipeline route. Following this further micro siting was undertaken to assess the indicative pipeline route in greater detail and refine it to respond to local constraints. To do this, a review of all linear features was undertaken to determine whether the pipeline could be amended, or the construction methodology could be changed to reduce effects or risks associated with identified constraints. This included reviewing all vegetation, watercourses and roads intersected by the indicative pipeline route. Alongside this, an avoidance criterion was developed which provided guidelines in relation to suitable distances from a number of ecological features, such as records of protected species and ancient woodland.

To develop the AGP further, hydraulic modelling was undertaken on the evolving design of the pipeline between HTR and Otterbourne WSW which resulted in changes to the number of AGP required to support the transfer of water. This hydraulic modelling considered the topography of the evolving pipeline route, the diameter of the pipeline and the water quality requirements relating to the time it takes to transfer water between HTR to Otterbourne WSW.

Following this hydraulic modelling, and the confirmation of the number of AGP required, AGP sites were identified within the AGP zones. These sites were then reviewed using the evaluation criteria for the BESPR and alternative pipeline routes. The outcomes of the evaluation were then reviewed to determine whether there would be alternative sites within the AGP zones that would reduce the risks and effects identified by the evaluation (Figure 2-28).

At this stage a continual review of the WRP site selection was also undertaken. The preferred sites for the WRP and HLPS were selected at Gate Two[23] using a site selection exercise that identified suitable sites for the infrastructure and then evaluated these sites against a range of environmental, planning, constructability and engineering considerations. Section 3 of Gate Two Annex 5: Options Appraisal Process – Gate Two Supporting Technical Report sets out the initial site selection of the WRP and HLPS. Following the summer 2022 Non-Statutory Consultation, a review of the initial site selection of the WRP was undertaken to verify that the outcomes of the initial site selection process was robust and remained valid considering the time that had passed since Gate Two. This included testing the site identification criteria to determine whether any additional sites that weren’t previously identified could be suitable for the WRP.

When sites for the WRP were identified in the initial site selection process, land that comprised existing development was not included as these developments would likely need to be displaced to accommodate the WRP. However, engagement with Havant Borough Council following the summer 2022 Non-Statutory Consultation highlighted that there may be existing employment sites within the 1.5 km search area from Budds Farm WTW that could be available for the WRP.

The review also tested whether any sites less than the 6-ha minimum site size, but larger than 3.2 ha could be suitable for the WRP. 3.2 ha is considered to be the minimum area required to develop the WRP but would not be large enough to accommodate space for construction compounds, tunnel shafts for pipelines, or the HLPS. Additional land would therefore be required if a site below 6 ha was identified.

Following the identification of additional sites (Figure 2-28) and the amendment of sites that had been identified in the initial site selection, a review of environmental, planning and engineering considerations was undertaken to identify any consenting and delivery risks associated with these parcels. The environmental, planning and engineering review was also undertaken for sites identified in the initial site selection so that all sites could be compared equally. The review was undertaken by a range of relevant subject matter experts.

Figure 2-28 WRP Parcels Included in the Continual Review Process

Engagement with Havant Borough Council has been undertaken throughout this review process to set out the approach and outcomes to understand whether there were any additional sites that had not been considered.

2.11 Utilisation

2.11.1 Utilisation Rates

As discussed in Chapter 2: Solution Design, the Pywr modelling undertaken focussed on three-time horizons; 2038 (Table 2-17), 2042 (Table 2-18) and 2051 (Table 2-19). These were chosen as they best represented the situation prior to the introduction of the T2ST SRO, in 2040 (shown by the 2038 results) and situations following T2ST implementation (shown by the 2042 and 2051 results). The latter two-time horizons (2042 and 2051) differ slightly in that 2051 represents harsher environmental destinations, different demands and new options being utilised. For example, in 2051 the additional capacity at Farlington WSW becomes live, which was not utilised in 2042, and this can be fed directly from HTR.

Table 2-17 - Utilisation of the HWTWRP and associated infrastructure for a normal and drought year in 2038.

Asset Component	Normal Year Operational Average			1-in-500-year Drought Event		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
HTR Volume (Ml)	10000.00	10000.00	10000.00	8683.19	9619.71	10000.00
HTR to Otterbourne WSW (Ml/d)	23.08	33.08	50.68	23.08	44.02	71.24
WRP (Ml/d)	10.00	31.57	54.32	28.44	48.57	60.00
BHS to HTR (Ml/d)	0.00	3.69	28.54	0.00	0.00	0.00

Table 2-18 - Utilisation of the HWTWRP and associated infrastructure for a normal and drought year in 2042.

Asset Component	Normal Year Operational Average			1-in-500-year Drought Event		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
HTR Volume (Ml)	7742.36	9879.82	10000.00	1300.00	6197.08	9994.25
HTR to Otterbourne WSW (Ml/d)	25.00	30.93	55.79	25.00	39.65	78.28
WRP (Ml/d)	60.00	60.00	60.00	60.00	60.00	60.00
BHS to HTR (Ml/d)	0.00	2.82	21.36	0.00	0.60	5.88

Table 2-19 - Utilisation of the HWTWRP and associated infrastructure for a normal and drought year in 2051.

Asset Component	Normal Year Operational Average			1-in-500-year Drought Event		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
HTR Volume (Ml)	7305.68	9880.74	10000.00	1300.00	6191.29	10000.00
HTR to Otterbourne WSW (Ml/d)	28.80	47.31	69.54	26.68	53.51	90.00
WRP (Ml/d)	60.00	60.00	60.00	60.00	60.00	60.00
BHS to HTR (Ml/d)	0.00	3.17	40.00	0.00	0.17	5.18

2.11.2 Uncertainty in Utilisation Rates

Uncertainty around the utilisation rates for 2038, 2042 and 2051 is mostly inherent with the use of a model such as the Pywr model. Regarding the remaining uncertainties relating to climate change, key exports and transfer profiles, further optimisation will be completed of each model to refine the results further and diminish uncertainties as best as possible.

WRSEs IVM has currently selected the integrated HTR options as part of the Best Value Plan (BVP). The BVP continues to be updated as the options develop, providing a continuous review of best value criteria that would improve and increase any multi-sector benefits received from the solutions.

2.11.3 Risk and Assumptions

There are various risks and assumptions associated with the utilisation figures considered within the Pywr model. The first, most general, assumption relates to the simplified representation of the network in what is a resource allocation model rather than a hydraulic model. The network is represented as nodes (inputs, links, storages, outputs) connected by edges, with costs (or penalties) applied to prioritise resource allocation. Key properties of a hydraulic system (such as maximum and minimum flow constraints, storage capacities and approximate process losses) are represented however, the model shares out water subject to supply, demand and other imposed constraints on a daily time step.

The numerical groundwater model used in the SW portion of the Pywr model has associated uncertainties and assumptions. It is a simplified representation of the regional hydrogeology and is imperfectly calibrated to observed groundwater levels and river flows. For the PW portion of the model, uncertainties derive from the assumptions and use of empirical relationships with groundwater levels measured at Idsworth to generate model inflows.

The model has tested against a 48-year time series containing a 1-in-500-year drought event, together with the assumptions of the preferred planning scenario (Situation 4). To explore the implications of the uncertainly associated with climate change, population growth and future abstraction limits, the less conservative core scenario (Situation 8) has also been explored, along with less severe (shorter return period) drought events.

Groundwater abstraction can reduce the flow of rivers that are hydraulically connected to the aquifer. It is important for the Hampshire Pywr model to be able to account for the way in which abstraction of groundwater from the Chalk aquifer affects flows in the River Test and River Itchen, as river flows control how much water is available for surface water abstraction.

The cost values applied at various nodes within the model need not necessarily have any relationship with financial cost. They are parameters used to control (by biasing or weighting) the behaviour of the model. Cost differences trigger the prioritisation of certain flow transfers (for example, prioritising certain “cheaper” routes, the use of particular inputs and the satisfaction of demand centres). Model behaviour can be greatly influenced by costs, and there may be situations in which behaviour changes dramatically in response to a small change in cost distribution. This introduces risk in how the model may perform in future applications. Costs set to achieve a certain pattern of behaviour may lead to a ”brittle” model setup that behaves in unexpected, or unwanted, ways when parts of the system are changed. For this reason, it is important to review costs and associated prioritisations for each scenario and ensure that model behaviour reflects a plausible, or reasonable, pattern of network usage. Sensitivity analysis allows the influence of costs on model behaviour to be explored, and any critical costs to be identified.

It should be noted that the initial model runs for the time slices 2038, 2042 and 2051 were undertaken in order to validate the outputs of the WRSE investment model – in particular, they were to test the plausibility of the WRSE utilisation results in the context of smaller (daily, as opposed to annual) time steps and a more detailed representation of the network and its constraints. Costs were adjusted to achieve as close fit as possible to the WRSE results. However, the resulting pattern of usage may not reflect an optimised situation, or the way in which the system would actually be operated in practice. For this reason, further runs are planned to explore system optimisation.

For the purpose of this modelling exercise and to align as best as possible with the WRSE model, sweetening flows were enforced on various transfers; however, such flows were not consistently applied across the network. In the early stages of modelling, this was to help align with the WRSE results before exploring alternative scenarios. This imposes risk, as there potentially is a higher water demand in certain areas than the model has accounted for. The model used to produce these utilisation rates works with demand values taken from dry year annual average data, therefore the model is working on a worst-case scenario approach to meeting demand requirements. Whilst completing the initial set of model runs, to best align with the WRSE BVP results, exports such as the SW export were given fixed profiles for normal and dry year operation which reflected the WRSE BVP utilisation figures. This was due to uncertainty in what these profiles would accurately look like however will be refined in future model runs.

2.11.4 Additional Benefit from 3rd Party Options

The integrated options around HTR provide social and environmental benefits, primarily driven by the HTR. Other than HTR the rest of the integrated options are the construction of pipeline transfers. These options will support the environmental destination requirements (especially around the River Test and River Itchen) and improve the reliability of current water supply to SW and PW. Due to these options being (underground) pipelines there are no direct multi-sector benefits. However, there is an indirect benefit to, both household and non-household water users as this additional source of water will reduce the need for drought actions i.e., TUBs, NEUB's and hose pipe bans to be implemented.

WRSE have included several multi-sector options in the revised draft Regional Plan which would involve water companies working with other sectors on shared solutions that provide multiple benefits. There are also options, that if modified, could provide water for other sectors[24]. To date the best value planning process has picked the solutions to be progressed to solve the water deficit whilst producing the best value for nature, multi-sector use and customers.

2.12 Water Resource Benefit

As a result of more detailed modelling being available the WRSE group have assessed the scale of the water resource challenges, as being greater than anticipated by those in the National Framework for Water Resource. The range of information informing the preparation of the baseline supply-demand balance of the regional model and plan includes information on factors affecting future supplies and resource demands, including population growth, climate change and environmental policies and aspirations.

Therefore, because of this, the WRSE forecasts differ from those in the National Framework for Water Resources Given the scale and complexity of the challenges, WRSE have designed a regional planning process that is capable of modelling and assessing many different potential futures, to help water companies to select a resilient and adaptive best value plan.

This includes additional scenario runs that consider possible lower impactful environmental destinations, including those represented in the National Framework for Water Resources[25]. Through combining the demand forecasts and supply forecasts WRSE can calculate how these will balance in the future, and how much water is needed as a result[26]. The supply demand balance plots are created for individual water resource zones (WRZ) which are then aggregated to company and regional level. Further detail of this approach and the considerations can be found in the WRSE revised draft Regional Plan.

2.12.1 Deployable Output

The WRSE IVM has selected the 60 Ml/d maximum capacity from the WRP from the date it is first available under all planning scenarios (Table 2-20) and utilises it to maximum capacity (Table 2-21) in all the adaptive planning scenarios.

Table 2-20 - Earliest selection of recharge from HTR from Budds Farm WTW under each planning scenario

Planning Scenario	Supply-demand balance situation								
	1	2	3	4	5	6	7	8	9
NYAA	2036	2036	2036	2036	2036	2036	2036	2036	2036
1:100 DYAA	2036	2036	2036	2036	2036	2036	2036	2036	2036
1:500 DYAA	2036	2036	2036	2036	2036	2036	2036	2036	2036
1:500 DYCP	2036	2036	2036	2036	2036	2036	2036	2036	2036

Table 2-21 - Maximum utilisation (Ml/d) of HTR from Budds Farm WTW under each planning scenario

Planning Scenario	Supply-demand balance situation								
	1	2	3	4	5	6	7	8	9
NYAA	60.00	60.00	31.09	60.00	60.00	30.11	60.00	35.71	27.62
1:100 DYAA	60.00	58.86	32.97	60.00	57.82	20.00	56.50	40.00	20.00
1:500 DYAA	60.00	60.00	41.14	60.00	60.00	26.09	60.00	39.96	20.00

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[24] WRSE Revised Draft Regional Plan August 2023 (Section 12.62, page 121)

[25] WRSE Revised Draft Regional Plan August 2023 (Section 4.5, page 32)

[26] WRSE Revised Draft Regional Plan August 2023 (Section 5.1-5.6, page 51

1:500 DYCP	20.00	21.62	21.42	20.00	20.51	20.00	20.00	20.00	20.00

Table 2-22 - Earliest selection of bulk import from HTR to Otterbourne WSW under each planning scenario

Planning Scenario	Supply-demand balance situation								
	1	2	3	4	5	6	7	8	9
NYAA	2036	2036	2036	2036	2036	2036	2036	2036	2036
1:100 DYAA	2036	2036	2036	2036	2036	2036	2036	2036	2036
1:500 DYAA	2036	2036	2036	2036	2036	2036	2036	2036	2036
1:500 DYCP	2036	2036	2036	2036	2036	2036	2036	2036	2036

Table 2-23 - Maximum utilisation (Ml/d) of bulk import from HTR to Otterbourne WSW under each planning scenario .

Planning Scenario	Supply-demand balance situation								
	1	2	3	4	5	6	7	8	9
NYAA	55.53	44.89	30.44	60.00	45.46	30.11	60.00	30.69	27.62
1:100 DYAA	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00
1:500 DYAA	90.00	90.00	86.78	90.00	90.00	87.01	90.00	90.00	67.95
1:500 DYCP	69.00	69.00	69.00	69.00	69.00	69.00	69.00	66.85	59.31

The WRSE IVM selected HTR to Otterbourne WSW in situations as soon as it becomes available in 2036 (Table 2-22). The maximum utilisation of this option occurs under the 1-in-500-year DYAA scenario (Table 2-23).

WRSE has been working with us and the HWTWRP SRO project team throughout the planning process to ensure that the current understanding of the project is aligned with the representation in the WRSE RSS and IVM model. The WRSE IVM model has selected the solution as part of the BVP. The solution is part of a wider range of solutions around HTR which when fully developed will have greater benefit than any solution independently and will help to increase the reliability of supply for both SW and PW.

2.12.2 Deployable Output – Water Resource Zone

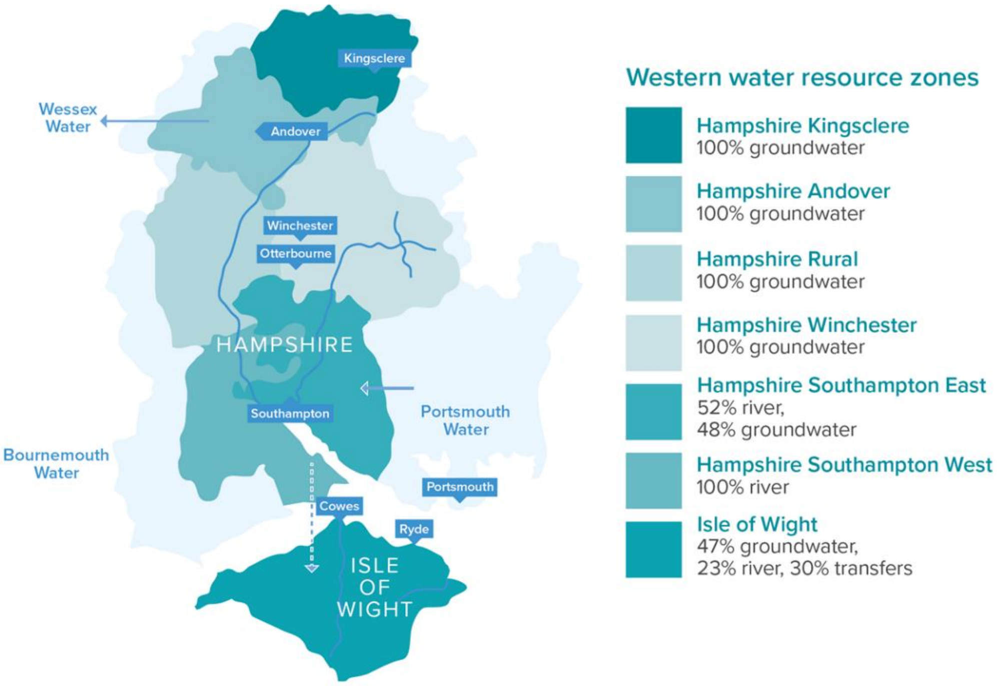

Figure 2-29 - SW Western Water Resource Zones

The estimates of DO have been calculated through the development and application of a number of advanced mathematical models to estimate hydrological yield. SW have used stochastically generated, but historically plausible, synthetic time series of weather to consider water resource availability under very severe droughts.

These climate data sets have been used in conjunction with the computer models of the aquifers, rivers, reservoirs and supply networks within SWs areas (Figure 2-29) to determine the DO of each WRZ under different drought conditions (Table 2-24).

Table 2-24 - Summary of baseline DO at the WRZ level.*

	DO by return period (DYAA/MDO) – Ml/d				DO by return period (PDO) – Ml/d			
WRZ	1-in-500-year	1-in-500-year	1-in-100-year	1-in-2-year	1-in-500-year	1-in-500-year	1-in-100-year	1-in-2-year
Hampshire Andover	22.86	22.86	22.86	22.86	24.80	24.80	24.80	24.80
Hampshire Kingsclere	8.75	8.75	8.75	8.75	9.28	9.28	9.28	9.28
Hampshire Winchester	22.52	22.52	22.52	22.52	24.40	24.40	24.40	24.40
Hampshire Rural	10.35	10.35	10.35	10.35	10.35	10.35	10.35	10.35
Hampshire South East	20.49	32.46	45.65	77.97	41.00	58.38	78.36	108.42
Hampshire South West	0	0	0	73.54	0	0	11.85	78.8
Isle of Wight	23.96	25.89	26.07	26.58	30.54	34.09	34.33	34.65

The bulk imports and exports represent transfers of water in and out of a WRZ respectively. This covers transfers between WRZs within the company as well as imports and exports with other neighbouring water companies or other formal transfers. SW have several bulk transfer agreements with neighbouring water companies and also transfer water across WRZs. For this plan, is has been agreed with the neighbouring water companies that all of the existing transfers will continue to be available at the current volumes. Bulk transfer agreements with neighbouring water companies are included as options in the options appraisal investment modelling upon the expiry of the current contractual term.

As described in Chapter 2: Solution Design, the primary WRZ benefited by the HWTWRP will be Hampshire South East, receiving 60 Ml/d average and a peak of 90 Ml/d. This water will then be transferred from this zone onto Hampshire South West and north to Hampshire Winchester.

2.12.3 Overview of Modelling Approach

To ensure alignment of the supply forecasts and option appraisals, SW have worked with the regional group to provide the outputs so that results for the entire region are produced from a single source consistent between regional and company plans. Similarly, SWs revised draft WRMP24 maintains consistency with the revised draft WRSE Regional Best Value Plan. The revised draft WRMP has been developed using the BVP and preferred scenario agreed by all WRSE member companies in July 2023. This ensures there are consistent assumptions on regionally strategic resources such as the SESRO proposal.

As identified in the Regional Plan, WRSE's investment modelling has identified that no other water companies have available options that can help to meet the deficits in the SW areas through the period until the HWTWRP is delivered. As a consequence, the potential implications of SW's WRMP re-consultation and finalisation are limited to SW's WRMP, and no consequential impacts on other company WRMPs would result.

Modelling has been undertaken on a range of levels to understand the available sources this including surface water and groundwater, the following sections provide additional information on these modelling developments.

2.12.4 Surface Water Modelling

To understand the availability of supplies from river sources such as the Rother and the Medway, SW have used hydrological modelling. Several hydrological models have been developed using the EA 'CATCHMOD' catchment modelling code implemented in Python ('PyCatchmod')[27]. These models primarily cover SWs' Central and Eastern areas, the river flows in the baseflow dominated River Test and River Itchen in the Western area were simulated using a regional groundwater model.

The hydrological models SW used were largely unchanged from those used for the WRMP19. The River Rother hydrological characterisation has been updated to improve low flow fits and to an include enhanced representation of groundwater impacts on the river.

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[27] Tomlinson, J, Arnott, J and Petch, L, pycatchmod: A Cython implementation of the rainfall runoff model CATCHMOD (Wilby, 1994), Version 1.1

This hydrological modelling approach is consistent with that set out in WRSE (2021)[28] and the regional modelling methodology.

Hydrological models may be used to assess the potential impacts of drought on river flows. These models have used CATCHMOD (Greenfield, 1984)29 rainfall-runoff hydrological models to model river flows since 2005.

The flow models are calibrated against observed data and are used to simulate the likely river flows which would occur in a catchment given a particular sequence of weather. The models have been developed to produce flow sequences from the synthetic stochastic rainfall and PET sequences as well as the historic records of rainfall and PET.

2.12.5 Groundwater Modelling

Groundwater resources are typically more complex and computationally intensive to model than surface water resources, as models must consider aquifer properties, variation in groundwater levels, antecedent operation, interference effects and asset and licence constraints.

To improve the efficiency of the water resource modelling approach, SW worked with other member companies of the WRSE to develop a common Groundwater Framework (WRSE, 2021)[30]. The aim of this framework was to develop and select the most appropriate modelling method for including groundwater resources within the regional system simulation model.

The Groundwater Framework (WRSE, 2021) proposes a standard assessment approach to be applied across all WRSE water companies and WRZs. Application of the framework assigned a weighted score across different source characteristics and suggests the DO modelling approach and system simulator representation that should be employed. Generally, the higher scoring a source the more suitable and the more benefit would be gained from dynamic representation within the system simulator model.

The framework proposed a semi-quantitative characterisation of each groundwater source over three phases:

- Phase A - Background Information: This includes the source name, type of source (e.g. single borehole, well and adit etc), the Water Framework Directive (WFD) groundwater body from which it abstracts and if it is a confined or unconfined source. This information is not considered in the framework prioritisation scores but provides some context when considering appropriate modelling methodology and potential grouping of some sources;
- Phase B - Prioritisation Criteria: This considers the prioritisation of sources for dynamic modelling based on their importance and potential value of their representation within the simulator. Four key criteria are considered in the scoring:
  - DO constraints and in particular the sensitivity of DO to climate factors with a higher score being assigned to sources that have drought sensitive yields. DO and climate change assessments for previous WRMPs;
  - Conjunctive-use benefits consider the interaction of a groundwater source with other downstream or downgradient sources or to the environment. It considers the extent to which groundwater source impacts on surface water and the designation of that impacted surface water under the WFD. Sites score highly if there are downstream impacts on surface water or conjunctive use with surface water abstractions;
  - Sensitivity to antecedent conditions mostly considers the role of groundwater storage in providing a benefit to yields at a site. It considers whether operation of a source may have a later impact on groundwater yield; and
  - Proportionality/threshold benefit. The intention of this score was to provide an indication of the possible strategic importance of a site primarily measured through its DO volume. Whilst it was scored these criteria were not used to determine if a source should be considered for dynamic modelling as it only provides an understanding of source size, not of its other hydrogeological or environmental characteristics.
- Phase C - Methodology: A review of current and available methodology and suitability of the sources as well as the outcome of the assessment and overall prioritisation assessment balancing the feasibility of implementation with the overall aim and methodology approach identified.

The final stage of the framework is to determine a proposed DO modelling approach for each groundwater source.

At each stage of the framework assessment, the suggested modelling approach or score could be overridden. However, if this is done a justifying comment supporting the change had to be included and to provide a track record of the manual adjustment to the framework outcome to ensure governance.

The (anonymised) scores for all SW sources will be included within the upcoming revised draft WRMP24.

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[28] WRSE Method Statement: Hydrological Modelling 2022

[29] Greenfiled, B. G., 1984. The Thames Catchment Model. Thames Water Authority, Reading.

[30] WRSE Method Statement: Groundwater Framework 2021

Following assessment, SW determined that the yield of three highest priority groundwater sources should be dynamically simulated within the regional system simulation model:

- River Itchen groundwater;
- Twyford; and
- Pulborough.

These sources are all constrained by Hands off Flow licence conditions in associated surface waters and where flow sequences were to be available within the RSS model.

Many of the groundwater sources are asset or infrastructure constrained and are not sensitive to groundwater level variations or drought. The yield of these sources was supplied as a non-varying static DO time series of PDO and Minimum DO (MDO) to the RSS model.

2.12.6 Regional System Simulation Modelling

It is essential that the water company hydrological and hydrogeological modelling is considered as part WRSE RSS modelling (Figure 2-30). Using coherent climate data across the WRSE region the water company model outputs were used to calibrate a common regional system simulation model, this was then used to produce outputs such as DO.

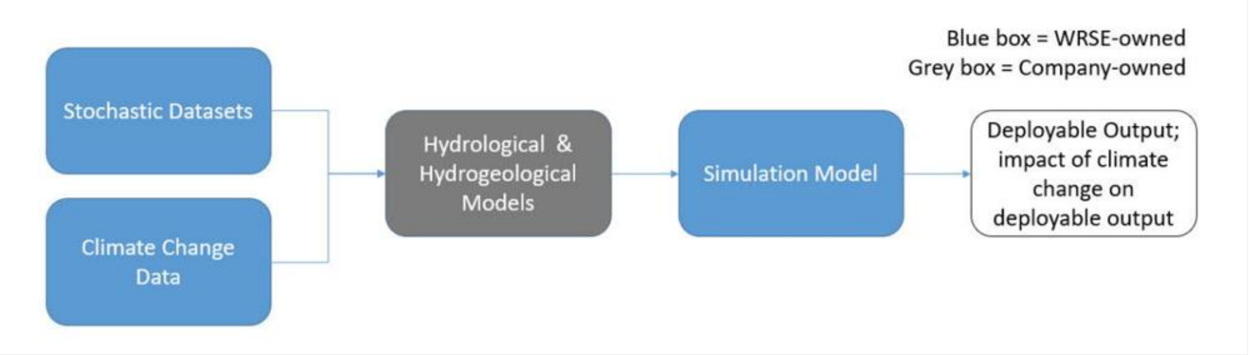

Figure 2-30 - The integrated process with other WRSE member companies for development of SW's supply demand models.

To derive WRZ level estimates of SWs DO as required by the WRPG, the regional RSS model has been developed collaboratively with WRSE and neighbouring water companies. The overall approach is set out in WRSE (2021)[31].

The WRSE RSS models have been used to produce both the baseline DO assessments (see WRSE (2021))[32] and assessments of uncertain future impacts of climate change (see WRSE (2021))[33]. The model is used to produce values to feed into the WRSE investment model and water resource planning tables.

The sub-models in the WRSE RSS have been re-constructed in Pywr to a similar level of detail as the existing Aquator system simulation models, although there was simplification of the model to speed up run time. New models were developed in Pywr because it offers improved functionality for handling stochastic flow and climate sequences and more efficient run times, especially when scaled up to a regional level model. The sub-model performance was validated against the existing Aquator models where possible to ensure system behaviours and source operation was modelled appropriately.

The SW components of the RSS model were constructed from five sub-models and were used along with other appropriate techniques for smaller groundwater bodies. These were used to provide the summary of baseline DO at the WRZ level (Table 2-24).

2.12.7 Adaptive Planning and Uncertainty

All the supply demand forecasts modelled have degrees of uncertainty. The water sector deals with a percentage of this uncertainty through a planning factor, known as headroom. For the WRSE revised draft Regional Plan a consistent approach for determining headroom has been adopted across the member companies, this is consistent with the industry accepted methodology[34] set out by UK Water Industry Research.

The traditional approach to defining headroom has been to identify uncertainty in the supply demand components and include an allowance for the uncertainty in the demand forecasts. However, with the industry movement away from a single forecast approach to adaptive planning, this approach has had to change. The newly adopted adaptive planning approach takes account of the uncertainty rising from a range of forecasts by having multiple "branches" defined by different forecast scenarios exploring different modelling uncertainties. To avoid double counting risks, WRSE have removed any components used to define a "branch" (environmental destination, growth

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[31] WRSE Method Statement: Regional System Simulation Model 2022

[32] WRSE Method Statement: Calculation of Deployable Output 2022

[33] WRSE Method Statement: Climate Change – Supply Side Methods 2022

[34] An Improved Methodology for assessing headroom

etc.) from the headroom assessment. Headroom profiles for different combinations of scenarios were combined to generate a combined headroom profile, referred to as the hybrid headroom profile. These headroom profiles were generated at a WRZ level for both the DYAA and DYCP.

Combining the variables (see Chapter 2: Solution Design) in differing combinations resulted in 580 different potential future water requirements covering the full range of the challenges that are faced. Whilst these 580 potential futures are formed from different combinations of the individual scenarios, these individual combinations can give very similar results. The adaptive pathway branches have been selected so that they are all have a similar probability of occurring[35], given what is known about future risks at this point.

Adaptive planning works by defining a set of potential pathways based upon different variables or conditions.

A preferred pathway is determined by setting out how a company's investments will be prioritised using the "preferred" branches which would be built in a response to conditions. This will include:

- The short-term actions that need to start now, and the longer-term investments that each pathway will require;
- Any preparatory actions that are needed now and going forward to allow the longer-term options to be available if required; and
- A monitoring plan that identifies what situation is being tracked and what will trigger choosing one pathway over another.

The adaptive planning approach isn't just looking for the quickest fixes, or the smallest schemes that can be built in response to immediate needs but is considering the optimum set of solutions for the longer term, and across many different potential futures.

The fully adaptive plan looks across all the potential branches and derives a set of programmes that efficiently adapt to the uncertainties. To do this the WRSE model applies a technique known as 'progressive hedging' to determine those options which need to be developed in the short-term, to provide the necessary platform to adapt to the different pathways in the future. The plan aims to avoid locking the region into more costly strategies by maintaining flexibility.

To maintain flexibility, an initial strategy needs to be picked which then has branch review points that balance the timings of investment decisions. Given the factors WRSE have used are; environmental destination, climate change and growth, and that water companies plan these in five-year WRMP cycles, WRSE have developed the branching review point to occur at the start/end of the Asset Management Plan (AMP) periods. This allows the theoretical branch points into two options to trigger a change in branch[72] and thus investment decisions.

- Risk based trigger – when do the future uncertainties caused by environmental, climate change and growth factors exceed the target headroom; and
- Policy decision-based trigger – when can decision regarding the final environmental destination be?

The WRSE adaptive plan can be broken down into three stages covering different timeframes[36]:

Stage 1: The core part of the plan (non-branching part) defines the period up to 2035, this part of the plan:

- Sets out the schemes, studies and investigations that are required to be delivered in the next AMP;
- Identify schemes that are common across all plans and are focused on the business plan requirements;
- Highlight which strategic decisions will be required to adapt to drought resilience, building on the initial set of schemes, being delivered for the South East;
- Focus on the demand management strategies, key resource schemes etc; and
- Show when the next decision points are and the fact that permission for several key future schemes will be required.

Stage 2: The timeframe from 2035 to 2050 is driven by alternative plans for environmental destination and increased drought resilience. The decision point for these pathways occurs in 2035 following the investigations undertaken in the core plan phase. Following the decision point in 2035, the Government will then set out the final environmental destinations and from this point the region will then know which schemes are required to be delivered to meet the final expectations having already put the building blocks in place.

Stage 3: Beyond 2050 the plan sets out a range of potential future strategies. It is this part of the plan that could describe what might happen if longer term trends prevail. This part of the Regional Plan is subject to significant change and influence from innovation, new government policies and future societal change.

The preferred pathway Situation 4, has been used as the reported pathway for the WRSE revised draft Regional Plan as it meets the WRPG growth forecast requirements, incorporates environmental destination and takes account of potential climate change impacts.

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[35] WRSE Revised Draft Regional Plan August 2023 (Section 6.40 -6.55, pages 62-64)

[36] WRSE Revised Draft Regional Plan August 2023 (Section 6.79, page 71)

2.12.8 Levels of Service

Customers expect a certain level of service, particularly in terms of risk management to their supply interruptions and demand restrictions due to drought. Water companies express levels of service in terms of the expected frequency of restrictions i.e. temporary use bans (TUBs) and non-essential use bans (NEUBs) that customers are willing to accept, and the frequency of drought permits and orders, allowing modified abstraction regimes at sources.

A key principle is that the water supply system should be resilient to severe drought events, and its robustness should be assessed against a range of drought scenarios up to, and including, low probability (extreme) droughts (such as a 1-in- 500-year return period with an annual probability of 0.2%[37]). Although such low probability events are unlikely, their economic and social impact would be significant, and there is still around a 10% chance of such an event occurring up to 2075. In addition to the levels of service SW must ensure the supply is consistent with the regulations from both the Drinking Water Inspectorate (DWI) Water safety plans[38], and Ofwat's Standards of service[39].

For WRMP24, water companies are planning to be resilient to droughts of up to 1-in-500-year severity by 2041. This is a step change from WRMP19 required by WRPG and will help ensure secure water supplies for customers even in extremely rare drought events. However, to achieve these targets SW will need to reduce demand and develop new and alternative sustainable sources of water. SW's target levels of service for restrictions, permits and orders have been determined (Table 2-25) however, there is a potential that these could change as a result of the operational mitigation plan.

Table 2-25 - Target levels of service

Level of Service	Annual Chance	Return Period	Chance of at least 1 occurrence between 2025 and 2075
Customer target			
Advertising to restrict water use	20%	1-in-5 year	100%
Temporary Use Ban on different categories of water use	10%	1-in-10 year[40]	90%
Drought Order (Non-Essential Use Ban)	5%	1-in-20 year[41]	92%
Environmental target			
Application for drought Permits and Orders to increase supplies through relaxation of abstraction license conditions, increase in licensed quantities or other measures[42]	5%	1-in-20 year[42]	92%

Temporary restrictions of customers water use, such as TUBs and NEUBs, balance the need to invest significant amounts in water resources that may increase customers' bills. During pre-consultation for WRMP24 with customers, TUBs and NEUBs were not seen as a significant concern, as they do not occur very often and had limited impact on most customers. Most participants felt they were not a priority when improving future service levels – although there was also no appetite for an increase in the frequency of restrictions. To meet customer expectations, SW plan to maintain the target level of service for demand restrictions, including TUBs and NEUBs in keeping with the revised draft Drought Plan 2022. Water savings made as a result of temporary drought measures are in addition to those saved as part of day-to-day water efficiency activities, although they are only used when needed.

Western Area

SW has an agreement in place with the EA (the Section 20 agreement) which specifies the phasing of TUBs and NEUBs in affected water resource zones in the Western area (Hampshire South East and Hampshire South West). TUBs are required before implementation of the River Test Drought Permit and partial implementation of NEUBs is required before the River Test or River Itchen Drought Orders are implemented.

SW's assessment of flows on the River Test for the Drought Plan suggests that a drought permit would need to be applied for around once every four to five years whilst developing the long-term water resource options to offset the impact of the 2018 abstraction licence changes. Current EA guidance on drought permits and orders requires that steps are taken to reduce demand before drought permits are either applied for or implemented. Supported by recent modelling, it is therefore expected that the restrictions may need to be imposed on water use at a similar frequency to drought permit and order applications, i.e., around once every five years (Table 2-26).

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[37] Water resources planning guideline April 2023 (Section 4.7)
[38] Water safety plans - Drinking Water Inspectorate
[39] Standards of service - Ofwat
[40] Frequency of first implementation but would be introduced via a phased approach.
[41] The 1-in-500-year target is to be achieved by 2041. SW's target level of service is less than this in some WRZs prior to 2041.
[42] For HSE the short-term level of service for these drought permits and orders (up to 2027) could be less than expected target.

Table 2-26 - Forecast reduced level of service in Hampshire

Level of Service	Company Target Level of Service	Reduced Level of Service for Hampshire based on flow modelling for the River Test and Itchen	Defining Trigger set out in drought plan
Advertising to restrict water use	1-in-5 year	1-in-2 year	60-day River Test Drought Permit Trigger
Temporary Use Ban on different categories of water use	1-in-10 year	1-in-5 year	35-day River Test Drought Permit Trigger
Drought Order (Non-Essential Use Ban)	1-in-20 year	1-in-20 year	Candover Drought Order Trigger

The risk to customers in Hampshire has been communicated consistently throughout the current published (2019) Drought Plan, and the consultation in 2022 and in 2021 on the latest draft Drought Plan. The message is also reported consistently alongside all material provided to the HWTWRP and highlighted as one of the drivers of the need for the project.

Since 2019, two drought permit applications have been made for the River Test, once in 2019 and again in 2022, however neither of which were used. In addition to this, TUBs have been implemented once in this period, in 2022. The actual frequency of restrictions experienced by customers in Hampshire is therefore broadly in line with the risks highlighted. These risks are expected to remain elevated until delivery of the HWTWRP is complete.

The stated actual levels of service have therefore been maintained as being less than target, including the assessment that TUBs and drought permit applications may be required more frequently than the target level of service in the Western Area until the HWTWRP is delivered.

It should also be noted that in their representations to the draft water resource management plan, some stakeholders have suggested that the temporary relaxation in the level of service for TUBs within Hampshire should be made permanent. They argue that this would help to reduce reliance on drought permits and orders, and potentially avoid the need for some high-cost and less environmentally favourable resource options.

The supply-demand balance modelling undertaken alongside WRSE does not currently allow for optimization of the level of service at low return periods as the primary planning focus is on severe droughts. Under all drought scenarios outside normal year, SW assume that TUBs and NEUBs will be in place.

2.12.9 Outages

Planned outages occur when SW need to undertake maintenance or improvement works. A provision for outages is included within the supply-demand forecast used in the modelling presented in this annex. To determine the outage allowance for the upcoming revised draft WRMP, a consistent methodology has been agreed and followed with the other WRSE companies[43]. This ensures that SW will be aligned with the WRSE revised draft Regional Plan and consistent in approach.

2.13 Long Term Opportunities and Scalability

The solution benefits, consistent with that presented in the WRSE revised draft Regional Plan and revised draft WRMP24 can be found in Chapter 8: Solution Costs and Benefits and Annex 8: Solution Costs and Benefits.

2.13.1 Risk of Flooding and Coastal Erosion

The proposed pipeline route between the HLPS and Otterbourne WSW is predominantly located in Flood Zone 1 (Low Probability), however, will interact with Flood Zones 2 and 3 (Medium and High Probability, respectively) in the limited areas where it crosses watercourses. These include the Rivers Meon, Hamble and Itchen, amongst others. The pipeline is considered ‘Water Compatible’ land use under the National Planning Policy Framework (PPF)/Flood Risk and Coastal Change Planning Practice Guidance (PPG) (i.e. “Water transmission infrastructure and pumping stations”) and is therefore considered acceptable within Flood Zones 2 and 3. Detailed flood data has been provided by the EA for some crossing locations, which will be used to help inform the detailed design of the crossings as appropriate.

All AGP locations will be within Flood Zone 1, however, there is a slight encroachment of Flood Zones 2 and 3 on the eastern boundary of the land parcel proposed for the WRP. The main WRP, is however, to be developed entirely within Flood Zone 1 (Figure 2-31). The Preliminary Flood Risk Assessment (PFRA) has also considered surface water flood risk and a larger number of potential AGP locations; some of which were subsequently discounted based on this risk. All shortlisted AGP locations have either a Low or Very Low surface water flood risk, which does not warrant further assessment. Groundwater flood risk to the project is being considered as part of a separate Hydrogeological Impact Assessment.

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[43] WRSE Method Statement: Outage 2021

Information on historical flood events has been obtained from the Lead Local Flood Authority (Hampshire County Council); this confirms that the shortlisted AGP locations have not experienced recorded flooding in the past.

The PFRA covers the entirety of the proposed pipeline route and the AGPs between the HLPS and Otterbourne WSW. Detailed Flood Risk Assessments (FRA) are currently being produced for the remaining AGPs (WRP, BPT-1 and IPS-A, IPS-B, BPT-4 and IPS-3D). The FRAs will be based on the micro-sited boundaries for these assets. The principal consideration of the detailed FRAs is the sustainable management of the additional volume and rate of surface water generated by these assets, which will all be located on ‘Greenfield’ sites.

The detailed FRAs will align with the requirements of the Lead Local Flood Authority (LLFA) to include Sustainable Drainage Systems (SuDS) to mitigate the impact of the AGP development on flood risk elsewhere, to improve the water quality of the surface water drainage from each AGP, and to contribute towards the project’s BNG requirements. SW will be liaising with Risk Management Authorities (RMA) (including local councils) and the LLFA to obtain ‘in-principle’ approval of the emerging SuDS designs for the AGPs.

Two outline SuDS strategies have been produced for the WRP and BPT-4 (Figure 2-9), which demonstrate the feasibility of the final intended SuDS design for each asset. The SuDS calculations include the appropriate Climate Change Allowances for Rainfall Intensity over the design lifetime of each AGP.

Figure 2-31 - Flood Map for WRP Site showing Flood Zone 2 (light blue) and 3 (dark blue)

A Feature Manipulation Engine (FME) routine is being developed to identify suitable parcels of land that, as part of the reinstatement of the pipeline route post construction, could be used to deliver nature-based solutions to provide a) attenuation of flood waters; b) phosphorus removal from river waters; and c) biodiversity enhancements/BNG.

The short-listed land parcels will need to meet a strict rule set including being currently ‘Greenfield’; located within the Draft Order Limits for the route; not be of existing significant ecological value such as a Site of Special Scientific Interest (SSSI); will need to interact with Flood Zones 2 or 3, or the surface water flood risk zones, and/or include a Main River or Ordinary Watercourse. SW will collaborate with landowners, RMA’s including local councils, the LLFA, the EA and Natural England (NE) in order to identify if these benefits can be realised.

The pipeline route is located within the South Hampshire area and is included within the Partnership for Urban South Hampshire Strategic Flood Risk Assessment (SFRA). This is a partnership of twelve local authorities around the Solent that aim to improve the environmental, cultural and economic performance of the area. The SFRA’s interactive mapping includes climate change predictions for the years 2025, 2055, 2085 and 2115.

The SFRA’s climate change flood risk mapping shows that all short-listed AGPs will be located outside future Flood Zones 2 and 3 and would remain resilient to flood risk in the year 2115, which covers the lifetime of the development. There will be slightly more encroachment of Flood Zones 2 and 3 within the Havant WRP boundary by 2115, however, the main WRP is still to be developed entirely in Flood Zone 1. Greater areas of the pipeline will be within Flood Zones 2 and 3, however, as the pipeline is ‘Water Compatible’ development, it is considered acceptable in these flood risk areas and will remain resilient over its lifetime.