Thames Water

Final Water Resources Management Plan 2019

Technical Appendices

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Appendix R.

Scheme dossiers

A. Supply options: Scheme dossiers

Thames Water WRMP19 Supply Options

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1 Introduction

1.1 Structure of Appendix

This appendix provides a high-level description of the water resource elements that have been included in the Constrained List for Thames Water's 2019 Water Resources Management Plan. Firstly, resource elements are described, followed by the system elements that are required for delivering the additional resource into the distribution network. Following this introduction, the structure of the document is as follows:

- Water Resource Elements
  - Desalination (Section 2)
  - Raw water transfers (Section 3)
  - Water reuse (Section 4)
  - Raw Water Purchase (Section 5)
  - Inter-company transfers (Section 6)
  - Inter-zonal transfers (Section 7)
  - Groundwater (Section 8)
  - Reservoirs (Section 9)
- System Elements
  - Raw water conveyance (Section 10)
  - Water treatment works (Section 11)
  - Network reinforcement (Section 12)

1.2 Overview of Constrained List and Preferred Programme Elements

An overview of the elements included in the Constrained List and how they can be combined to provide water resources options is shown in Table 1.1 for the London Water Resources Zone (WRZ). Tables 1.2 and 1.3 show the elements required for reinforcement of the London raw water system and the London transmission network depending upon whether resources are supplied from the east of London or the West of London.

The Thames Valley Constrained List elements are set out in Table 1.4 covering:

- Guildford WRZ
- Henley WRZ
- Kennet Valley WRZ
- Slough Wycombe and Aylesbury (SWA) WRZ
- Swindon and Oxfordshire (SWOX) WRZ

A summary of the elements included in the Preferred Programme is set out in Table 1.5 for London and Table 1.6 for the Thames Valley WRZs.

Table 1.1: Constrained List Elements - London WRZ

Option Type	Resource Element		Conveyance Element		Raw Water System	Treatment Element		Network Element
	Location	DO* (DYAA) Ml/d	Location	Nominal Capacity Ml/d		Location	Nominal Capacity Ml/d	
Water reuse	**Deephams** (RES-RU-DPH)	45	**Deephams to KGV** (CON-RU-DPH-KGV)	60		**East London** (WTW-LON-COP-100)	100	See network reinforcement matrix - Table 1.3
			Deephams to TLT extension (CON-RU-DPH-TLTEX)		See raw water system matrix - Table 1.2			
	Beckton 100 Ml/d (RES-RU-BEC-100)	95	**Beckton to Lockwood shaft** (CON-RU-BEC-LCK)	800		**East London** (WTW-LON-COP-100/150)	100 150 200 300	
	Beckton 150 Ml/d (RES-RU-BEC-150)	138						
	Beckton 200 Ml/d	183						
	Beckton 300 Ml/d	268						
Raw Water Transfer (see note 1)	**Vyrnwy** (RES-RWTS-VYR-60/148/180	60/148/180	**Deerhurst to Culham** (CON-RWT-DEH-CLM-300/400/500)	300/400/500	See raw water system matrix - Table 1.2	**Kempton** (WTW-LON-KEM-300 / 150 / 100)	300 150 100	See network reinforcement matrix - Table 1.3
	Mythe (RES-RWTS-MYT)	15						
	River Wye to Deerhurst (RES-RWTS-WYE-60.3)	60						
	Netheridge to River Severn (RES-RWTS-NTH)	35						
	Minworth to River Avon (RES-RWTS-MIN)	115						
	Redeployment of Shrewsbury abstractions (RES-RWTS-SHR-12/30)	12/30						
	Oxford Canal (RES-RWTS-OXC-CRP-15)	11						
Desalination	**Beckton (blended)** (RES-DES-BEC-150)	142	N/A		N/A	N/A		See matrix - Table 1.3 - plus **Beckton to Coppermills** (NET-DES-BEC-COP)
	Crossness 100 Ml/d (RES-DES-CRO-100)	95			**Beckton-Crossness** (CON-RWS-BEC-CRO-300)			As above plus **Crossness to Beckton** (NET-DES-CRO-BEC)
	Crossness 200 Ml/d	189						
	Crossness 300 Ml/d	284						
New Reservoir (see note 2)	**Abingdon 75Mm3** (RES-RRR-ABI-75Mm3)	142	N/A		See raw water system matrix -Table 1.2	**Kempton** (WTW-LON-KEM-300 / 150 / 100)	300 150 100	See network reinforcement matrix - Table 1.3
	Abingdon 100Mm3 (RES-RRR-ABI-100Mm3)	190						
	Abingdon 125Mm3 (RES-RRR-ABI-125Mm3)	234						
	Abingdon 150Mm3 (RES-RRR-ABI-150Mm3)	275						
	Abingdon 30+ 100Mm3 (RES-RRR-ABI-30+100Mm3-P1/P2)	49+199						
	Abingdon 80+ 42Mm3 (RES-RRR-ABI-80+42Mm3-P1/P2)	151+83						
Aquifer Recharge	**AR/SLARS - Kidbrooke (SLARS1)** (RES-AR-SLARS1-7)	7	N/A		N/A	N/A		N/A
	AR Merton (SLARS3) (RES-AR-SLARS3)	5						
	AR Streatham (SLARS2) (RES-AR-SLARS2)	4						
Aquifer Storage and Recovery	**ASR South East London (Addington)** (RES-ASR-SEL)	3	N/A		N/A	N/A		N/A
	ASR Thames Valley/Thames Central (RES-ASR-TV)	3						
	ASR Horton Kirby (RES-ASR-HTK)	5						
Groundwater	**GW - Addington** (RES-GW-ADD)	1	N/A		N/A	N/A		N/A
	GW - London Confined Chalk (north) (RES-GW-LCC)	2						
	GW - Southfleet/Greenhithe (RES-GW-SOU)	8						
	GW - Honor Oak (RES-GW-HON)	1						
	GW - Merton recommissioning (RES-RC-MTN)	2						
	Epsom removal of constraints (RES-RC-EPS)	2						
	New River Head (RES-RC-NRV)	3						
Inter-company transfer	**Chingford raw water purchase** (RES-RWP-CHD)	20	N/A		N/A	N/A		N/A
	Didcot raw water purchase (RES-RWP-DID)	18	N/A		N/A	N/A		N/A

1. For the Severn Thames Transfer (STT) support elements the volumes shown represent the gross volumes released for the River Severn before allowance for losses. Actual deployable outputs depend upon the combination of support elements selected and the size of the transfer pipeline.
2: DOs used at programme appraisal are based upon the two zone DOs from WARMS2 analysis, reduced by 3% to account for stochastic analysis. For the London WRZ the DOs are capped at the two zone London DO, being the lower of the two zone London DO and the single zone London DO

Table 1.2: Raw water system reinforcement requirements for additional water resources in East or West London

Additional Raw Water Resource in West (Ml/d)	Additional raw Water Resource in East (Ml/d)								
	0	100	200	300	400	500	600	700	800
0	-	3	1,3,5	1-3,5,6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6
100	-	3	1,3,5	1-3,5,6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	1-3, 5, 6	
200		3	1,3,5	1-3,5,6	1-3, 5,6	1-3, 5, 6	1-3, 5, 6		
300		3	1,3,5	1-3,5,6	1-3, 5, 6	1-3, 5, 6			
400	7	3,7	1,3,5,7	1-3,5-7	1-3, 5-7				
500	7/8,10	3,7/8,10	1,3,5,7/8,10	1-3,5-7/8,10					
600	7/8,10	3, 7/8,10	1,3,5,7/8,10						
700	7/8,10	3, 7/8,10							
800	7/8,10								

East London

1. King George V Reservoir intake capacity increase (CON-RWS-KGV-360)
2. Chingford South (above Chingford Mill) intake capacity increase (CON-RWS-CHS-100)
3. TLT extension from Lockwood PS to King George V Reservoir intake (CON-RWS-LCK-KGV-800)
4. TLT upgrade to remove existing constraints to maximise transfer capacity (not shown in table) (CON-RWS-TLT-UPG-450)
5. Additional conveyance from King George V Reservoir to break tank (CON-RWS-KGV-BT-300)
6. Second Spine Tunnel from break tank to Reservoir 5 upstream of Coppermills WTW (CON-RWS-BT-COP-800)

West London

7. Datchet intake capacity increase with transfer to Queen Mother and Wraysbury Reservoirs (CON-RWS-DAT-300)
8. Littleton intake capacity increase with transfer to Queen Mary (CON-RWS-LTN-300)
9. Surbiton intake capacity increase with transfer to Walton inlet channel, required for Teddington DRA option only (not shown in table) (CON-RWS-SUR-100)
10. Additional conveyance from Queen Mary Reservoir to Kempton WTW (CON-RWS-QMR-KEM-800)

Table 1.3: Network reinforcement requirements for additional water resources treated in East or West London

West (Ml/d) \ East (Ml/d)	0	100	200	300	400	500	600	700	800
0	-	-	5	4,5	4,5	4,5	4,5	1,4,5	1,4,5
100	1	1	3,4,5	3,4,5	3,4,5	3,4,5	4,5	1,4,5	
200	1,3	1,3	3,4	3,4,5	3,4,5	3,4,5	3,4,5		
300	1,3	1,3	1,3,4	3,4,5	3,4,5	3,4,5			
400	1,3	1,3	1,3,5	3,4,5	3,4,5				
500	1,3,5,6	1,3,5,6	1,3,5	1,3,5					
600	1,2,3,5,6	1,3,5,6	1,3,5,6						
700	1,2,3,5,6	1,2,3,5,6							
800	1,2,3,5,6								

The network reinforcement requirements identified are:

1. Replace New River Head Pump 4 (NET-TWRM-NRV-PUM)
2. Replace Barrow Hill Pump 6 (NET-TWRM-BAR-PUM)
3. TWRM extension - Hampton to Battersea (NET-TWRM-HAM-BAT)
4. TWRM level controlled by new header tank at Coppermills WTW (NET-TWRM-COP-HEA) and pumping station (NET-TWRM-COP-PS)
5. TWRM extension - Coppermills to Honor Oak (NET-TWRM-COP-HON)
6. Resolve issues with supply to Surbiton during TWRM outage (no element reference)

Additional network reinforcement elements have been identified that are specific for individual options. These include:

7. Tunnel from Beckton to Coppermills WTW for blending of water from Beckton and Crossness desalination options (NET-DES-BEC-COP)
8. Tunnel from Crossness desalination plant site to Beckton to extend the Beckton-Coppermills tunnel to Crossness so that it can transfer resource from the proposed desalination plant at Crossness (NET-DES-CRO-BEC)
9. New shaft on the TWRM at Kempton is required the first phase of additional treatment (NET-TWRM-KEM)

Table 1.4: Constrained List Elements - Thames Valley WRZs

	Option Type	Resource Element Location	Resource Element DO Ml/d ADPW	Conveyance Element Location	Conveyance Element Nominal Capacity Ml/d	Raw Water System	Treatment Element Location	Treatment Element Nominal Capacity Ml/d	Network Element Location	Network Element Nominal Capacity Ml/d
Swindon & Oxfordshire (SWOX)	Raw Water Transfer	**Severn Thames Transfer** (See London WRZ for support elements)	See Table 1.1	**Deerhurst to Culham** (CON-RWT-DEH-CLM-300/400/500)	300 400 500	N/A	**Radcot WTW** (WTW-SWOX-RAD)	24 each phase	Transfers to service reservoir included in WTW elements	
		Oxford Canal (RES-RWTS-OXC-DKC-15)	12	**Dukes Cut to Farmoor** (CON-RWS-DKC-FMR)	15					
	New Reservoir	**Abingdon 75Mm3** (RES-RRR-ABI-75Mm3) **Abingdon 100Mm3** (RES-RRR-ABI-100Mm3) **Abingdon 125Mm3** (RES-RRR-ABI-125Mm3) **Abingdon 150Mm3** (RES-RRR-ABI-150Mm3) **Abingdon 30+ 100Mm3** (RES-RRR-ABI-30+100Mm3-P1 / P2) **Abingdon 80+ 42Mm3** (RES-RRR-ABI-80+42Mm3-P1/P2)	161 210 253 294 69+199 170+83	**Abingdon to Farmoor Reservoir** (CON-RWS-ABI-FMR) (if treatment capacity not required)	24	N/A	N/A	N/A	N/A	
							Abingdon SWOX WTW (WTW-SWOX-ABI) (if treatment capacity required)	24 each phase	Transfers to service reservoir included in WTW elements	
	Groundwater	**GW - Moulsford 1** (RES-GW-MOU)	3.5	N/A		N/A	N/A		N/A	
	Removal of constraints to DO	**Ashton Keynes borehole pumps** (RES-RC-ASH) **Britwell** (RES-RC-BTW)	1.5 1.3	N/A		N/A	N/A		N/A	
	Inter-zonal transfers		2.4 5	**Henley to SWOX** (RES-IZT-HEN-SWX-NET)	2.4 5	N/A	N/A		N/A	
		GW - Mortimer disused source (RES-GW-MOR)	4.5 2.3	**Kennet Valley to SWOX** (RES-IZT-KEN-SWOX-CLV)	6.7 2.3					
	Inter-company transfer		2.9	**Wessex Water to SWOX (Flaxlands)** (RES-ICT-WSX-FLX)	2.9	N/A	N/A		N/A	
Slough, Wycombe & Aylesbury (SWA)	Raw Water Transfer	**Severn Thames Transfer** (See London WRZ for support elements)	See Table 1.1	**Deerhurst to Culham** (CON-RWT-DEH-CLM-300/400/500)	300/400/500	N/A	**Abingdon SWA WTW** (WTW-SWOX-ABI-SWA)	24 each phase	**Abingdon to north SWA** (NET-IZT-AB-LC)	**72 / 48**
						New intake 80 / 53 (CON-RWS-SWA-MMM)	**Medmenham WTW** (WTW-SWA-MMM)	24 each phase	Transfers to service reservoir included in WTW elements	
		Oxford Canal (RES-RWTS-OXC-CRO-15)	12							
	New Reservoir	**Abingdon 75Mm3** (RES-RRR-ABI-75Mm3) **Abingdon 100Mm3** (RES-RRR-ABI-100Mm3) **Abingdon 125Mm3** (RES-RRR-ABI-125Mm3) **Abingdon 150Mm3** (RES-RRR-ABI-150Mm3) P1/P2) **Abingdon 80+ 42Mm3** (RES-RRR-ABI-80+42Mm3-P1/P2)	161 210 253 294 69+199 170+83	N/A		N/A	**Abingdon SWA WTW** (WTW-SWOX-ABI-SWA)	24 each phase	**Abingdon to north SWA** (NET-IZT-AB-LC)	**72 / 48**
						New intake 80 / 53 (CON-RWS-SWA-MMM)	**Medmenham WTW** (WTW-SWA-MMM)	24 each phase	Transfers to service reservoir included in WTW elements	
	Raw Water Purchase	**Didcot raw water purchase** (RES-RWP-DID)	18	N/A		**New intake 80 / 53** (CON-RWS-SWA-MMM)	**Medmenham WTW** (WTW-SWA-MMM)	24 each phase	Transfers to service reservoir included in WTW elements	
	Groundwater	**GW - Datchet** (RES-GW-DAT)	5.4	N/A		N/A	N/A		N/A	
	Inter-zonal transfers		2.4/5	**Henley to SWA** (RES-IZT-HEN-SWA-HAM)	2.4 / 5	N/A	N/A		N/A	
Guildford	Groundwater	**Dapdune licence disaggregation** (RES-GW-DAP)		N/A		N/A	N/A		N/A	
	Removal of constraints to DO	**Dapdune removal of constraints to DO** (RES-RC-DAP) **Ladymead WTW** (RES-RC-LAD)	7.8	N/A		N/A	N/A		**Shalford to Netley Mill** (NET-GUI-SFD-NML)	13.8
	Inter-co. transfers		10	**SouthEast Water to Guildford** (RES-ICT-SEW-GUI-MNT-10)	10	N/A	N/A		N/A	
Kennet Valley	Groundwater	**GW - Mortimer disused source (recommission)** (RES-GW-MOR)	4.5	N/A		N/A	N/A		N/A	
	Removal of constraints to DO	**East Woodhay borehole pumps** (RES-RC-EWO)	2.1	N/A		N/A	N/A		N/A	

Table 1.5: Preferred programme – London WRZ

Option Type	Resource Element Location	Resource Element DO* (DYAA) Ml/d	Conveyance Element Location	Conveyance Element Nominal Capacity Ml/d	Raw Water System	Treatment Element Location	Treatment Element Nominal Capacity Ml/d	Network Element
Water reuse	**Deephams** (RES-RU-DPH)	45	**Deephams to KGV** (CON-RU-DPH-KGV)	60	N/A	**East London WTW - 100Ml/d** (WTW-LON-COP-100) **Kempton WTW - 100Ml/d** (WTW-LON-KEM-100)		**New River Head Pump 4 replacement** NET-TWRM-NRV-PUM **Kempton WTW New shaft** NET-TWRM-KEM
Raw Water Transfer (see note 1)	**Vyrnwy** (RES-RWTS-VYR-60)	110	**Deerhurst to Culham** (CON-RWT-DEH-CLM-300)	300	N/A			
	Mythe (RES-RWTS-MYT)	12						
	Netheridge to River Severn (RES-RWTS-NTH)	18						
	Redeployment of Shrewsbury abstractions (RES-RWTS-SHR-30)	15						
	Oxford Canal (RES-RWTS-OXC-CRP-15)	11						
New Reservoir (see note 2)	**Abingdon 150Mm3** (RES-RRR-ABI-150Mm3)	275	N/A		N/A			
Aquifer Recharge	**AR/SLARS - Kidbrooke (SLARS1)** (RES-AR-SLARS1-7)	7	N/A		N/A			
	AR Merton (SLARS3) (RES-AR-SLARS3)	5						
Aquifer Storage and Recovery	**ASR South East London (Addington)** (RES-ASR-SEL)	3	N/A		N/A			
	ASR Horton Kirby (RES-ASR-HTK)	5						
Groundwater	**GW - Addington** (RES-GW-ADD)	1	N/A		N/A			
	GW - Southfleet/Greenhithe (RES-GW-SOU)	8						
	GW - Merton recommissioning (RES-RC-MTN)	2						
	Epsom removal of constraints (RES-RC-EPS)	2						
	New River Head (RES-RC-NRV)	3						
Inter-company transfer	**Chingford raw water purchase** (RES-RWP-CHD)	20	N/A		N/A			
	Didcot raw water purchase (RES-RWP-DID)	18	N/A		N/A			

1 : Vyrnwy DO includes unsupported element

2: DOs used at programme appraisal are based upon the two zone DOs from WARMS2 analysis, reduced by 3% to account for stochastic analysis. For the London WRZ the DOs are capped at the two zone London DO, being the lower of the two zone London DO and the single zone London DO

Table 1.6: Preferred programme – Thames Valley WRZs

	Option Type	Resource Element Location	Resource Element DO Ml/d ADPW	Conveyance Element Location	Conveyance Element Nominal Capacity Ml/d	Raw Water System	Treatment Element Location	Treatment Element Nominal Capacity Ml/d	Network Element Location	Network Element Nominal Capacity Ml/d
SWOX	**New Reservoir** (see note 1)	**Abingdon 150Mm3** (RES-RRR-ABI-150Mm3)	294	N/A		N/A	N/A		N/A	
SWA	**New Reservoir** (see note 1)	**Abingdon 150Mm3** (RES-RRR-ABI-150Mm3)	294	N/A		**New intake 53** (CON-RWS-SWA-MMM-53)	**Medmenham WTW** (WTW-SWA-MMM)	24	N/A	
	Groundwater	**GW - Datchet** (RES-GW-DAT)	5.4	N/A		N/A	N/A		N/A	
Guildford	**Groundwater**	**Dapdune licence disaggregation** (RES-GW-DAP)		N/A		N/A	N/A		N/A	
	Removal of constraints to DO	**Dapdune removal of constraints to DO** (RES-RC-DAP) **Ladymead WTW** (RES-RC-LAD)	7.8	N/A		N/A	N/A		**Shalford to Netley Mill** (NET-GUI-SFD-NML)	13.8
	Inter-co. transfers			N/A		N/A	N/A		N/A	
Kennet Valley	**no options included in preferred programme**									

1 : Reservoir DOs used at programme appraisal are based upon the two zone DOs from WARMS2 analysis, reduced by 3% to account for stochastic analysis. For the London WRZ the DOs are capped at the two zone London DO, being the lower of the two zone London DO and the single zone London DO

1.3 Element references

Each resource element has been allocated a unique reference. The element references comprise an element type, sub-type, location and size (where there is more than one size variant). Table 1.7 provides a list of abbreviations used for element references.

Table 1.7: Abbreviations used for element references

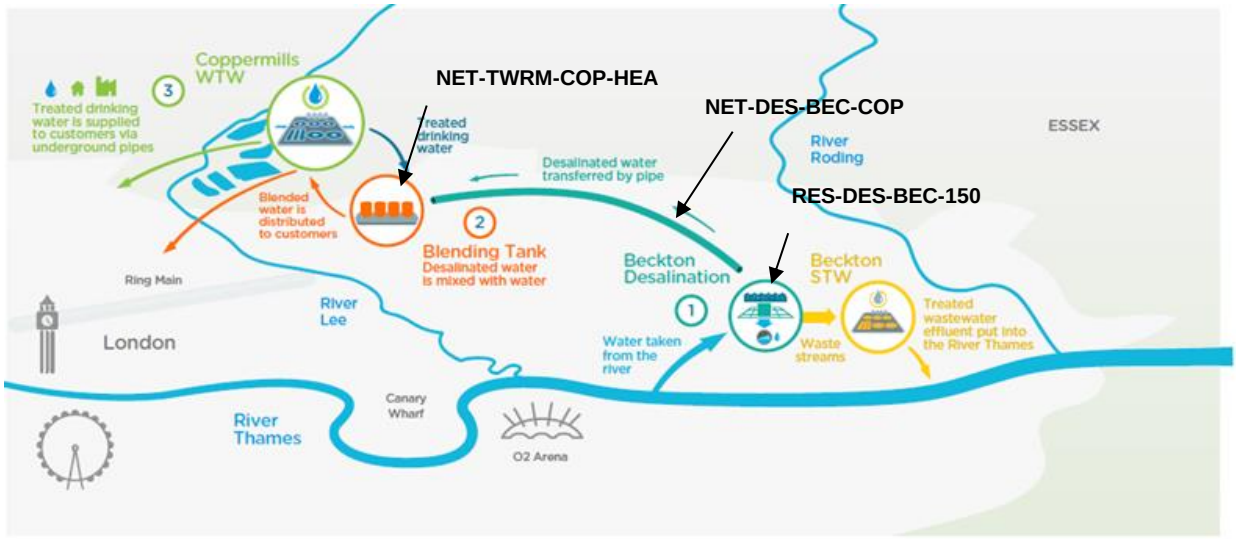
Type	Sub-type	Location
RES (Resource)	DES (Desalination)	BEC (Beckton)
		CRO (Crossness)
	RWTS (Raw Water Transfer Support)	MIN (Minworth)
		MYT (Mythe)
		NTH (Netheridge)
		OXC-CRP (Oxford Canal to Cropredy)
		OXC-DKC (Oxford Canal to Duke's Cut)
		SHR (Shrewsbury)
		VYR (Vyrnwy)
		WYE (Wye)
	RU (Reuse)	BEC (Beckton)
		DPH (Deephams)
	WRP (Raw Water Purchase)	DID (Didcot)
		CHD (Chingford)
	ICT (Inter-Company Transfer)	SEW-GUI-MNT (South East Water to Guildford, Mount Service Reservoir)
		WSX-FLX (Wessex Water to SWOX, Flaxlands Service Reservoir)
	IZT (Inter-Zonal Transfers)	HEN-SWA-HAM (Henley to SWA, Hambleden WTW)
		HEN-SWX-NET (Henley to SWOX, Nettlebed)
		KEN-SWOX-CLV (Kennet Valley to SWOX, Cleeve)
	AR (Artificial Recharge)	SLARS (South London Artificial Recharge Scheme)
	ASR (Aquifer Storage and Recovery)	HTK (Horton Kirby)
		SEL (South East London)
		TV (Thames Valley)
	GW (Groundwater)	ADD (Addington)
		DAP (Dapdune)
		DAT (Datchet)
		HON (Honor Oak)
		LCC (London Confined Chalk)
		MOR (Mortimer)
		MOU (Moulsford)
		SOU (Southfleet/Greenhithe)
	RC (Removal of Constraints)	ASH (Ashton Keynes)
		BTW (Britwell)
		DAP (Dapdune)
		DAT (Datchet)
		EPS (Epsom)
		EWO (East Woodhay)

Type	Sub-type	Location
		LAD (Ladymead)
		MTN (Merton)
		NRV (New River Head)
	RRR (Reservoir)	ABI (Abingdon)
CON (Conveyance)	RU (Reuse)	BEC-LCK (Beckton to Lockwood)
		DPH-KGV (Deephams to King George V)
		DPH-TLTEX (Deephams to TLT extension)
	RWS (Raw Water Systems)	ABI-FMR (Abingdon to Farmoor)
		BEC-CRO (Beckton to Crossness)
		BT-COP (Break tank to Coppermills)
		CHS (Chingford South intake)
		DAT (Datchet intake)
		DKC-FMR (Duke's Cut to Farmoor)
		KGV (KGV Reservoir intake)
		LCK-KGV (Lockwood PS to KGV Intake)
		LTN (Littleton intake)
		MMM (Medmenham intake)
		QMR-KEM (Queen Mary Reservoir to Kempton WTW)
		SUR (Surbiton intake)
		TLT-UPG (Thames Lee Tunnel Upgrade)
	RWT (Raw Water Transfers)	DEH-CLM (Deerhurst to Culham)
WTW (Water Treatment Works)	LON (London)	COP (Coppermills)
		KEM (Kempton)
	SWA (Slough, Wycombe & Aylesbury)	MMM (Medmenham)
	SWOX (Swindon and Oxford)	ABI (Abingdon)
		ABI-SWA (Abingdon to SWA)
		RAD (Radcot)
NET (Network Reinforcement)	DES (Desalination)	BEC-COP (Beckton to Coppermills)
		CRO-BEC (Crossness to Beckton)
	GUI (Guildford)	SFD-NML (Shalford to Netley Mill)
	IZT (Inter-Zonal Transfers)	AB-LC (Abingdon to Long Crendon)
	TWRM (Thames Water Ring Main)	BAR-PUM (Barrow Hill Pump)
		COP-HEA (Coppermills Header Tank)
		COP-HON (Coppermills WTW to New Honor Oak SR)
		COP-PS (Coppermills Pumping Station)
		HAM-BAT (Hampton WTW to Battersea)
		KEM (Kempton WTW New shaft)
		NRV-PUM (New River Head Pump)

2 Desalination

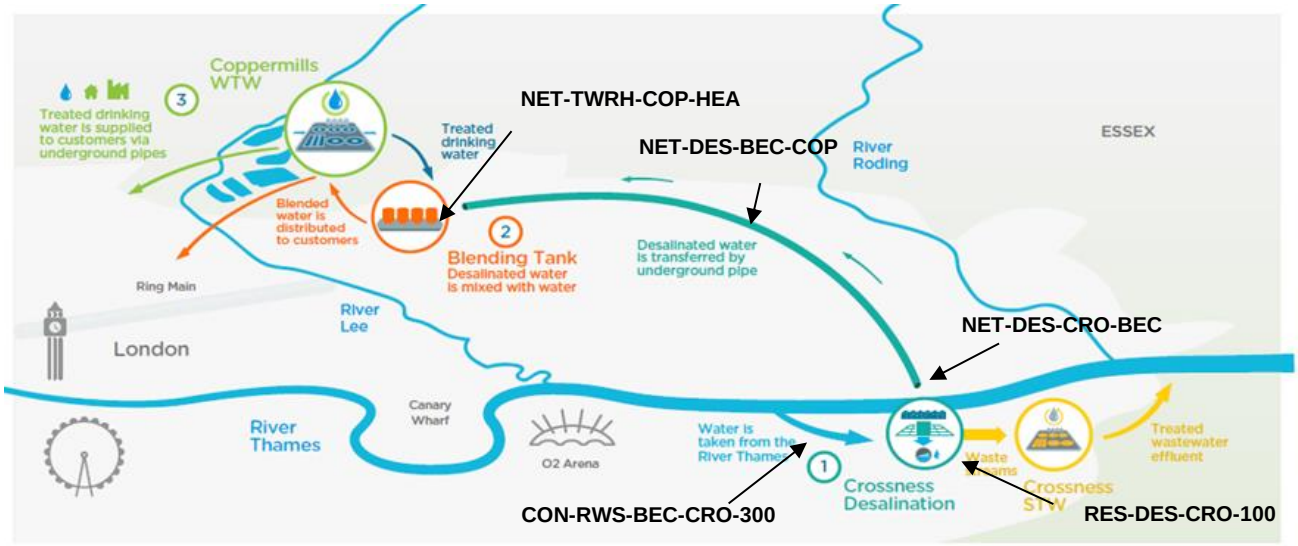
2.1 Beckton Desalination treatment plant (150Ml/d) - RES-DES-BEC-150

Name	Desalination – Beckton Desalination treatment plant
WRMP19 Reference	RES-DES-BEC-150
Element Type	Resource
WRZ	LONDON
Engineering Scope	Brackish estuarine water shall be abstracted at low tide and used as raw water for the desalination plant. The new 150 Ml/d desalination plant will be located on land within the existing Beckton STW site. Treatment includes clarification, rapid gravity filters, ultrafiltration membranes, reverse osmosis, re-mineralisation, disinfection and final chemical treatment. The desalinated water will then be transferred via a tunnel to the Coppermills WTW Thames Water Ring Main (TWRM) shaft location and blended with potable treated water from Coppermills WTW prior to entering supply.
Engineering Components	▪ 150Ml/d treatment works containing; Water abstracted through eel screens, storage reservoirs, clarification, and rapid gravity filters (RGF), ultra-filtration (UF) membranes, multistage reverse osmosis (RO) membranes, water conditioning to add alkalinity and hardness, disinfection and final water chemical addition. The waste streams from the clarifiers, RGF, UF membranes and the neutralised chemical cleaning wastewater will be pumped back to the Beckton STW inlet works for treatment. Brine waste stream from the RO will be returned to the final effluent channel for blending prior to discharge in the River Thames. ▪ Raw Water Abstraction Pumps 1,750kW (5 Nr 250kW duty pumps, 2 Nr 250kW standby pumps) ▪ Settled Water Forwarding Pumps 375kW (4 Nr 75kW duty pumps, 1 Nr 75kW standby pump) ▪ Treated Water Pumps 600kW (2 Nr 200kW duty pumps, 1 Nr 200kW standby pump) ▪ Waste Water Return Pumps 54kW (2 Nr 18kW duty pumps, 1 Nr 18kW standby pump) ▪ Land requirements: Maximum (permanent works) 34,500 m^2 for desalination plant
Benefit	DO benefit of 142 Ml/d for Phase 1 – 1x150Ml/d
Lead Time	10 years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	The Beckton desalination (150 Ml/d) option is dependent on the following elements: • NET-DES-BEC-COP (Conveyance of treated water to Coppermills for blending and supply) • NET-TWRM-COP-HEA (New Header tank at Coppermills WTW) • NET-TWRM-COP-PS (New Coppermills pumping station for new header tank) To provide an additional resource to London WRZ the following system element is also required: • Additional capacity in the Thames Water ring main.


Coppermills WTW
3
Treated drinking water is supplied to customers via underground pipes
NET-TWRM-COP-HEA
NET-DES-BEC-COP
RES-DES-BEC-150
ESSEX
River Roding
Treated drinking water
Desalinated water transferred by pipe
Blended water is distributed to customers
2
Blending Tank
Desalinated water is mixed with water
Beckton Desalination
Beckton STW
1
Water taken from the river
Waste streams
Treated wastewater effluent put into the River Thames
Ring Main
River Lee
London
Canary Wharf
River Thames
O2 Arena

2.2 Crossness Desalination treatment plant (100Ml/d) - RES-DES-CRO-100

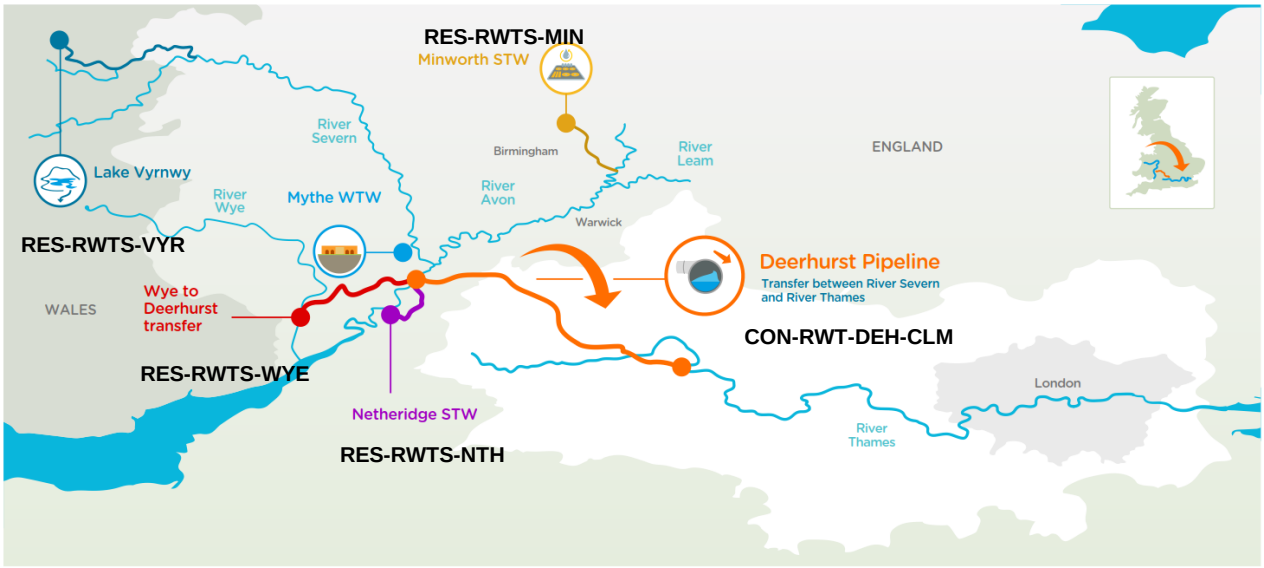
Name	Desalination – Crossness desalination treatment plant (3 phases of 100Ml/d)
WRMP19 Reference	RES-DES-CRO-100
Element Type	Resource
WRZ	LONDON
Engineering Scope	Brackish estuarine water shall be abstracted at low tide and used as raw water for the desalination plant. The new 100 Ml/d desalination plant will be located on land to the south of the existing Crossness STW site. Treatment includes clarification, rapid gravity filters, reverse osmosis re-mineralisation and disinfection. The desalinated water will then be transferred via a tunnel to Beckton to then be transferred to the Coppermills WTW Thames Water Ring Main (TWRM) shaft location and blended with potable treated water from Coppermills WTW prior to entering supply.
Engineering Components	▪ 100Ml/d phase treatment works containing; water abstracted through eel screens, storage reservoirs, clarification, and rapid gravity filters (RGF), ultra-filtration (UF) membranes, multistage reverse osmosis (RO) membranes, water conditioning to add alkalinity and hardness, disinfection and final water chemical addition. The waste streams from the clarifiers, RGF, UF membranes and the neutralised chemical cleaning wastewater will be pumped back to the Crossness STW inlet works for treatment. Brine waste stream from the RO will be returned to the final effluent channel for blending prior to discharge in the River Thames. ▪ Raw Water Abstraction Pumps 3,180kW (4 Nr 530kW duty pumps, 2 Nr 530kW standby pumps) ▪ Settled Water Forwarding Pumps 275kW (4 Nr 55kW duty pumps, 1 Nr 55kW standby pump) ▪ Treated Water Pumps 555kW (2 Nr 185kW duty pumps, 1 Nr 185kW standby pump) ▪ Waste Water Return Pumps 45kW (2 Nr 15kW duty pumps, 1 Nr 15kW standby pump) ▪ Land requirements: Maximum (permanent works) 15,000 m^2 (per phase) for desalination plant
Benefit	DO benefit of: ▪ 95 Ml/d for Phase 1 – 1x100Ml/d ▪ 189 Ml/d for Phase 2 – 2x100Ml/d ▪ 284 Ml/d for Phase 3 – 3x100Ml/d
Lead Time	10 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	The first phase of Crossness desalination is dependent on the following elements: ▪ CON-RWS-BEC-CRO-300 (Conveyance of raw water from Beckton to Crossness desalination plant) ▪ NET-DES-CRO-BEC (Conveyance of treated water to Beckton) ▪ NET-DES-BEC-COP (Conveyance of treated water to Coppermills for blending and supply) ▪ NET-TWRM-COP-HEA (New Header tank at Coppermills WTW) ▪ NET-TWRM-COP-PS (New Coppermills pumping station for new header tank) The above elements are sized to have sufficient capacity for all 3 phases (3x100Ml/d) of Crossness desalination and do not need to be duplicated for phase 2 and phase 3. ▪ To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the Thames Water ring main.


Coppermills WTW
3
Treated drinking water is supplied to customers via underground pipes
Treated drinking water
NET-TWRH-COP-HEA
NET-DES-BEC-COP
River Roding
ESSEX
Blended water is distributed to customers
2
Blending Tank
Desalinated water is mixed with water
Desalinated water is transferred by underground pipe
Ring Main
River Lee
London
NET-DES-CRO-BEC
River Thames
Canary Wharf
O2 Arena
Water is taken from the River Thames
1
Crossness Desalination
Waste streams
Crossness STW
Treated wastewater effluent
CON-RWS-BEC-CRO-300
RES-DES-CRO-100

3 Raw Water Transfers

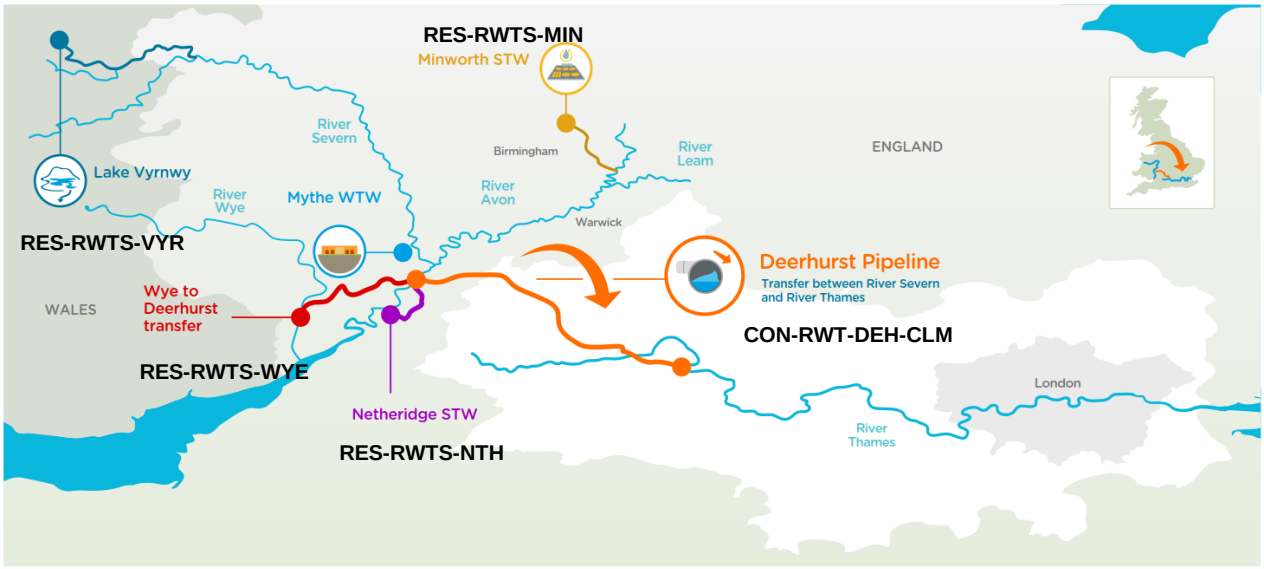
3.1 Minworth STW to River Avon 115 Ml/d – RES-RWTS-MIN

Name	
WRMP19 Reference	RES-RWTS-MIN
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	This option involves the construction of a tertiary treatment plant and laying of a new pipeline from Minworth WTW to the river Avon, downstream of Warwick (at the Sowe confluence) to allow transfer of up to 115 Ml/d for abstraction in the lower Severn at Deerhurst.
Engineering Components	The element is offered by Severn Trent Water and includes all engineering works required to deliver the flow to the River Avon ▪ Tertiary treatment and intake after the treatment ▪ Pumping station at Minworth WTW ▪ Rising main ▪ An outfall to the River Avon
Benefit	Maximum capacity delivered at the discharge to the River Avon is 115 Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 58, 65 and 65 Ml/d.
Lead Time	The lead time of the Severn Thames Transfer Deerhurst Pipeline conveyance element is 10 years, supporting resource options will be delivered in this timescale
Mutual exclusivities	None
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance (CON-RWT-DEH-CLM).



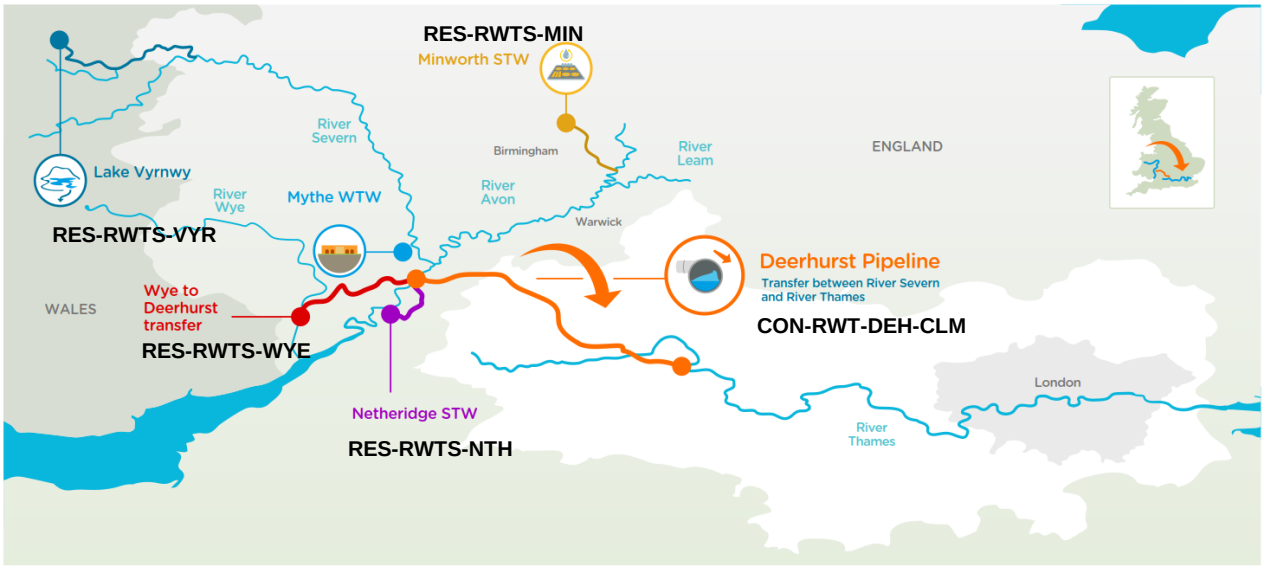
3.2 Mythe WTW 15 Ml/d- RES-RWTS-MYT

Name	Mythe WTW – unused part of licence (Severn Trent Water)
WRMP19 Reference	RES-RWTS-MYT
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Transfer of unused part of licence at Mythe Water Treatment Works (WTW) for abstraction downstream at Deerhurst. Mythe WTW is located on the River Severn near Tewkesbury, 5km northeast of Deerhurst. STWL have advised that only minor works would be required at Mythe WTW and elsewhere to release the licence. The works would be delivered by Severn Trent Water and no details have been provided.
Engineering Components	Minor works
Benefit	Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the 12 Ml/d benefit for 300, 400 and 500 Ml/d pipelines.
Lead Time	1 Year
Mutual exclusivities	A resource that could be used by all Severn Thames Transfer conveyance options, however as an option not mutually exclusive with other options.
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance. (CON-RWT-DEH-CLM).



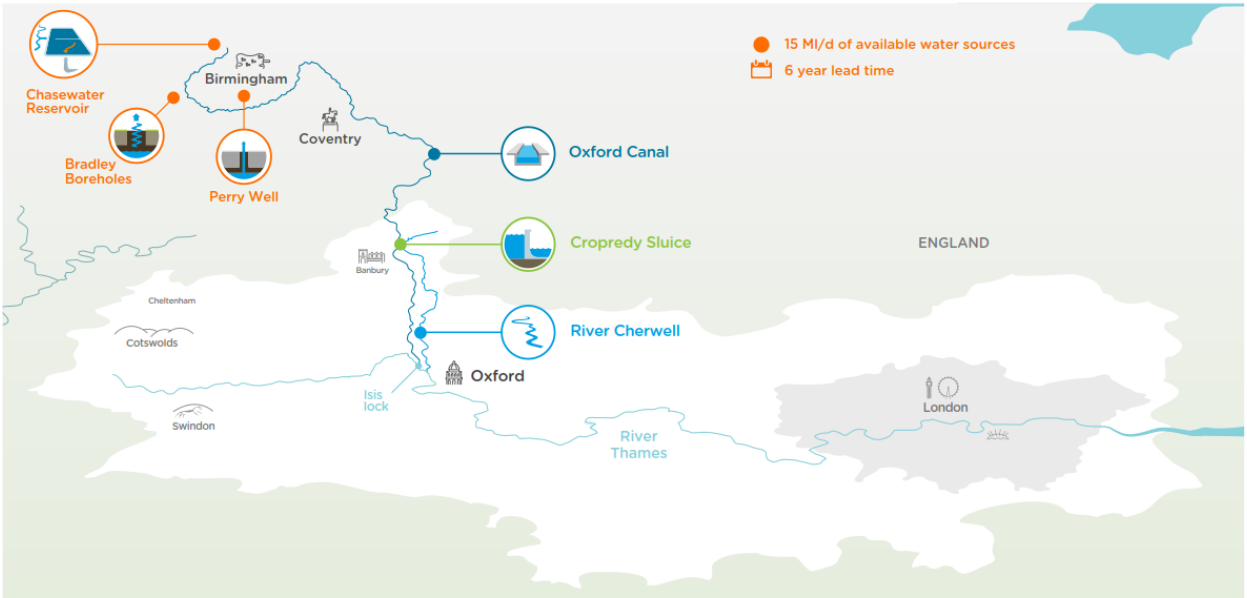
3.3 Netheridge STW to River Severn 35 Ml/d - RES-RWTS-NTH

Name	
WRMP19 Reference	RES-RWTS-NTH
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Transfer of a 35 Ml/d of final effluent from Netheridge Sewage Treatment Works to the River Severn downstream of the proposed water intake at Deerhurst to replace water abstracted to the Severn Thames Transfer Deerhurst Pipeline Conveyance.
Engineering Components	The element is offered by Severn Trent Water and includes all engineering works required to deliver the flow to the River Severn. ▪ An intake manhole to enable the required flow to be directed to the Netheridge FE pumping station ▪ A pumping station which would pump the water from Netheridge STW to River Severn at Deerhurst; ▪ A rising main; ▪ An outfall to the River Severn; ▪
Benefit	Maximum capacity delivered at the discharge to the River Severn is 35 Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 18, 20 and 20 Ml/d.
Lead Time	The lead time of the Severn Thames Transfer Deerhurst Pipeline conveyance element is 10 years, supporting resource options will be delivered in this timescale
Mutual exclusivities	None
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance. (CON-RWT-DEH-CLM).



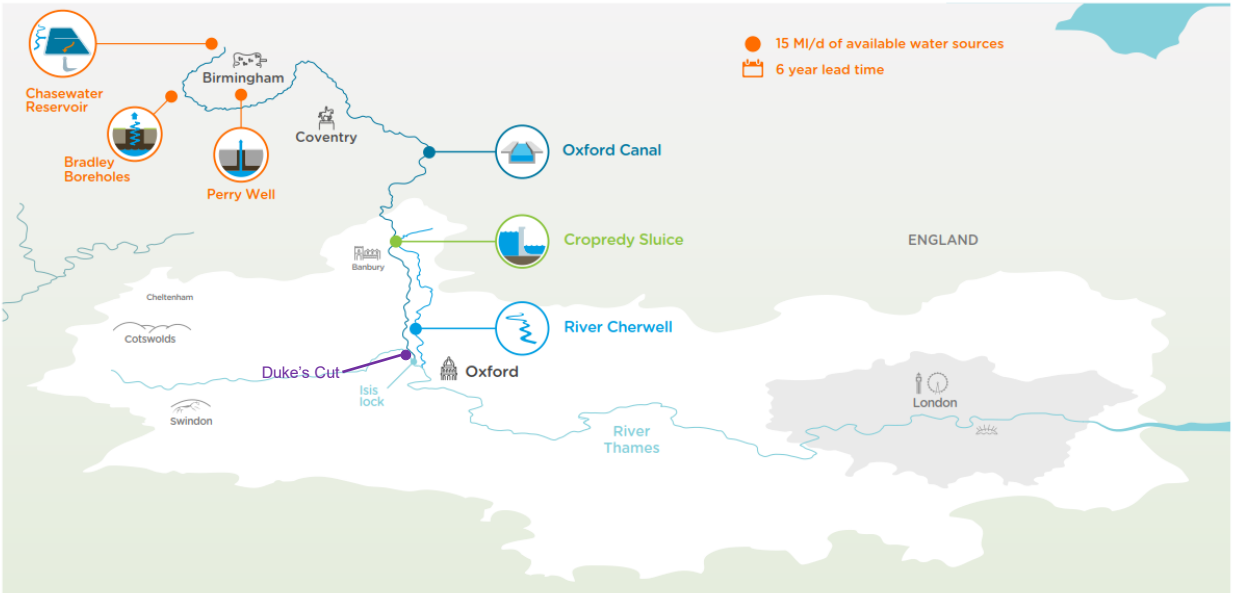
3.4 Oxford Canal - BCN Surplus – Raw Water Transfer Resource (Cropredy) - RES-RWTS-OXC-CRP-15

Name	Oxford Canal - BCN Surplus – Raw Water Transfer Resource (Cropredy)
WRMP19 Reference	RES-RWTS-OXC-CRP-15
Element Type	Resource
WRZ	LON / SWA
Engineering Scope	This element includes upgrades to the canal network to transfer 15 Ml/d surplus from the Wolverhampton Levels to Cropredy, where it is discharged to the River Cherwell for onward transfer to the River Thames. The resource comprises the use of surplus water from the Wolverhampton Level (combination of Bradley borehole and Chasewater Reservoir), which is fed into the Wolverhampton level via Brasshouse Sluice. Fed down Farmers Bridge Flight and Aston Flight onto the Erdington Level. Further flow augmentation can be provided if required via Perry Well borehole. Transfer then occurs down the Minworth and Curdworth Flight to Fazeley Junction. Transfer up the Coventry & Ashby Canal and North Oxford Canal, then over the South Oxford Summit and down the Claydon Flight. Release is then into the River Cherwell via an automated control structure.
Engineering Components	All engineering works provided by others – the Canal and River Trust (CRT), key elements including: ▪ Three new Pump Stations ▪ Rebuild two Pump Stations ▪ Bypass pipelines (400mm diameter) ▪ Bypass weirsAll engineering works provided by others.
Benefit	Deployable output benefit of 11 Ml/d
Lead Time	5 Years
Mutual exclusivities	This element is mutually exclusive with the Oxford Canal (Duke's Cut) (RES-RWTS-OXC-DKC-15) and Datchet Intake Increase (CON-RWS-DKC-FMR) elements.
Interdependencies/ Exclusivity	This resource could support the following new WTWs: ▪ Medmenham WTW (WTW-SWA-MMM) ▪ Kempton WTW (WTW-LON-KEM)



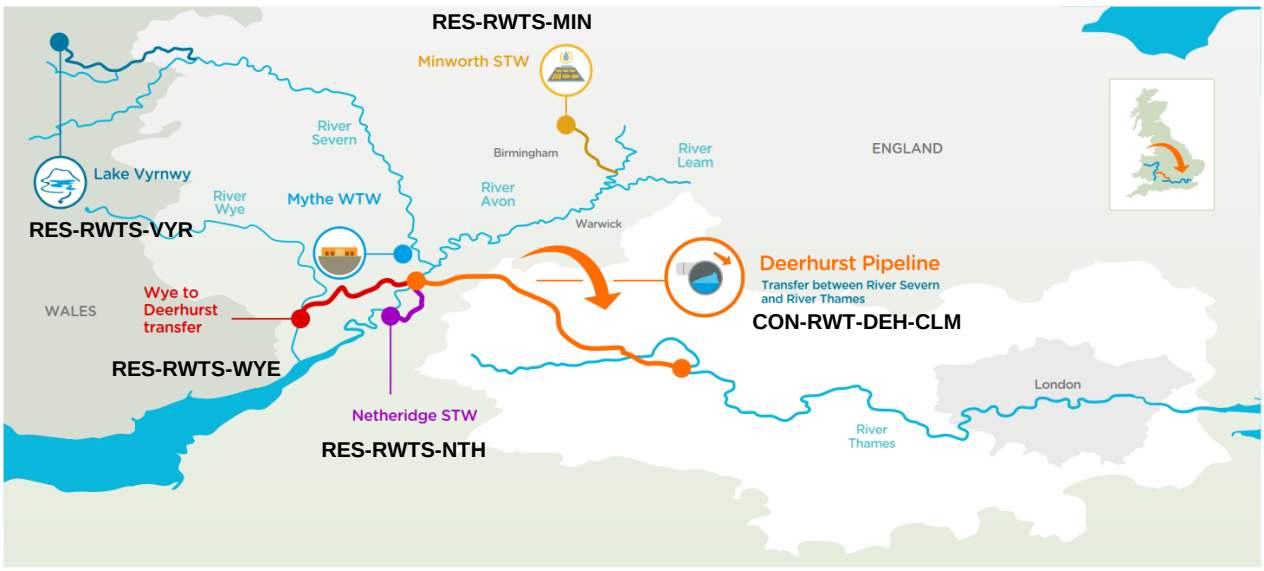
3.5 Oxford Canal - BCN Surplus – Raw Water Transfer Resource (Duke's Cut) - RES-RWTS-OXC-DKC-15

Name	Oxford Canal - BCN Surplus – Raw Water Transfer Resource (Duke's Cut)
WRMP19 Reference	RES-RWTS-OXC-DKC-15
Element Type	Resource
WRZ	SWOX
Engineering Scope	This element includes upgrades to the canal network to transfer 15 Ml/d surplus from the Wolverhampton Levels to upstream of Duke's Cut. From that point, the water would be transferred to the River Thames upstream of Farmoor Reservoir, in the Dukes Cut to Farmoor 15 Ml/d Pipeline (CON-RWS-OXC-FRM-15). The resource comprises the use of surplus water from the Wolverhampton Level (combination of Bradley borehole and Chasewater Reservoir), which is fed into the Wolverhampton level via Brasshouse Sluice. Fed down Farmers Bridge Flight and Aston Flight onto the Erdington Level. Further flow augmentation can be provided if required via Perry Well borehole. Transfer then occurs down the Minworth and Curdworth Flight to Fazeley Junction. Transfer up the Coventry & Ashby Canal and North Oxford Canal, then over the South Oxford Summit and down the Claydon Flight. Release is into the River Cherwell via an automated control structure. After connectivity between the Oxford Canal and River Cherwell transfer back into the Oxford Canal for abstraction upstream of Duke's Cut.
Engineering Components	All engineering works provided by others – the Canal and River Trust (CRT), key elements including: ▪ Three new Pump Stations ▪ Rebuild two Pump Stations ▪ Bypass pipelines (400mm diameter) ▪ Bypass weirsAll engineering works provided by others.
Benefit	Deployable output benefit of 12 Ml/d
Lead Time	5 Years
Mutual exclusivities	This element is mutually exclusive with the RES-RWTS-OXC-CRP-15.
Interdependencies/ Exclusivity	This element is interdependent with CON-RWS-DKC-FMR



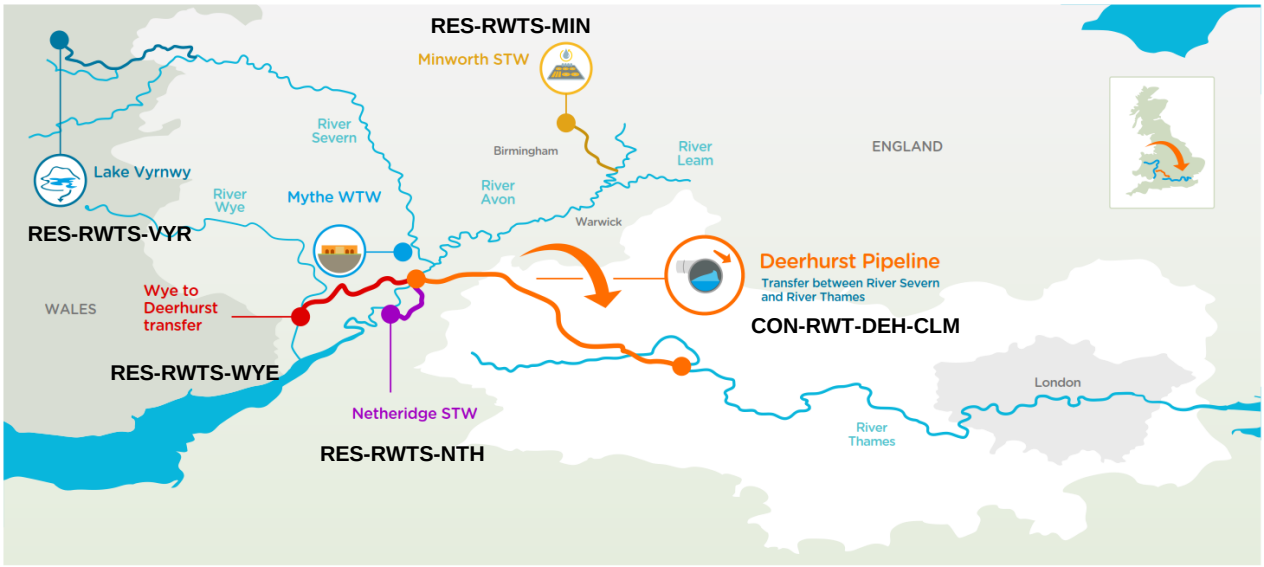
3.6 Redeployment of Severn Trent Water Abstraction at Shrewsbury 12Ml/d – RES-RWTS-SHR-12

Name	
WRMP19 Reference	RES-RWTS-SHR-12
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Redeployment of existing Severn Trent Water abstraction at Shrewsbury on the River Severn. Abstraction at Shrewsbury currently serves Severn Trent Water customers in Shrewsbury and Oswestry. United Utilities and Severn Trent Water have offered to provide an alternative supply to Oswestry and Shrewsbury, thereby reducing abstraction from the upper River Severn at Shrewsbury and leaving water in the river for abstraction at Deerhurst.
Engineering Components	No engineering components considered.
Benefit	Maximum capacity delivered at the discharge to the River Severn is 12 Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 6, 7 and 7 Ml/d.
Lead Time	The lead time of the Severn Thames Transfer Deerhurst Pipeline conveyance element is 10 years, supporting resource options will be delivered in this timescale
Mutual exclusivities	This option is mutually exclusive of Vyrnwy 180 (RES-RWTS-VYR-180) andRedeploymentand Redeployment of ST Abstraction at Shrewsbury 30 Ml/d (RES-RWTS-SHR-30) .
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance (CON-RWT-DEH-CUL).



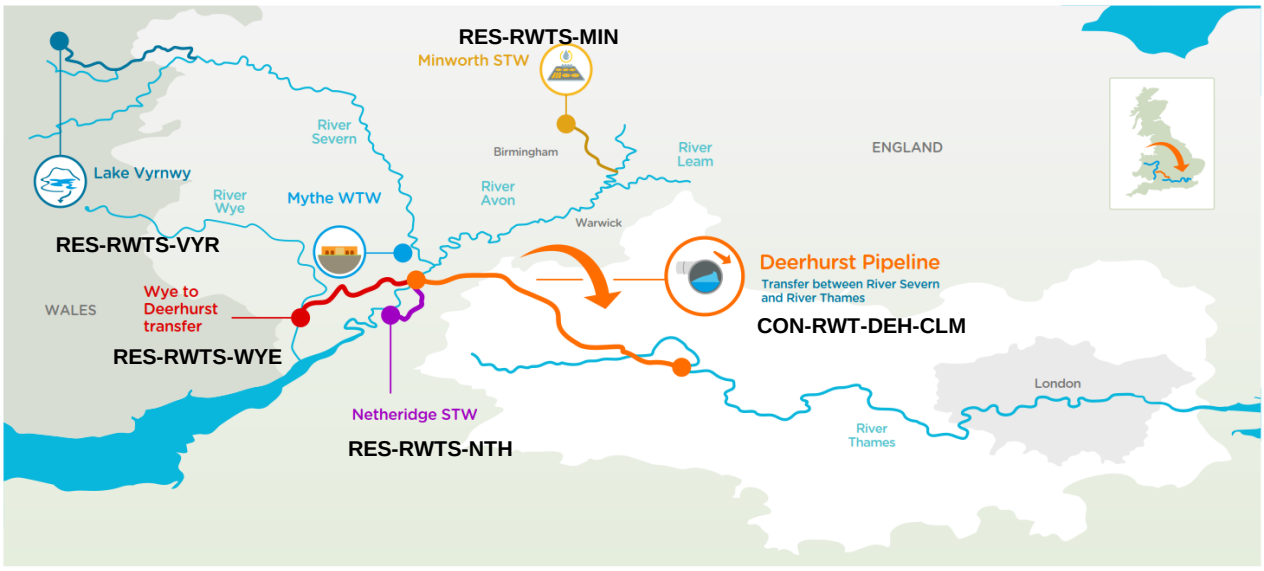
3.7 Redeployment of Severn Trent Water Abstraction at Shrewsbury 30Ml/d – RES-RWTS-SHR-30

Name	
WRMP19 Reference	RES-RWTS-SHR-30
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Redeployment of existing Severn Trent Water abstraction at Shrewsbury on the River Severn. Abstraction at Shrewsbury currently serves Severn Trent Water customers in Shrewsbury and Oswestry. United Utilities and Severn Trent Water have offered to provide an alternative supply to Oswestry and Shrewsbury, thereby reducing abstraction from the upper River Severn at Shrewsbury and leaving water in the river for abstraction at Deerhurst. In this option UU/STWL would undertake further work to increase the volume of water available for redeployment from 12 Ml/d to 30 Ml/d.
Engineering Components	No engineering components considered.
Benefit	Maximum capacity delivered at the discharge to the River Severn is 30 Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 15, 17 and 17 Ml/d.
Lead Time	The lead time of the Severn Thames Transfer Deerhurst Pipeline conveyance element is 10 years, supporting resource options will be delivered in this timescale
Mutual exclusivities	This option is mutually exclusive of Vyrnwy 180 180 (RES-RWTS-VYR-180) and the Redeployment of ST Abstraction at Shrewsbury 12 Ml/d (RES-RWTS-SHR-12).
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance. (CON-RWT-DEH-CLM).



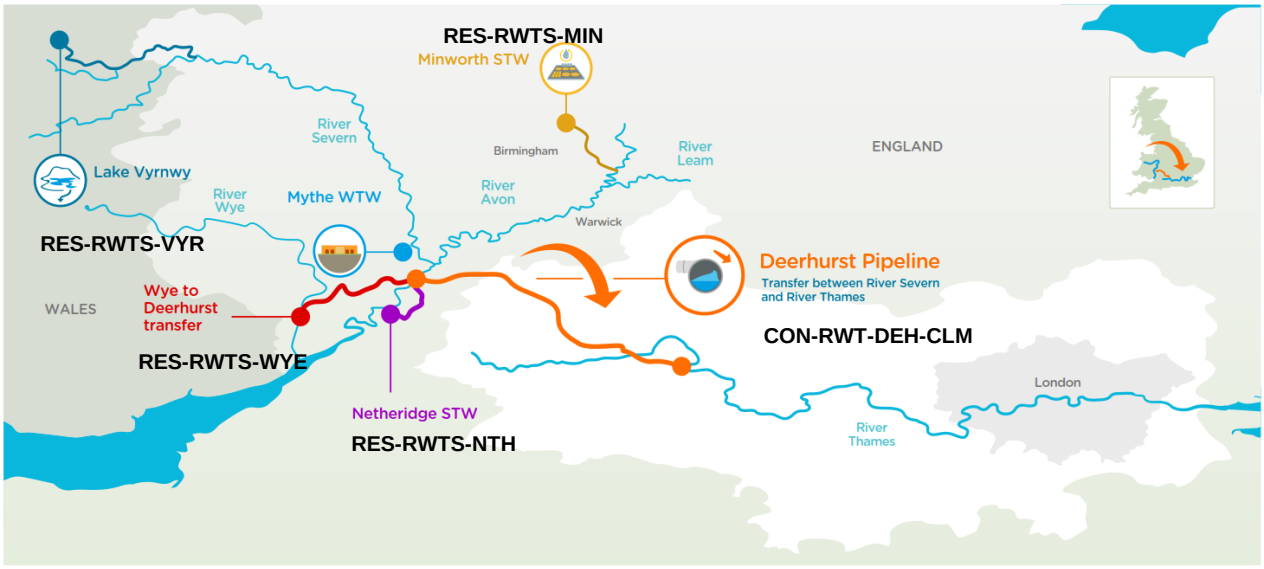
3.8 Lake Vyrnwy (United Utilities) – 180 Ml/d - RES-RWTS-VYR-180

Name	Lake Vyrnwy (United Utilities) – 180 Ml/d
WRMP19 Reference	RES-RWTS-VYR-180
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Release of water from Lake Vyrnwy, which is an existing river regulation reservoir, into the River Vyrnwy (a tributary of the River Severn) for later abstraction and transfer into the Thames Water area. The reservoir is owned and operated by Severn Trent Water but supplies water to United Utilities, who have offered the water to Thames Water.
Engineering Components	It is assumed that water will be released to River Vyrnwy through existing dam pipework and valves with only minor works.
Benefit	Maximum capacity delivered at the discharge to the River Vyrnwy is 180Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 90, 102 and 102 Ml/d.
Time Lead	1 Year
Mutual exclusivities	A resource that could be used by all Severn Thames Transfer conveyance options. This element is mutually exclusive with the two other Vyrnwy resource elements (RES-RWTS-VYR-148 and RES-RWTS-VYR-60) and also the two Shrewsbury options (RES-RWTS-SHR-12 and RES-RWTS-SHR-30).
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance (CON-RWT-DEH-CLM).



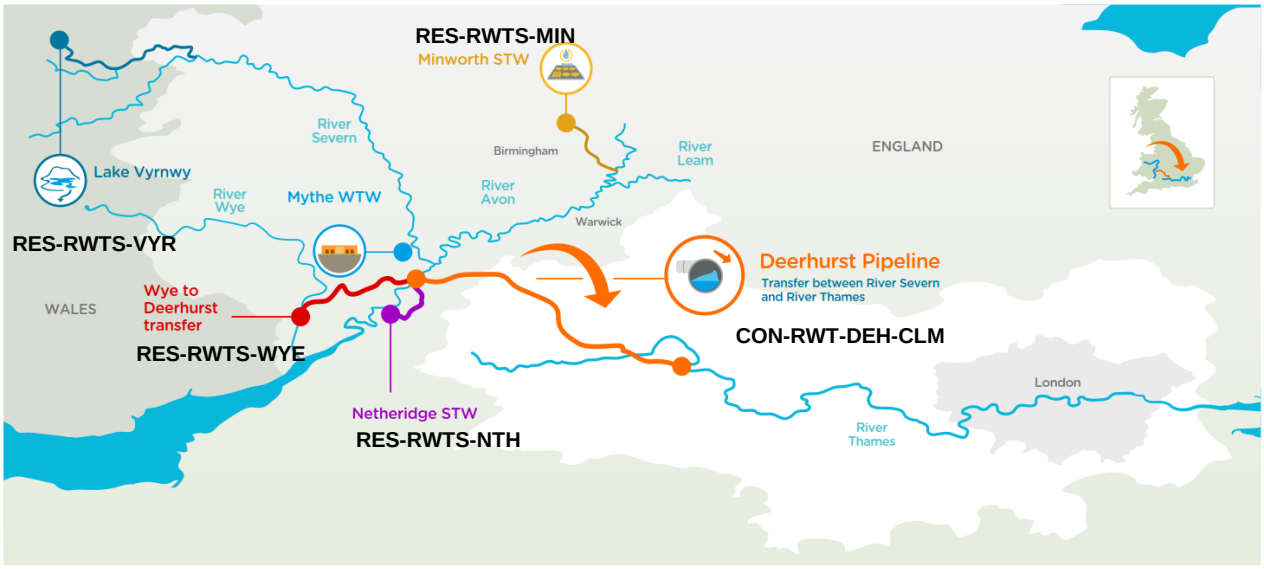
3.9 Lake Vyrnwy (United Utilities) – 148 Ml/d - RES-RWTS-VYR-148

Name	Lake Vyrnwy (United Utilities) – 148 Ml/d
WRMP19 Reference	RES-RWTS-VYR-148
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Release of water from Lake Vyrnwy, which is an existing river regulation reservoir, into the River Vyrnwy (a tributary of the River Severn) for later abstraction and transfer into the Thames Water area. The reservoir is owned and operated by Severn Trent Water but supplies water to United Utilities, who have offered the water to Thames Water.
Engineering Components	It is assumed that water will be released to River Vyrnwy through existing dam pipework and valves with only minor works.
Benefit	Maximum capacity delivered at the discharge to the River Vyrnwy is 148Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 74, 84 and 84 Ml/d.
Lead Time	1 Year
Mutual exclusivities	A resource that could be used by all Severn Thames Transfer conveyance options. This element is mutually exclusive with the two other Vyrnwy resource elements (RES-RWTS-VYR-180 and RES-RWTS-VYR-60).
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance (CON-RWT-DEH-CLM).



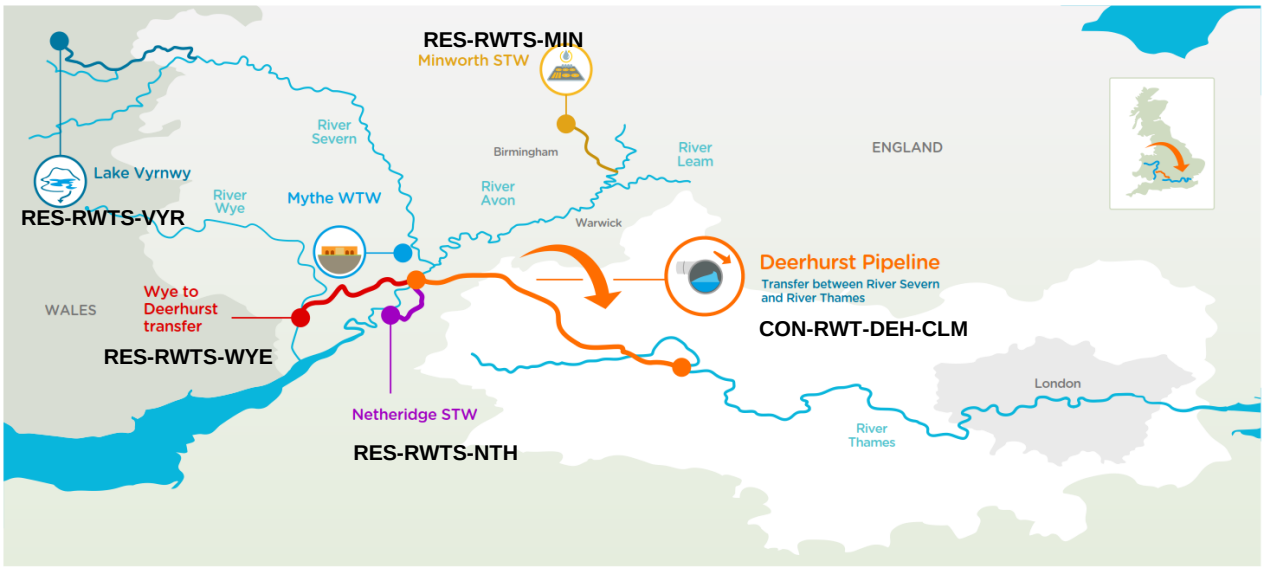
3.10 Lake Vyrnwy (United Utilities) – 60 Ml/d - RES-RWTS-VYR-60

Name	Lake Vyrnwy (United Utilities) – 60 Ml/d
WRMP19 Reference	RES-RWTS-VYR-60
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Release of water from Lake Vyrnwy, which is an existing river regulation reservoir, into the River Vyrnwy (a tributary of the River Severn) for later abstraction and transfer into the Thames Water area. The reservoir is owned and operated by Severn Trent Water but supplies water to United Utilities, who have offered the water to Thames Water.
Engineering Components	It is assumed that water will be released to River Vyrnwy through existing dam pipework and valves with only minor works.
Benefit	Maximum capacity delivered at the discharge to the River Vyrnwy is 60 Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 30, 34 and 34 Ml/d.
Lead Time	1 Year
Mutual exclusivities	A resource that could be used by all Severn Thames Transfer conveyance options. This element is mutually exclusive with the two other Vyrnwy resource elements (RES-RWTS-VYR-180 and RES-RWTS-VYR-148).
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance (CON-RWT-DEH-CLM).



3.11 River Wye to Deerhurst 60.3Ml/d - RES-RWTS-WYE-60.3

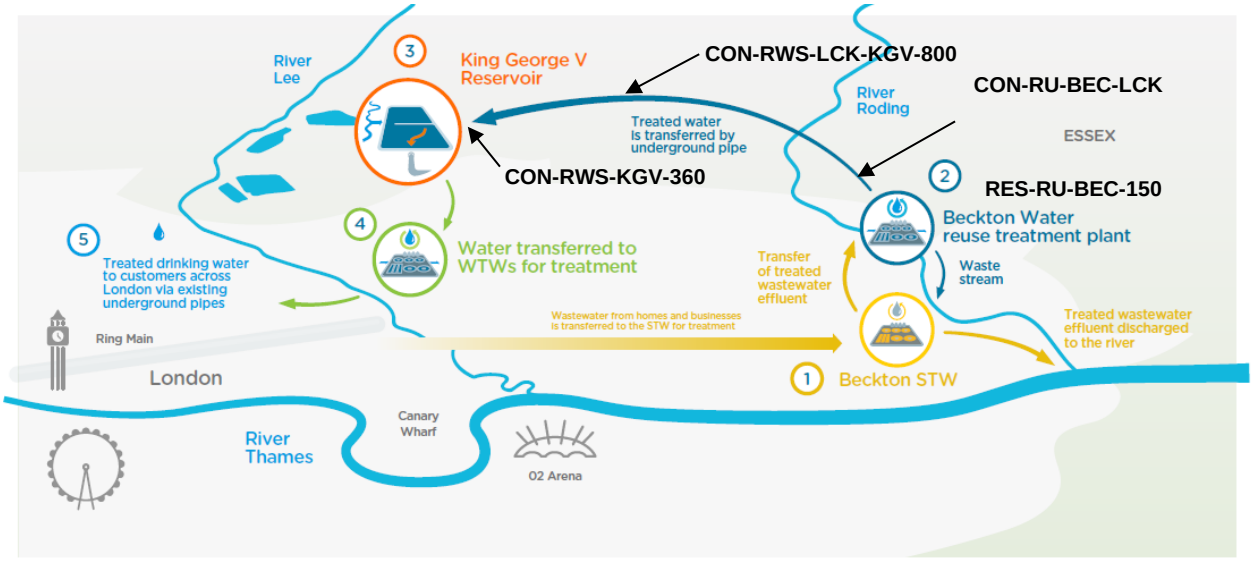
Name	
WRMP19 Reference	RES-RWTS-WYE-60.3
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Transfer of 60.3 Ml/d from the River Wye, north of Ross on Wye to the inlet chamber at the proposed Deerhurst WTW for onward transfer to the River Thames in the Deerhurst Pipeline. This option is offered by Welsh Water from existing licences on the River Wye, development of replacement resource for Welsh Water is not included in the option scope.
Engineering Components	The element is offered by Welsh Water and includes all engineering works required to deliver the flow to Deerhurst WTW. ▪ A river intake structure at Ross on Wye including inlet screens and a pipeline culvert to the pumping station; ▪ A pumping station to transfer the water to Deerhurst treatment works; ▪ A rising main; ▪ A discharge structure upstream of the inlet tank at Deerhurst WTW; ▪ Washouts along the route provided with permanent discharge pipework to adjacent watercourses;
Benefit	Maximum capacity delivered at the discharge to the River Thames is 60.3 Ml/d. Stochastic modelling allowing for climate change, other abstractors and 20% losses gives the following benefits for 300, 400 and 500 Ml/d pipelines respectively: 37, 42 and 42 Ml/d.
Lead Time	The lead time of the Severn Thames Transfer Deerhurst Pipeline conveyance element is 10 years, supporting resource options will be delivered in this timescale
Mutual exclusivities	None
Interdependencies/ Exclusivity	Dependent on the provision of a conveyance i.e. – the Severn Thames Transfer pipeline conveyance.



4 Water reuse

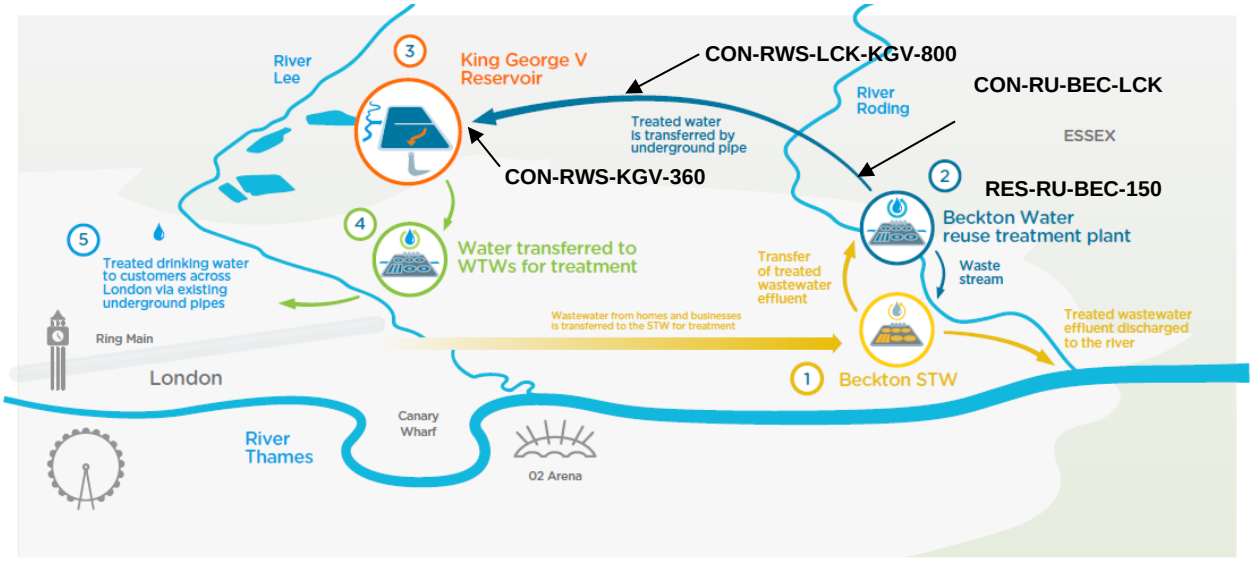
4.1 Beckton Reuse (100Ml/d) - RES-RU-BEC-100

Name	Beckton Reuse (100Ml/d)
WRMP19 Reference	RES-RU-BEC-100
Element Type	Resource
WRZ	LONDON
Engineering Scope	Planned indirect potable reuse (IPR) is the process of actively managing returns of highly treated wastewater effluent to water courses above abstraction points. Treated effluent from the Beckton Sewage Treatment Works is to be subjected to an advanced treatment process to produce a high purity water stream. The treated water will then be pumped to a proposed discharge location above the inlet for King George V. Reservoir on the River Lee Diversion to supplement the raw water supply to the Lee Valley reservoirs. The proposed site for the treatment will be within the Beckton STW boundary to the north of the operational area. The water reuse treatment plant will be built in three phases of 100 Ml/d each.
Engineering Components	▪ 300 Ml/d Water reuse treatment plant built in 3x100 Ml/d phases, each phase consisting of the following treatment processes: duty/standby pressurised automatic backwash screens, ferric addition, Ultrafiltration plant complete with filtrate pumps, backwash, and clean in place (CIP) system, RO membrane plant, hydrogen peroxide and UV treatment, remineralisation plant consisting of a lime and CO_2 dosing, waste stream system. ▪ Final effluent pumping station 500 kW (1 Nr 250 kW duty pump, 1 Nr 250 kW standby pump) ▪ Treated water pumping station 1060 kW (1 Nr 530 kW duty pump, 1 Nr 530 kW standby pump) ▪ Effluent washwater return pumping station 220 kW (1 Nr 110 kW duty pump, 1 Nr 110 kW standby pump) ▪ Land requirements: Maximum 45,000 m^2 for reuse plant (3 phases) and 2,000 m^2 for final effluent abstraction works
Benefit	Deployable output of: 95 Ml/d for 100 Ml/d (1x100 Ml/d element). 183 Ml/d for 200 Ml/d (2x100 Ml/d elements). 268 Ml/d for 300 Ml/d (3x100 Ml/d elements).
Time Lead	8 Years
Mutual exclusivities	This element can be combined with the RES-RU-BEC-150 element up to the maximum limit of reuse from Beckton.
Interdependencies/ Exclusivity	The first phase of Beckton reuse is dependent on the following elements: ▪ CON-RU-BEC-LCK (Conveyance of treated water from Beckton to Lockwood pumping station) ▪ CON-RWS-LCK-KGV-800 (Lockwood PS to KGV Reservoir intake) The above elements are sized to have sufficient capacity for all 3 phases (3x100Ml/d) of Beckton and do not need to be duplicated for phase 2 and phase 3 To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Lee Diversion into the Lee Valley Reservoirs and from there conveyed to a Water Treatment Works in east London; ▪ Additional treatment in east London. ▪ Additional capacity in the Thames Water ring main.


River Lee
3
King George V Reservoir
CON-RWS-LCK-KGV-800
River Roding
CON-RU-BEC-LCK
ESSEX
Treated water is transferred by underground pipe
CON-RWS-KGV-360
2
RES-RU-BEC-150
Beckton Water reuse treatment plant
4
Water transferred to WTWs for treatment
5
Treated drinking water to customers across London via existing underground pipes
Transfer of treated wastewater effluent
Waste stream
Wastewater from homes and businesses is transferred to the STW for treatment
Treated wastewater effluent discharged to the river
Ring Main
London
1
Beckton STW
Canary Wharf
River Thames
02 Arena

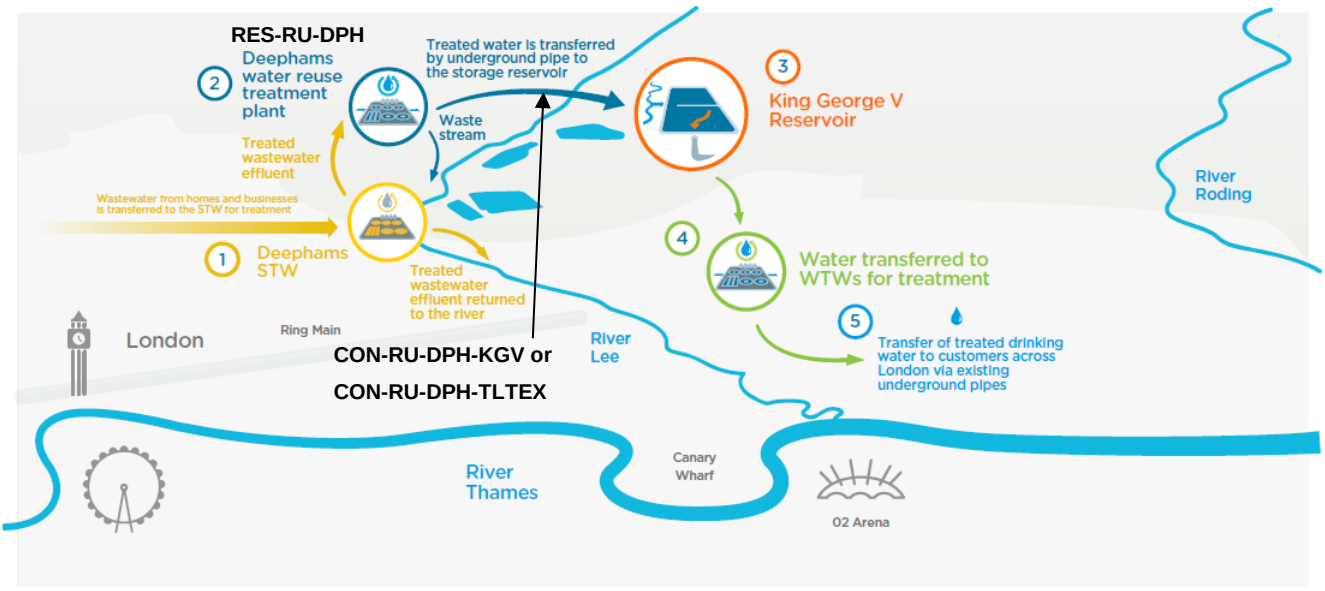
4.2 Beckton Reuse (150Ml/d) - RES-RU-BEC-150

Name	Beckton Reuse (150Ml/d)
WRMP19 Reference	RES-RU-BEC-150
Element Type	Resource
WRZ	LONDON
Engineering Scope	Planned indirect potable reuse (IPR) is the process of actively managing returns of highly treated wastewater effluent to water courses above abstraction points. Treated effluent from the Beckton Sewage Treatment Works is to be subjected to an advanced treatment process to produce a high purity water stream. The treated water will then be pumped to a proposed discharge location above the inlet for King George V Reservoir on the River Lee Diversion to supplement the raw water supply to the Lee Valley reservoirs. The proposed site for the treatment will be within the Beckton STW boundary to the north of the operational area. The water reuse treatment plant will be built in two phases of 150 Ml/d each.
Engineering Components	▪ 300 Ml/d Water reuse treatment plant built in 2x150 Ml/d phases, each phase consisting of the following treatment processes: duty/standby pressurised automatic backwash screens, ferric addition, Ultrafiltration plant complete with filtrate pumps, backwash, and clean in place (CIP) system, RO membrane plant, hydrogen peroxide and UV treatment, remineralisation plant consisting of lime and CO_2 dosing, waste stream system. ▪ Final effluent pumping station 710 kW (1 Nr 355 kW duty pump, 1 Nr 355 kW standby pump) ▪ Treated water pumping station 1500 kW (1 Nr 750 kW duty pump, 1 Nr 750 kW standby pump) ▪ Effluent washwater return pumping station 370 kW (1 Nr 185 kW duty pump, 1 Nr 185 kW standby pump) ▪ Land requirements: Maximum 45,000 m^2 for reuse plant (2 phases) and 2,000 m^2 for final effluent abstraction works
Benefit	Deployable output of 138 Ml/d for 150 Ml/d element and 268 Ml/d for 300 Ml/d (2x150 Ml/d)
Time Lead	8 Years
Mutual exclusivities	This element can be combined with the RES-RU-BEC-100 element up to the maximum limit of reuse from Beckton.
Interdependencies/ Exclusivity	The first phase of Beckton reuse is dependent on the following elements: ▪ CON-RU-BEC-LCK (Conveyance of treated water from Beckton to Lockwood pumping station) ▪ CON-RWS-LCK-KGV-800 (Lockwood PS to KGV Reservoir intake) The above elements are sized to have sufficient capacity for both phases (2x150Ml/d) of Beckton and do not need to be duplicated for phase 2. To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the Lee Valley Reservoirs and conveyed to a Water Treatment Works in east London; ▪ Additional treatment in east London; ▪ Additional capacity in the Thames Water ring main.


River Lee
3
King George V Reservoir
CON-RWS-LCK-KGV-800
River Roding
CON-RU-BEC-LCK
ESSEX
Treated water is transferred by underground pipe
CON-RWS-KGV-360
2
RES-RU-BEC-150
Beckton Water reuse treatment plant
4
Water transferred to WTWs for treatment
5
Treated drinking water to customers across London via existing underground pipes
Transfer of treated wastewater effluent
Waste stream
Wastewater from homes and businesses is transferred to the STW for treatment
Treated wastewater effluent discharged to the river
Ring Main
London
1
Beckton STW
Canary Wharf
River Thames
02 Arena

4.3 Deephams Reuse (46.5Ml/d) - RES-RU-DPH

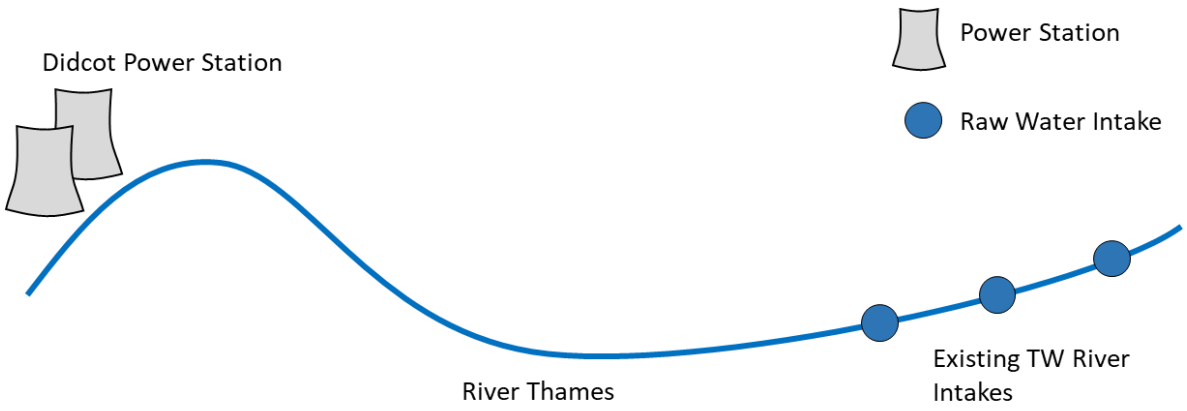
Name	Deephams Reuse (46.5Ml/d)
WRMP19 Reference	RES-RU-DPH
Element Type	Resource
WRZ	LONDON
Engineering Scope	Planned indirect potable reuse (IPR) is the process of actively managing returns of highly treated wastewater effluent to water courses above abstraction points. Treated effluent from the Deephams Sewage Treatment Works is to be subjected to an advanced treatment process to produce a high purity water stream. The treated water will then be pumped to a proposed discharge location on the River Lee Diversion with the opportunity to discharge into the William Girling or King George V Reservoir. This water will supplement the raw water supply in the Lee Valley reservoirs. The proposed site for the treatment will be within the Deephams STW site boundary.
Engineering Components	▪ 46.5 Ml/d Water reuse treatment plant, consisting of the following treatment processes: duty/standby pressurised automatic backwash screens, ferric addition, ultrafiltration plant complete with filtrate pumps, backwash, and clean in place (CIP) system, RO membrane plant, Hydrogen peroxide and UV treatment (AOP), remineralisation plant consisting of a lime and CO_2 dosing, waste stream system, returned to the Deephams STW inlet works for treatment. ▪ Final effluent pumping station 220 kW (1 Nr 110 kW duty pump, 1 Nr 110 kW standby pump) ▪ Treated water pumping station 180 kW (1 Nr 90 kW duty pump, 1 Nr 90 kW standby pump) ▪ Effluent washwater return pumping station 120 kW (2 Nr 40 kW duty pump, 1 Nr 40 kW standby pump) ▪ Land requirements: Maximum 14,500 m^2 for reuse plant
Benefit	Deployable Output benefit of 45 Ml/d
Lead Time	6 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	The Deephams Reuse option comprises two elements. The other element is one of the following: ▪ CON-RU-DPH-KGV (Conveyance of treated water from Deephams to KGV Reservoir) **OR** ▪ CON-RU-DPH-TLTEX (Conveyance of treated water from Deephams to the discharge location at a shaft on the TLT Extension) ▪ This first element would be used if the Lockwood PS to KGV Reservoir tunnel (CON-RWS-LCK-KGV-800) was not constructed at the time of implementing Deephams reuse. To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the Lee Valley Reservoirs and conveyed to a Water Treatment Works in east London; ▪ Additional treatment in east London; ▪ Additional capacity in the Thames Water ring main.


RES-RU-DPH
2
Deephams water reuse treatment plant
Treated water is transferred by underground pipe to the storage reservoir
Waste stream
Treated wastewater effluent
3
King George V Reservoir
River Roding
Wastewater from homes and businesses is transferred to the STW for treatment
1
Deephams STW
Treated wastewater effluent returned to the river
4
Water transferred to WTWs for treatment
5
Transfer of treated drinking water to customers across London via existing underground pipes
London
Ring Main
CON-RU-DPH-KGV or
CON-RU-DPH-TLTEX
River Lee
River Thames
Canary Wharf
02 Arena

5 Raw Water Purchase

5.1 Didcot Raw Water Purchase - RES-RWP-DID

Name	Didcot Raw Water Purchase
WRMP19 Reference	RES-RWP-DID
Element Type	Resource
WRZ	LONDON / SWA
Engineering Scope	Agreement between Thames Water and RWE NPower that NPower will abstract less than the maximum amount of their abstraction licence at Didcot Power Station. This water would then be available downstream for abstraction at Thames Water intakes.
Engineering Components	none
Benefit	Deployable output benefit of 18 Ml/d
Lead Time	0 Years
Mutual exclusivities	none
Interdependencies/ Exclusivity	For a SWA solution, the additional elements required are the New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM)CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM)



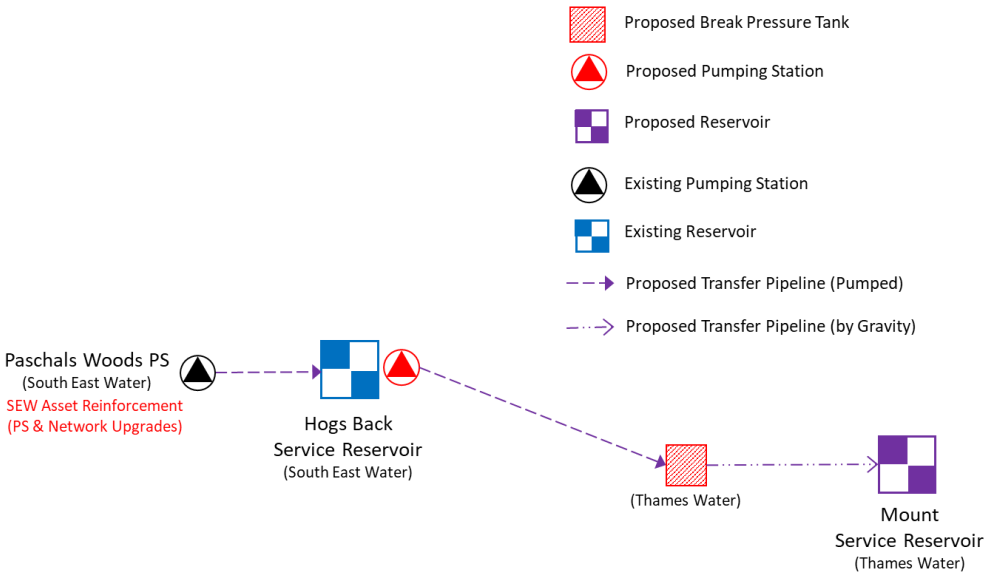
5.2 Chingford Raw Water Purchase - RES-RWP-CHD

Name	Chingford Raw Water Purchase
WRMP19 Reference	RES-RWP-CHD
Element Type	Resource
WRZ	LONDON
Engineering Scope	Thames Water have an existing agreement to export from east London to Essex and Suffolk Water. There is an agreed reduction in the transfer that provides a benefit to London. This option is for continuation of the agreed reduction in the export quantities from 2035/36, providing 20 Ml/d deployable output for London.
Engineering Components	none
Benefit	Deplyable output benefit of 20 Ml/d
Lead Time	0 Years (but not before 2035/36)
Mutual exclusivities	none
Interdependencies/ Exclusivity	To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the Lee Valley Reservoirs and conveyed to a Water Treatment Works in east London; ▪ Additional treatment in east London; ▪ Additional capacity in the Thames Water ring main.

6 Inter Company Transfers

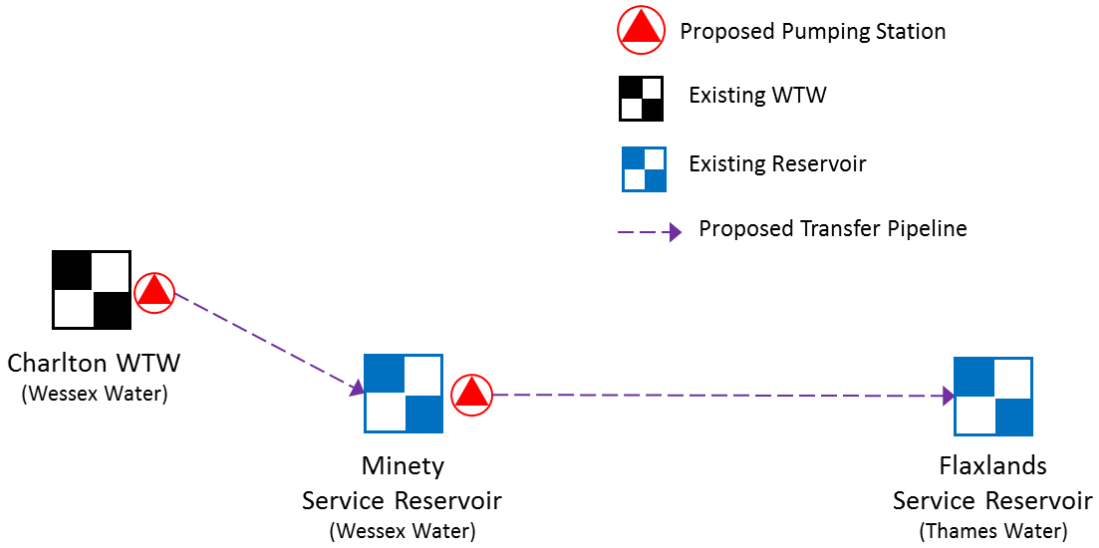
6.1 South East Water to Guildford Transfer - RES-ICT-SEW-GUI-MNT-10

Name	South East Water to Guildford Inter-company transfer
WRMP19 Reference	RES-ICT-SEW-GUI-MNT-10
Element Type	Resource
WRZ	Guildford
Engineering Scope	Inter-zonal (inter-company) transfer of 10 Ml/d from Hogs Back Service Reservoir (SR) in South East Water (SEW) supply area to Mount SR in Guildford WRZ.
Engineering Components	Within SEW Supply area: ▪ 6 km of 450mm main from Colonels Gate to Mytchett Place, Keogh Barracks ▪ 1.5km of 250mm main inlet to Hogs back SR ▪ New 90 kW pumping station at Hogs Back, adjacent to the existing SR (1 No 45 kW duty pump and 1 No 45 kW standby pump). Pumping head of 26 m. ▪ 8 Ml storage at Hogs Back SR ▪ Booster upgrade (10Ml/d) at Paschals Wood requiring a new building/kiosk and new power supply. ▪ 5,000 m^2 land area for the new pumping station at Hogs Back SR and for additional 8 Ml storage Within Guildford WRZ: ▪ 8.7 km treated water pipeline (6 km pumped and 2.7 km gravity) from Hogs Back SR (SEW) to Mount SR (350mm diameter), to be laid in open cut, with some short sections of directional drilling under the A31 and A3 major roads. ▪ Break pressure tank located at the end of the pumped treated water pipeline section to provide 1 hour storage. ▪ 850 m^2 land area for the new break tank.
Benefit	10 Ml/d peak deployable output (DO) provided to the Guildford WRZ
Lead Time	5 Years
Mutual exclusivities	none
Interdependencies/ Exclusivity	No interdependency with other WRMP elements



6.2 Wessex to SWOX (2.9Ml/d) - RES-ICT-WSX-FLX

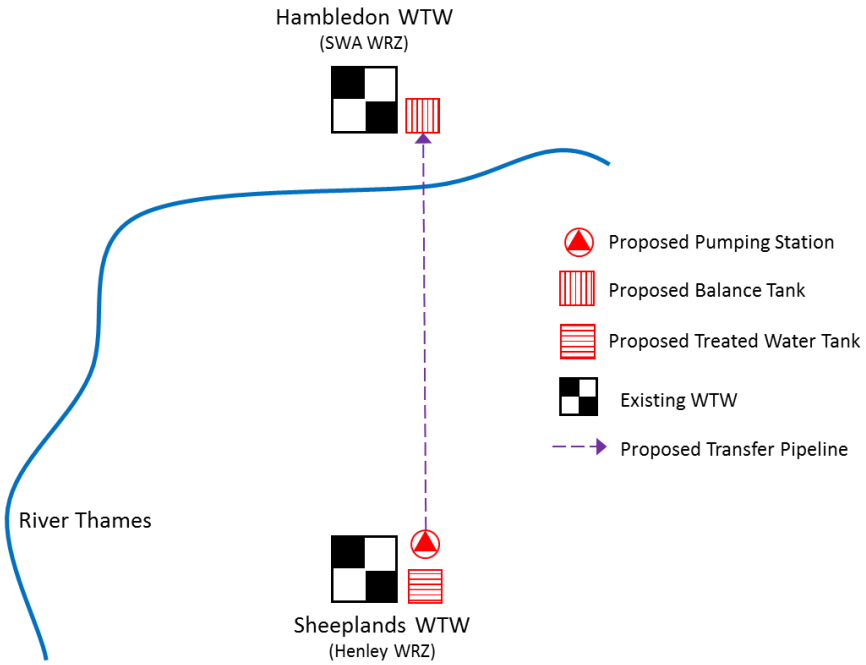
Name	Wessex to SWOX 2.9 Ml/d – Inter-zonal (inter-company) transfer
WRMP19 Reference	RES-ICT-WSX-FLX
Element Type	Resource
WRZ	SWOX
Engineering Scope	Inter-zonal (inter-company) transfer of 2.9 Ml/d from Wessex Water's Charlton WTW to Thames Water's Flaxlands Service Reservoir (SR).
Engineering Components	▪ A 2.9 Ml/d treated water pipeline from Charlton WTW to Minety SR, 250 mm diameter, (3,750m) and from Minety SR to Flaxlands SR, 250 mm diameter (8,950m). ▪ A new 74 kW pump station (1 No 37 kW duty pump and 1 No 37 kW standby pump) and borehole pumps at Charlton WTW (Wessex Water). ▪ A new 74 kW pump station (1 No 37 kW duty pump and 1 No 37 kW standby pump) at Minety SR (Wessex Water). ▪ 283 m^2 land area for Charlton WTW pumping station and 1,845 m^2 land area for Minety SR pumping station.
Benefit	2.9 Ml/d peak deployable output (DO) provided to the SWOX WRZ
Time Lead	5 Years
Mutual exclusivities	none
Interdependencies/ Exclusivity	No interdependency with other WRMP elements



7 Inter Zonal Transfers

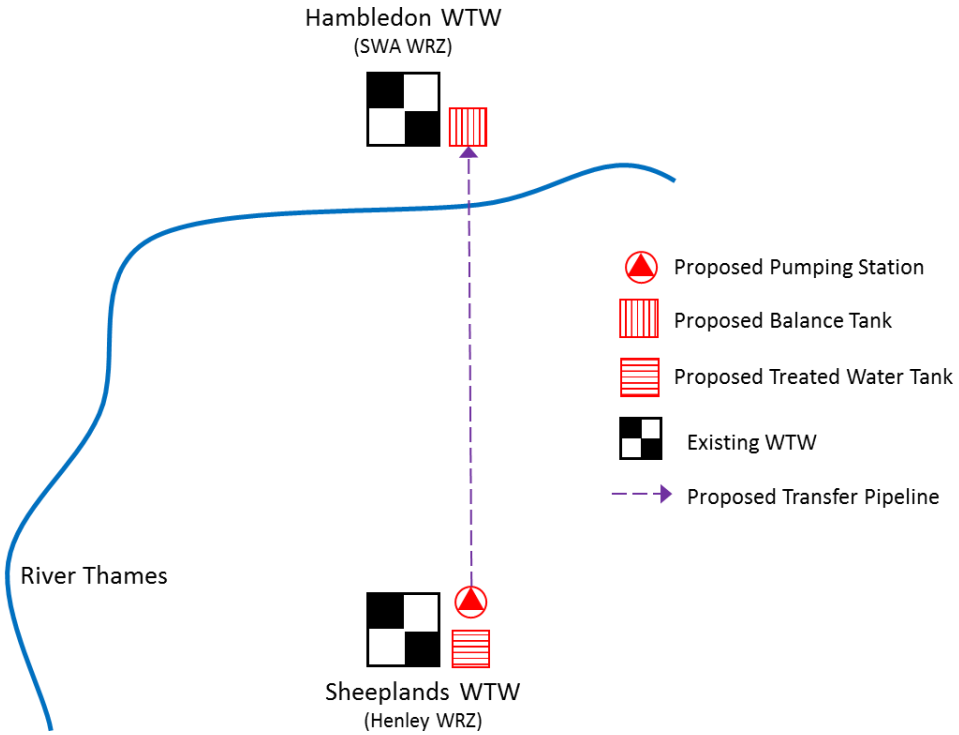
7.1 Henley to SWA (2.4Ml/d) - RES-IZT-HEN-SWA-HAM-2.37

Name	Henley to SWA 2.37 Ml/d – Inter-zonal transfer
WRMP19 Reference	RES-IZT-HEN-SWA-HAM- 2.37
Element Type	Resource
WRZ	SWA
Engineering Scope	Inter-zonal transfer of 2.37 Ml/d from Sheeplands WTW in Henley WRZ to Hambleden WTW in SWA WRZ.
Engineering Components	▪ A 250 mm diameter treated water pipeline (9,300m9.9. km) to transfer 2.37 Ml/d from Sheeplands WTW to Hambleden WTW. ▪ New 74 kW pumping station at Sheeplands WTW (1 No 37 kW duty pump and 1 No 37 kW standby pump). ▪ New 600 m^3 balance tank at Hambleden WTW (1Ml/d) and new treated water tank at Sheeplands WTW ▪ Orthophosphate dosing at Sheeplands WTW1620 m^2 land area for the new pumping station
Benefit	2.4 Ml/d peak deployable output (DO) provided to the SWA WRZ
Lead Time	5 Years
Mutual exclusivities	▪ This element is mutually exclusive with the the Henley to SWA 5 Ml/d (RES-IZT-HEN-SWA-HAM-5), Henley to SWOX 2.37 Ml/d inter-zonal transfer option (RES-IZT-HEN-SWX-NET-2.37) and Henley to SWOX 5 Ml/d (RES-IZT-HEN-SWX-NET-5) inter-zonal transfer options.
Interdependencies/ Exclusivity	No interdependency with other WRMP elements



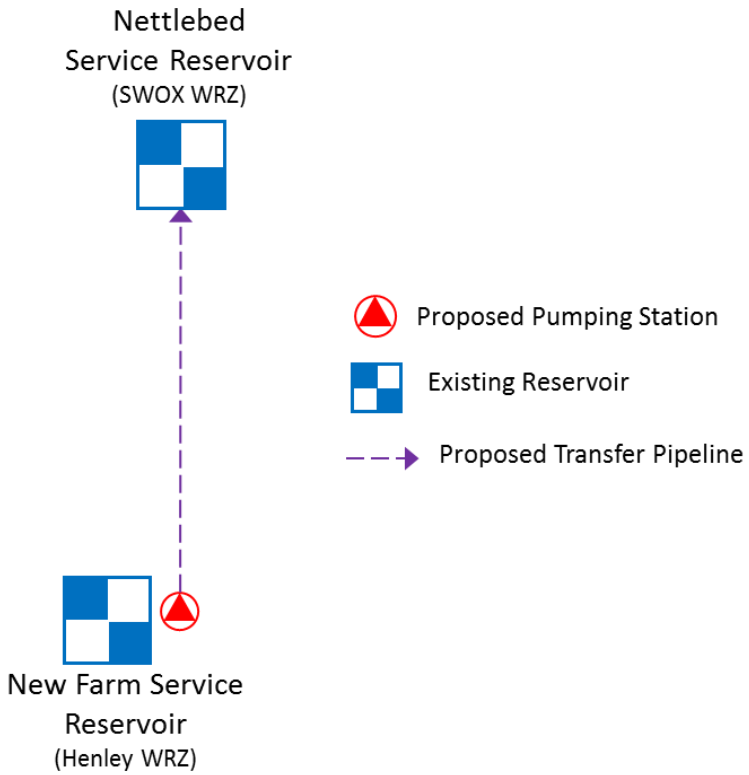
7.2 Henley to SWA (5 Ml/d) – RES-IZT-HEN-SWA-HAM-5

Name	Henley to SWA 5 Ml/d – Inter-zonal transfer
WRMP19 Reference	RES-IZT-HEN-SWA-HAM-5
Element Type	Inter-zonal transfer
WRZ	SWA
Engineering Scope	Inter-zonal transfer of 5 Ml/d from Sheeplands WTW in Henley WRZ to Hambleden WTW in SWA WRZ.
Engineering Components	▪ A 355 mm diameter treated water pipeline (9.9km) to transfer 5 Ml/d from Sheeplands WTW to Hambleden WTW. ▪ New 135kW pumping station at Sheeplands WTW (2 No 45 kW duty pump and 1 No 45 kW standby pump). ▪ New 1250 m^3 balance tank at Hambleden WTW and new treated water tank at Sheeplands WTW ▪ Orthophosphate dosing at Sheeplands WTW
Benefit	5 Ml/d peak deployable output (DO) provided to the SWA WRZ
Lead Time	5 Years
Mutual exclusivities	▪ This element is mutually exclusive with the Henley to SWA 2.37 Ml/d (RES-IZT-HEN-SWA-HAM- 2.37) as well as the Henley to SWOX 2.37 Ml/d inter-zonal transfer option (RES-IZT-HEN-SWX-NET-2.37) and Henley to SWOX 5 Ml/d (RES-IZT-HEN-SWX-NET-5) inter-zonal transfer options.
Interdependencies/ Exclusivity	No interdependency with other WRMP elements.



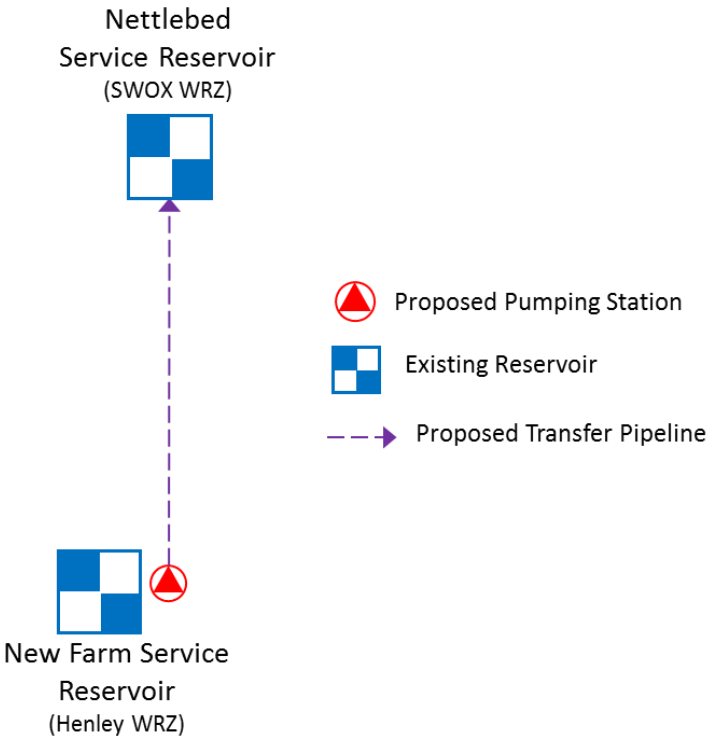
7.3 Henley to SWOX (2.4Ml/d) - RES-IZT-HEN-SWX-NET-2.37

Name	Henley to SWOX 2.37 Ml/d – Inter-zonal transfer
WRMP19 Reference	RES-IZT-HEN-SWX-NET-2.37
Element Type	Resource
WRZ	SWOX
Engineering Scope	Inter-zonal transfer of 2.4 Ml/d from New Farm SR in Henley WRZ to Nettlebed SR in SWOX WRZ.
Engineering Components	A 250 mm diameter treated water pipeline (5,900m.9 km) to transfer 2.37 Ml/d from New Farm SR to Nettlebed SR. New 110 220 kW pumping station at New Farm SR (1 No 55 110 kW duty pump and 1 No 55 110 kW standby pump). Pumping head of 115 m. 2,200 m^2 land area for the new pumping station.
Benefit	2.4 Ml/d peak deployable output (DO) provided to the SWOX WRZ
Lead Time	5 Years
Mutual exclusivities	This element is mutually exclusive with. Henley to SWOX 5Ml/d (RES-IZT-HEN-SWX-NET-5) as well as the Henley to SWA 5Ml/d (RES-IZT-HEN-SWA-HAM-5) and Henley to SWA 2.37Ml/d (RES-IZT-HEN-SWA-HAM-2.37) inter-zonal transfer options.
Interdependencies/ Exclusivity	No interdependency with other WRMP elements.



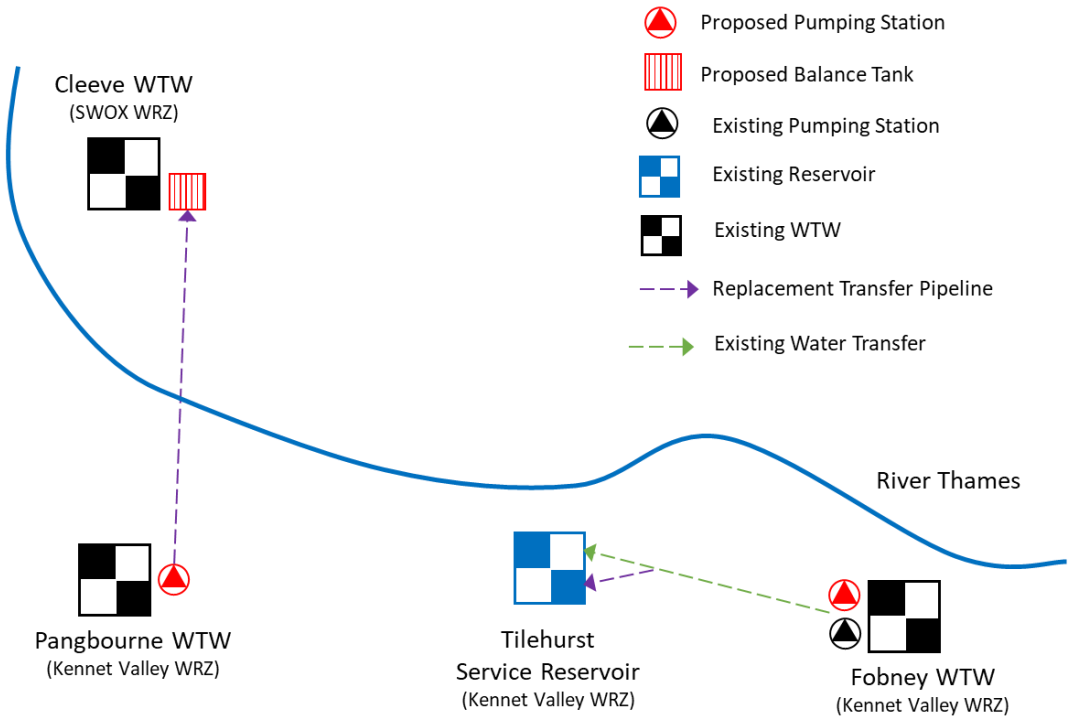
7.4 Henley to SWOX (5 Ml/d) – RES-IZT-HEN-SWX-NET-5

Name	Henley to SWOX 5 Ml/d – Inter-zonal transfer
WRMP19 Reference	RES-IZT-HEN-SWX-NET-5
Element Type	Resource
WRZ	SWOX
Engineering Scope	Inter-zonal transfer of 5 Ml/d from New Farm SR in Henley WRZ to Nettlebed SR in SWOX WRZ.
Engineering Components	▪ A 355 mm diameter treated water pipeline (5.9km) to transfer 5 Ml/d from New Farm SR to Nettlebed SR. ▪ New 450 kW pumping station at New Farm SR (1 No 255 kW duty pump and 1 No 255 kW standby pump).
Benefit	5 Ml/d peak deployable output (DO) provided to the SWOX WRZ
Lead Time	5 Years
Mutual exclusivities	This element is mutually exclusive with. Henley to SWOX (2.37Ml/d) - RES-IZT-HEN-SWX-NET-2.37) as well as the Henley to SWA 5Ml/d (RES-IZT-HEN-SWA-HAM-5) and Henley to SWA 2.37Ml/d (RES-IZT-HEN-SWA-HAM-2.37) inter-zonal transfer options.
Interdependencies/ Exclusivity	No interdependency with other WRMP elements.



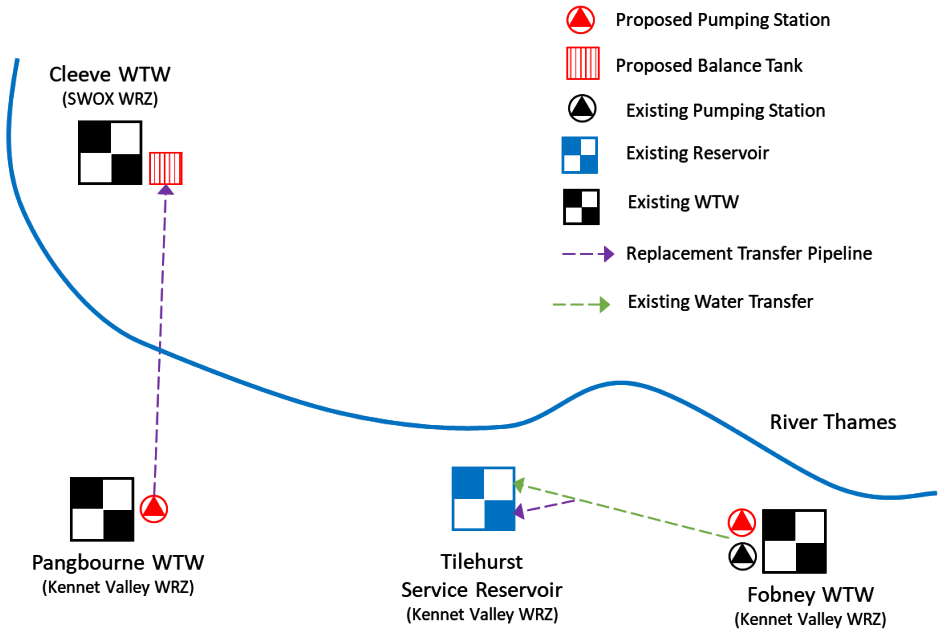
7.5 Kennet Valley to SWOX (2.3Ml/d) - RES-IZT-KEN-SWOX-CLV-2.3

Name	Kennet Valley to SWOX 2.3 Ml/d – inter-zonal transfer
WRMP19 Reference	RES-IZT-KEN-SWOX-CLV-2.3
Element Type	Resource
WRZ	SWOX
Engineering Scope	This element includes a new pipeline from Pangbourne WTW to Cleeve WTW to transfer 2.3 Ml/d of treated water and a new pumping station at Pangbourne WTW. Additionally, a new potable water pipeline is required for the end section of the existing main from Fobney WTW to Tilehurst SR, to enable an increase in flow in the pipeline.
Engineering Components	▪ New treated water pipeline from Pangbourne WTW to Cleeve WTW to transfer 2.3 Ml/d. Pipeline length: 9.4km. Pipeline diameter: 300mm. ▪ New 74 kW pumping station at Pangbourne WTW (1 No 37 kW duty pumps, 1 No 37 kW standby pump). ▪ A 1,500 m^3 balance tank at Cleeve WTW providing storage of 2x the pipeline volume (Pangbourne to Cleeve). The balance tank will enable pumping into one, or both, of the 900mm GATOX mains to Hagbourne SR. ▪ New treated water pipeline for the end section from Fobney WTW to Tilehurst SR. Pipeline length: 800m, pipeline diameter: 700mm. ▪ Additional pumps at the existing pumping station building at Fobney WTW: 1 No 75 kW duty pump, 1 No 75 kW standby pump. Total installed power capacity of 150 kW.
Benefit	2.3 Ml/d peak deployable output (DO) provided to the SWOX WRZ.
Time Lead	5 Years
Mutual exclusivities	This element is mutually exclusive with the Kennet Vallet to SWOX (RES-IZT-KEN-SWOX-CLV) element.
Interdependencies/ Exclusivity	None



7.6 Kennet Valley to SWOX (6.7Ml/d) - RES-IZT-KEN-SWOX-CLV-6.7

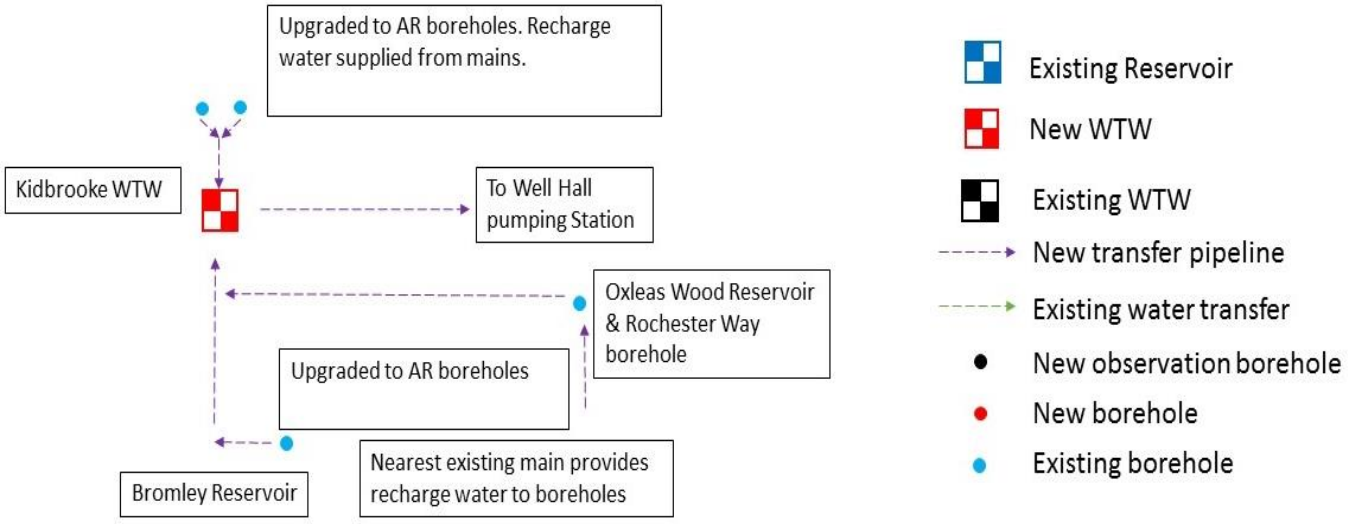
Name	Kennet Valley to SWOX 6.7 Ml/d – inter-zonal transfer
WRMP19 Reference	RES-IZT-KEN-SWOX-CLV-6.7
Element Type	Resource
WRZ	SWOX
Engineering Scope	This element includes a new pipeline from Pangbourne WTW to Cleeve WTW to transfer 6.7 Ml/d of treated water and a new pumping station at Pangbourne WTW. Additionally, a new potable water pipeline is required for the end section of the existing main from Fobney WTW to Tilehurst SR, to enable an increase in flow in the pipeline.
Engineering Components	▪ New treated water pipeline from Pangbourne WTW to Cleeve WTW to transfer 6.7 Ml/d. Pipeline length: 9.4km. Pipeline diameter: 300mm. ▪ New 148 kW pumping station at Pangbourne WTW (4 No 37 kW duty pumps, 1 No 37 kW standby pump). ▪ A 1,500 m^3 balance tank at Cleeve WTW providing storage of 2x the pipeline volume (Pangbourne to Cleeve). The balance tank will enable pumping into one or both of the 900mm GATOX mains to Hagbourne SR. ▪ New treated water pipeline for the end section from Fobney WTW to Tilehurst SR. Pipeline length: 800m, pipeline diameter: 700mm. ▪ Additional pumps at the existing pumping station building at Fobney WTW: 2 No 75 kW duty pump, 1 No 75 kW standby pump. Total installed power capacity of 225 kW.
Benefit	4.5 Ml/d Peak deployable output (DO) provided to the SWOX WRZ.
Time Lead	5 Years
Mutual exclusivities	This element is mutually exclusive with the Kennet Vallet to SWOX 2.3 Ml/d (RES-IZT-KEN-SWOX-CLV-2.3) element.
Interdependencies/ Exclusivity	To provide an additional resource to SWOX WRZ the following system elements are also required: ▪ An additional 4.5 Ml/d ground water capacity are to be developed at Mortimer WTW (RES-GW-MOR) to enable the release of 4.5 Ml/d supply capacity from Fobney WTW.



8 Groundwater

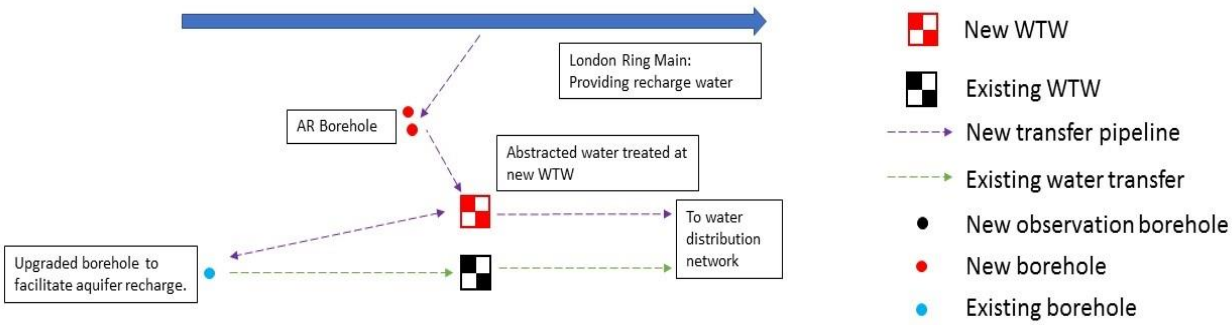
8.1 South London Artificial Recharge Scheme Kidbrooke - RES-AR-SLARS1-7

Name	South London Artificial Recharge Scheme (SLARS) - Kidbrooke
WRMP19 Reference	RES-AR-SLARS1-7
Element Type	Resource
WRZ	LONDON
Engineering Scope	Upgrading four existing boreholes for Artificial Recharge (one at the Rochester Way site, two at Kidbrooke and another at the Bromley Reservoir site. Construction of a new 8.1Ml/d WTW at the Kidbrooke borehole site to serve Rochester Way, Kidbrooke and Bromley Reservoir. Recharge water for the Kidbrooke boreholes will be provided from the local distribution main and will be recharge into the confined Chalk aquifer under mains pressure. Recharge water for Bromley Reservoir will be provided via the supply mains. Recharge water for Rochester Way boreholes will be provided via supply mains to the Oxleas Wood Reservoir (near Rochester Way). Water abstracted from the AR boreholes will be treated at the new Kidbrooke WTW. Treated water from the Kidbrooke WTW will be returned to supply via the Well Hall Pumping station when an additional resource for the London Water Resource Zone is required. A discharge consent for recharge of the Chalk aquiferpermit will be required from the Environment Agency for recharge of the Chalk aquifer.
Engineering Components	▪ Existing Kidbrooke boreholes will require new headworks and submersible abstraction pump (rated at 1.5 Ml/d), with variable speed drives (VSD). ▪ Existing Bromley reservoir borehole will have an abstraction pump installed (1.6 Ml/d duty at 115m total head and with 30kW motor). A new connection for recharge water will be made from this borehole to the existing mains (estimated 40m, 300mm diameter). ▪ Existing Rochester Way borehole will have an abstraction pump installed (3.5 Ml/d, total head 115m and with a 75kW motor). Recharge rates of 5Ml/d will be controlled by a motorised valve; no recharge pumping is necessary. ▪ A VSD booster pump will be installed at Oxleas Wood reservoir to pump recharge water to Rochester Way, with a duty of 5-10Ml/d, 20m total head and motor rating 37kW. A Category 4 RPZ will also be installed at the Oxleas Wood site to provide back siphonage protection. ▪ A 40m (300mm diameter) connection for recharge water to be constructed at the existing mains Bromley Reservoir site, taking water to an RPZ. A 7.1km (200mm diameter) transfer pipe will be constructed for raw water being pumped from Bromley to Kidbrooke WTW. ▪ Construction of a 3.8km (250mm diameter) main at Rochester Way borehole to transfer abstracted water to Kidbrooke WTW. ▪ A 300m (300mm diameter) main to be installed at Oxleas Wood to provide recharge water for Rochester Way. ▪ Construction of a new treatment works at the Kidbrooke site to include the following treatments; aeration, prechlorination, coagulation, flocculation, dual media rapid gravity filtration, GAC rapid gravity adsorption, plumbosolvency control, chlorination, partial dechlorination, chloramination.
Benefit	DO benefit is estimated as 7Ml/d average and 8.1Ml/d peak.
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on other system elements. This option will be operated under a similar strategy to the other SLARS schemes (AR-Streatham (RES-AR-SLARS2) and AR-Merton (RES-AR-SLARS3).


Upgraded to AR boreholes. Recharge water supplied from mains.
Kidbrooke WTW
To Well Hall pumping Station
Oxleas Wood Reservoir & Rochester Way borehole
Upgraded to AR boreholes
Nearest existing main provides recharge water to boreholes
Bromley Reservoir
Existing Reservoir
New WTW
Existing WTW
New transfer pipeline
Existing water transfer
New observation borehole
New borehole
Existing borehole

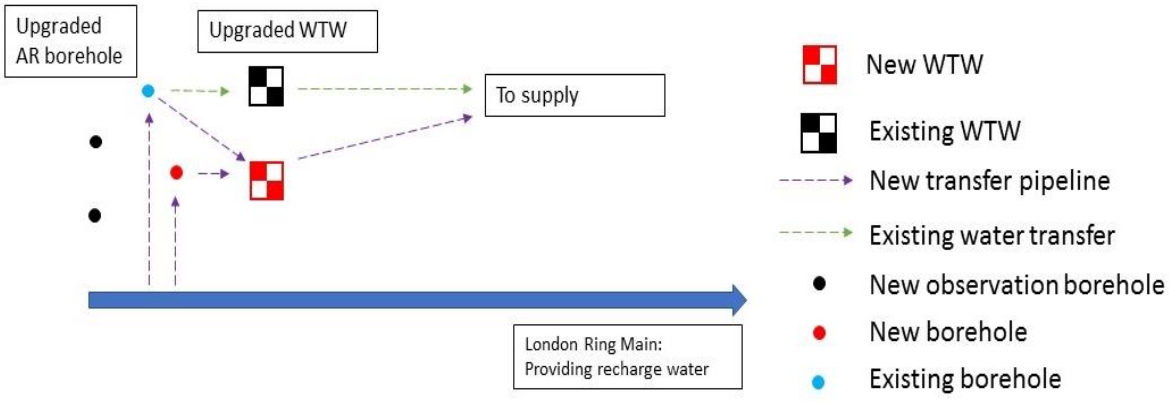
8.2 South London Artificial Recharge Scheme Streatham - RES-AR-SLARS2

Name	South London Artificial Recharge Scheme (SLARS) - Streatham
WRMP19 Reference	RES-AR-SLARS2
Element Type	Resource
WRZ	LONDON
Engineering Scope	Component of the larger SLARS project based on the development of boreholes for recharge/abstraction purposes in the confined Chalk. Upgrade of existing borehole at Streatham WTW and construction of new artificial recharge (AR) borehole on-site at the existing Streatham WTW. Construction of a new 17Ml/d WTW located on the existing WTW site. Recharged water is treated at the new WTW. A new licence and discharge consent will be required from the Environment Agency to allow abstraction/recharge from the Chalk. A winter licence from the River Thames will also be required to supply water during the recharge phase of the AR scheme.
Engineering Components	▪ New recharge/abstraction borehole; depth 130m, 762 62mm diameter, solid casing to 80m ▪ Variable speed drive (VSD) pump for new borehole for duty between 5 and 9Ml/d, total head of 130m and a 185kW motor. ▪ Redevelopment of existing borehole to become a recharge/abstraction borehole equipped with the same VSD pump as installed in new borehole. ▪ New recharge water connection (40m length, 300mm diameter) to the existing 42” main in Conyers Rd. ▪ Connection from treated water main to distribution network (40m length, 300mm dia). ▪ New run-to-waste sewer connection (40m length, 300mm diameter). ▪ Temporary land compound (1,600m^2). ▪ New 17Ml/d WTW with the following proposed treatment processes: – Pre-chlorination with sodium hypochlorite for oxidation of dissolved iron and manganese and to break up ammonia – Dual media rapid gravity filtration (DMF) – Granular activated carbon (GAC) pressure adsorption; – Orthophosphoric acid dosing for plumbosolvency control; – Chlorination with sodium hypochlorite; – Chlorine contact in four pressure vessels; and – Partial dechlorination with sodium bisulphite.
Benefit	4 Ml/d average 4.5 Ml/d peak
Lead Time	4 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	No other options in the constrained list are mutually exclusive with this option. The scheme is independent of the other sub-components of the larger SLARS project: SLARS Kidbrooke (RES-AR-SLARS1) and SLARS Merton (RES-AR-SLARS3) but will be used under a similar operating strategy.



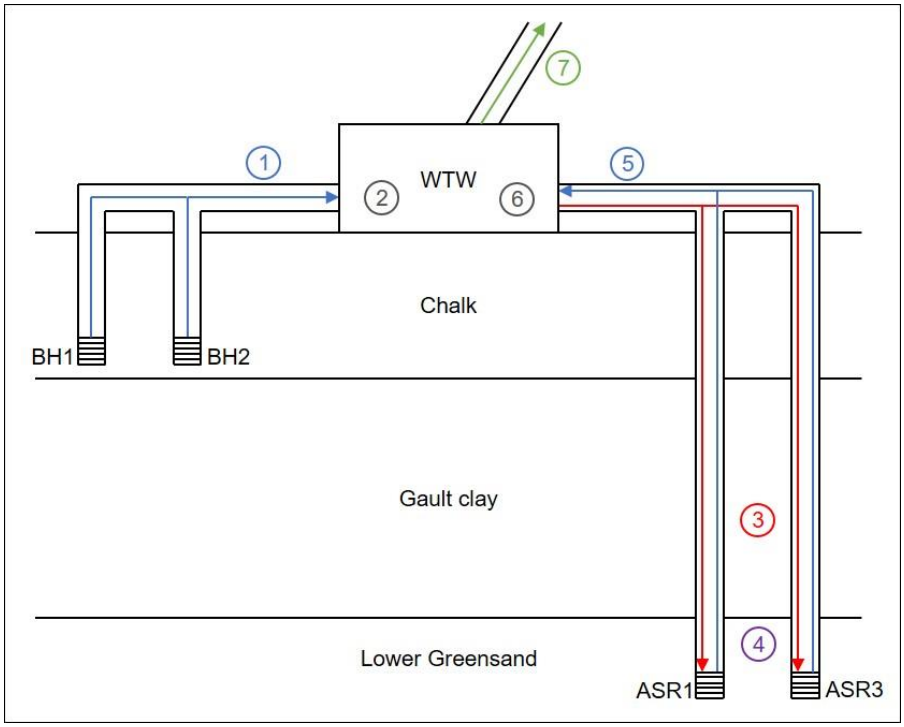
8.3 South London Artificial Recharge Scheme Merton Abbey - RES-AR-SLARS3

Name	South London Artificial Recharge Scheme (SLARS) – Merton Abbey
WRMP19 Reference	RES-AR-SLARS3
Element Type	Resource
WRZ	LONDON
Engineering Scope	This option involves upgrading the existing well and adit system at the Merton Abbey Water Treatment Works (WTW) for artificial recharge (AR) and the construction of a new AR borehole with two observations boreholes. The new AR borehole and two observation boreholes will be constructed north of the Byegrove Road site. A new WTW will be constructed at Merton Abbey to serve the Byegrove Road AR borehole. Recharge water for the Merton Abbey and Byegrove Road AR boreholes will be provided via the London Ring Main and will be recharged to the confined Chalk aquifer. Abstracted water from the AR boreholes will be treated at the new and upgraded WTWs. Treated water from the Merton Abbey WTW will be returned to local distribution mains when an additional resource is needed for the London Water Resource Zone. A new licence and discharge consent will be required from the Environment Agency to allow abstraction/recharge from the Chalk. A winter licence from the River Thames will also be required to supply water during the recharge phase of the AR scheme.
Engineering Components	▪ Installation of a new submersible pump, in the existing abstraction well, at Merton Abbey WTW, capable of pumping 8 Ml/d at a head of 110m. ▪ Construction of a 100m connection (250mm diameter) to existing main in Fortescue Road, to provide recharge water ▪ Construction of a new housing for the wellhead at Merton Abbey WTW. ▪ Construction of a new WTW (rated at 4.5 Ml/d, max) to treat water from the new AR borehole at the Byegrove Rd site. New treatment process will include: Pre-chlorination, Coagulation, Flocculation, Dual media pressure filtration, Plumbosolvency control, Chlorination, Chlorine contact in pressure vessels and partial dechlorination. ▪ Construction of a new connection from the new WTW to a local distribution main. A run to waste connection will be provided to the existing site drain. ▪ Construction of an AR borehole at Byegrove road (120m depth, 750 mm diameter, cased to 60m). ▪ Two observation boreholes for the AR borehole at Byegrove road. One (Chalk) at 120m depth, 200 mm diameter and cased to 60m; another (Thanet Sands) at 54m depth, 200mm diameter and cased to 41 m). ▪ Construction of a new connection pipeline (180m, 300mm diameter) to the distribution main in Byegrove road to provide recharge water. ▪ Construction of pipeline for water transfer from Byegrove AR borehole to new WTW (1.2 km, 300 mm diameter). ▪ Additional pumps are required at Byegrove Road AR borehole and the new WTW (both pumps rated at 4.5 Ml/d maximum flow, 110kW total installed power).
Benefit	5 Ml/d average 6 Ml/d peak
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is independent of the other sub-components of the larger SLARS project (RES-AR-SLARS1-7 and RES-AR-SLARS2). This option cannot be delivered without the recommissioning of the existing Merton Abbey groundwater source and associated WTW (RES-RC-MTN – Merton Recommissioning).


Upgraded AR borehole
Upgraded WTW
To supply
London Ring Main: Providing recharge water
New WTW
Existing WTW
New transfer pipeline
Existing water transfer
New observation borehole
New borehole
Existing borehole

8.4 Horton Kirby Aquifer Storage and Recovery – RES-ASR-HOR

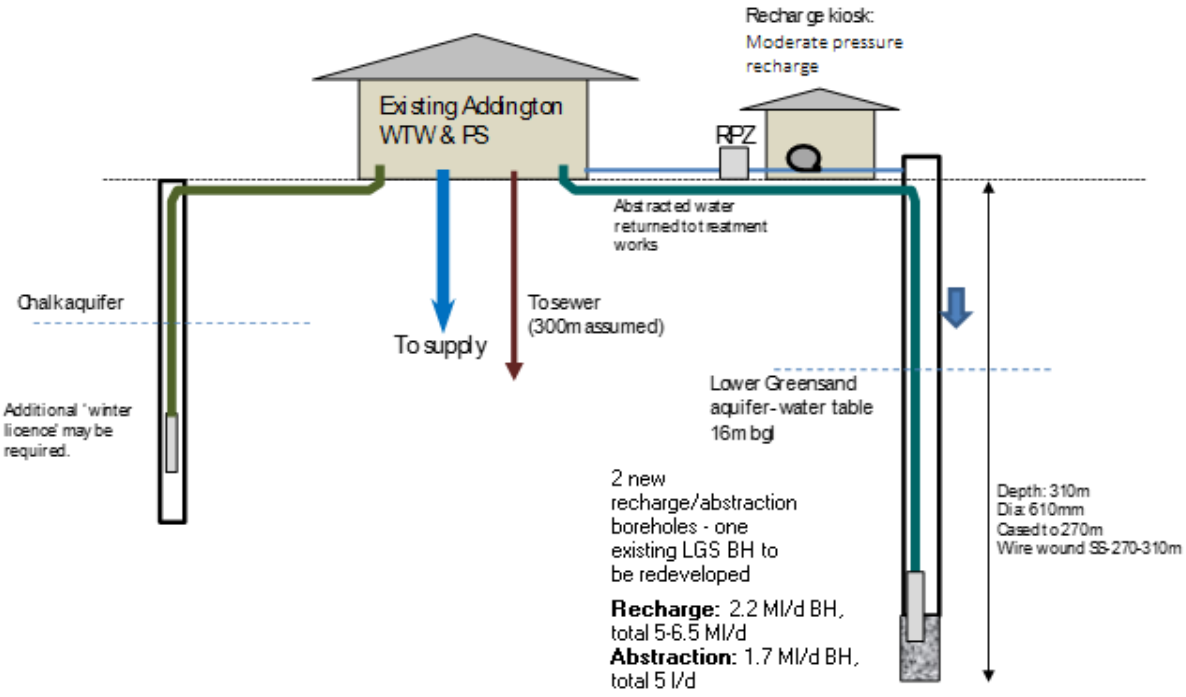
Name	Horton Kirby Aquifer Storage and Recovery
WRMP19 Reference	RES-ASR-HOR
Element Type	Resource
WRZ	LONDON
Engineering Scope	Construction of pipelines between two existing ASR boreholes in the Lower Greensand aquifer to an existing WTW (water treatment works) at Horton Kirby in Kent. Water abstracted from existing Chalk aquifer boreholes (via the mains supply) will be recharged into the two ASR boreholes during periods of water surplus and abstracted when needed and treated at the WTW. A new licence and discharge consent will be required from the Environment Agency to allow abstraction/recharge from the Lower Greensand aquifer.
Engineering Components	▪ 2.2km (250mm diameter) raw water pipeline to connect existing ASR3 borehole to existing Horton Kirby WTW. ▪ 200m (250mm diameter) raw water pipeline to connect existing ASR1 borehole to existing WTW. ▪ New run to waste pipelines from ASR3 and ASR1 to the River Darent (40m and 170m respectively, both 250mm diameter). ▪ Construction of borehole kiosks for ASR boreholes. ▪ Two borehole abstraction pumps at the ASR boreholes ▪ Two booster pumps for recharge to the ASR boreholes ▪ Two borehole pumps for abstraction from the Chalk boreholes ▪ Two force pumps to manage control of Horton Kirby WTW output to Farningham storage reservoir. ▪ Installation of turbidity meters at ASR boreholes. Upgrade of Horton Kirby WTW treatment capacity.
Benefit	The deployable output benefit for the London Water Resource Zone is estimated as 5.0 Ml/d.
Lead Time	5 years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	n/a



1. Additional abstraction from Chalk aquifer.
2. Treatment at WTW
3. Recharge of additional abstracted water to Lower Greensand Aquifer.
4. Storage in Lower Greensand aquifer.
5. Abstraction from storage, when required.
6. Treatment at WTW.
7. Distribution as potable water.

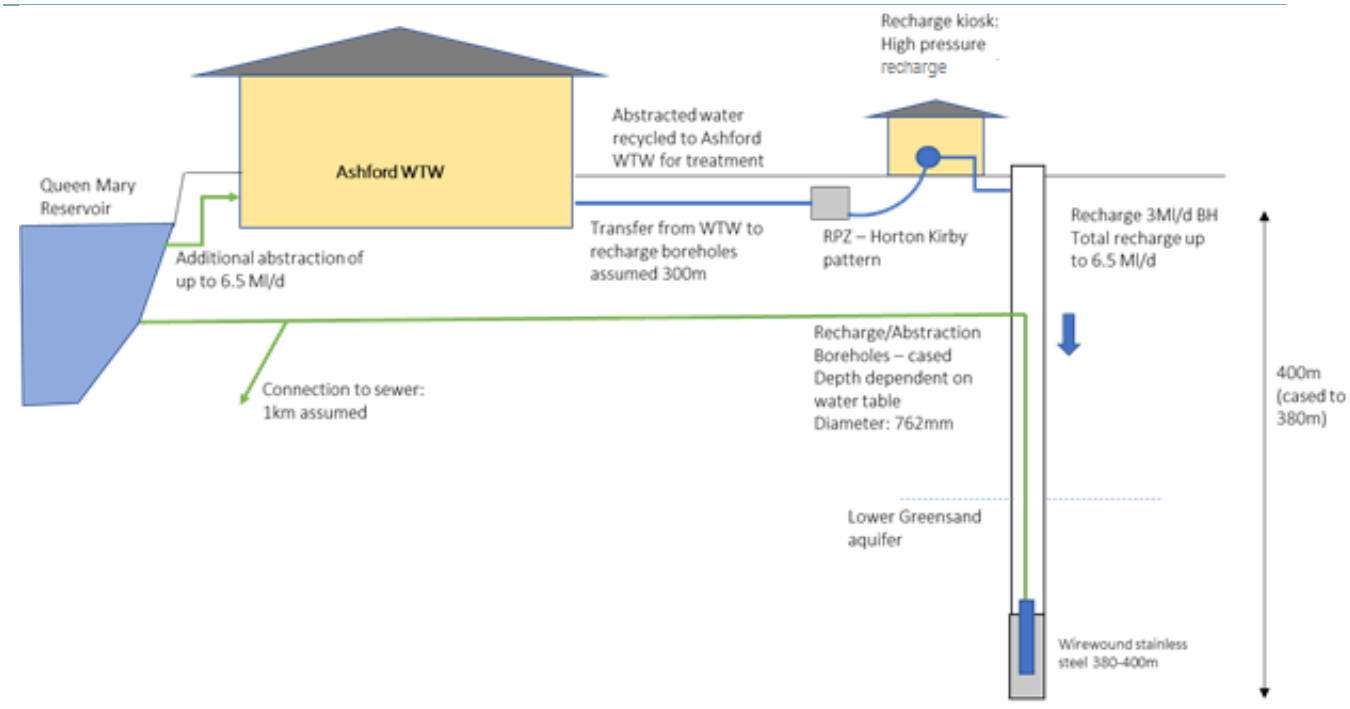
8.5 ASR South East London (Addington) - RES-ASR-SEL

Name	ASR South-East London (Addington)
WRMP19 Reference	RES-ASR-SEL
Element Type	Resource
WRZ	LONDON
Engineering Scope	Development of the existing Lower Greensand (LGS) borehole for recharge/abstraction purposes. Construction of two new recharge/abstraction boreholes in the LGS aquifer to provide a total of three operational ASR boreholes. Recharge water will be provided via the Addington supply main and abstracted water will be treated at the existing WTW. Waste and sludge discharges drain to an existing sewer connection and treated water will be returned to the Addington supply main when an additional resource for the London Water Resource Zone is required. A new licence and discharge consent will be required from the Environment Agency to allow abstraction/recharge from the Lower Greensand aquifer. As part of the application for consent, an understanding of potential impacts of the proposed option on water level (including nearby abstractors) and water quality will be prepared.
Engineering Components	▪ Two new recharge/abstraction boreholes (depth 310m, 610mm dia, steel casing to 270m). ▪ Three borehole pumps (1.7Ml/d (abstraction), 2.1Ml/d (recharge) each with max head lift of 150m each). ▪ New moderate pressure recharge building. ▪ Upgrade of Addington WTW to treat additional peak supply (refer to Addington borehole element summary). ▪ New pipelines from WTW to the two new off-site abstraction/recharge boreholes. 1400m of 200mm pipe required from WTW to ABH2 and 800m of 150mm pipe required from ABH2 to ABH3. Pipes are dual purpose recharge/abstraction. ▪ 242m^2 of private land for each of the two new boreholes. A temporary compound of 400m^2 adjacent to Addington WTW site. ▪ Total power standby requirements are 500kW.
Benefit	3 Ml/d average 5 Ml/d peak
Lead Time	10 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	No other options on the constrained list are mutually exclusive with this option. Delivery of this option in addition to the Addington new borehole option (RES-GW-ADD) will require a capacity upgrade of the Addington WTW to treat the additional peak supply. This is included in the Addington new borehole option (RES-GW-ADD).


Recharge kiosk:
Moderate pressure recharge
Existing Addington WTW & PS
RPZ
Abstracted water returned to treatment works
Chalk aquifer
To supply
To sewer (300m assumed)
Additional 'winter licence' may be required.
Lower Greensand aquifer - water table 16m bgl
2 new recharge/abstraction boreholes - one existing LGS BH to be redeveloped
Recharge: 2.2 Ml/d BH, total 5-6.5 Ml/d
Abstraction: 1.7 Ml/d BH, total 5 l/d
Depth: 310m
Dia: 610mm
Cased to 270m
Wire wound SS 270-310m

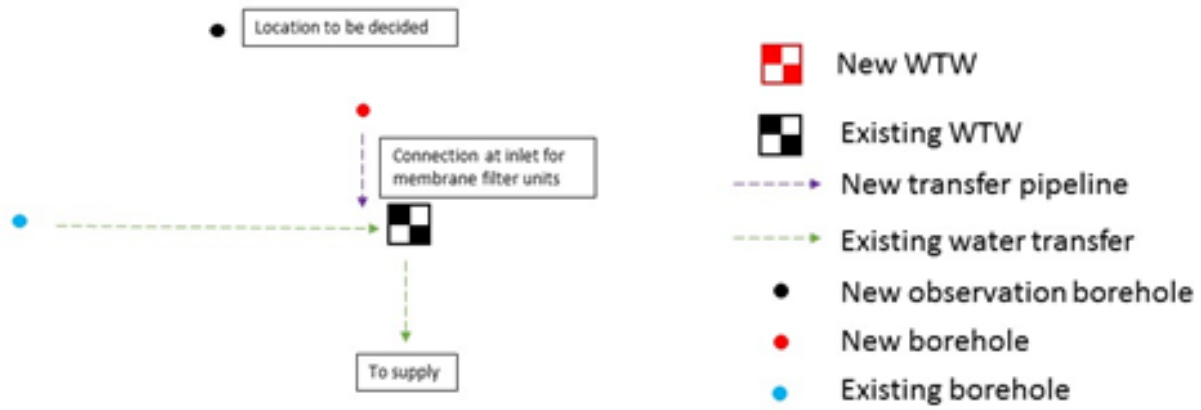
8.6 Thames Valley Central ASR - RES-ASR-TV

Name	Thames Valley/Thames Central ASR
WRMP19 Reference	RES-ASR-TV
Element Type	Resource
WRZ	LONDON
Engineering Scope	Construction of two new recharge/abstraction boreholes in the Lower Greensand aquifer (LGS) on-site at the existing Ashford water treatment works. Recharge water will be provided via the transfer main from the existing WTW. Water abstracted from ASR boreholes will be pumped to the Queen Mary Reservoir adjacent to the WTW. All waste and sludge discharge will be pumped to the local sewer via a new 1km sewer connection. Treated water will be returned to the supply main as an additional resource for the London Water Resource Zone, when required. A new licence and discharge consent will be required from the Environment Agency to allow abstraction/recharge from the Lower Greensand aquifer.
Engineering Components	▪ Two new ASR boreholes developed in the LGS at 400m deep, 610mm diameter and plain casing to 380m depth. Initially, first borehole will be treated as pilot borehole to test yield and assess scheme viability. Second borehole will then be drilled if tests are successful. ▪ One duty pump per borehole rated at 2.5Ml/d each with a max head lift of 150m each (pump duties to be confirmed following test pumping). ▪ New recharge pumping building. ▪ New 1km pipeline to sewer. ▪ Open cut construction of 300m pipe (250mm dia) to return water to Queen Mary Reservoir. ▪ Open cut construction of 1.05km pipe (150mm dia) to transfer water under mains pressure to recharge building.
Benefit	3Ml/d average. 5Ml/d peak
Lead Time	10 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependant on other system elements. No other options on the constrained list are mutually exclusive with this option.



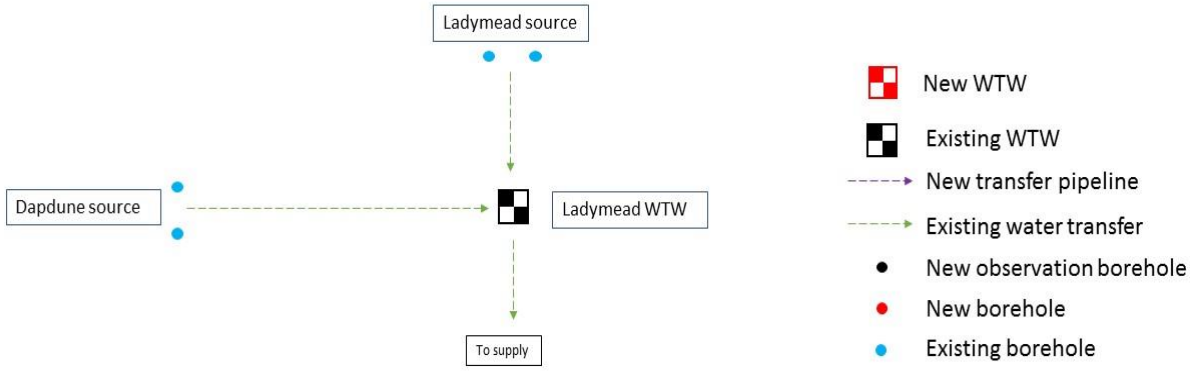
8.7 Addington Groundwater Development - RES-GW-ADD

Name	Addington groundwater development
WRMP19 Reference	RES-GW-ADD
Element Type	Resource
WRZ	LONDON
Engineering Scope	The option comprises the construction of a new borehole at Addington WTW, the improvement of existing WTW capacity by additional sodium bisulphate and phosphoric acid dosing capacity and the development of a new run to waste connection. Treated water will be an additional resource for the London Water Resource Zone.
Engineering Components	▪ New abstraction borehole; 100m depth, 762mm diameter, steel casing to 20m. ▪ Borehole pump rated at 4.5Ml/d, set at 70m. ▪ Abstraction pipework, approximately 35m long and 350mm diameter, connected to 380mm diameter inlet from existing well. ▪ A new run-to-waste connection to the existing 305mm drain. ▪ New observation borehole; 70m depth, 100mm diameter, plain casing to 5m. ▪ Upgrade of chemical dosing (sodium hypochlorite, sodium bisulphate and phosphoric acid) to provide an additional 5Ml/d treatment capacity.
Benefit	1 Ml/d average 1.5 Ml/d peak
Lead Time	3 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	No other options on the constrained list are mutually exclusive with this option. This option is not dependent on any other works. The Addington WTW does not have the capacity to treat the additional supply from the combined output of this option and the South East London ASR option (RES-ASR-SEL). If the South East London ASR option (RES-ASR-SEL) is not taken forward then the proposed upgrades to Addington WTW will not be required.



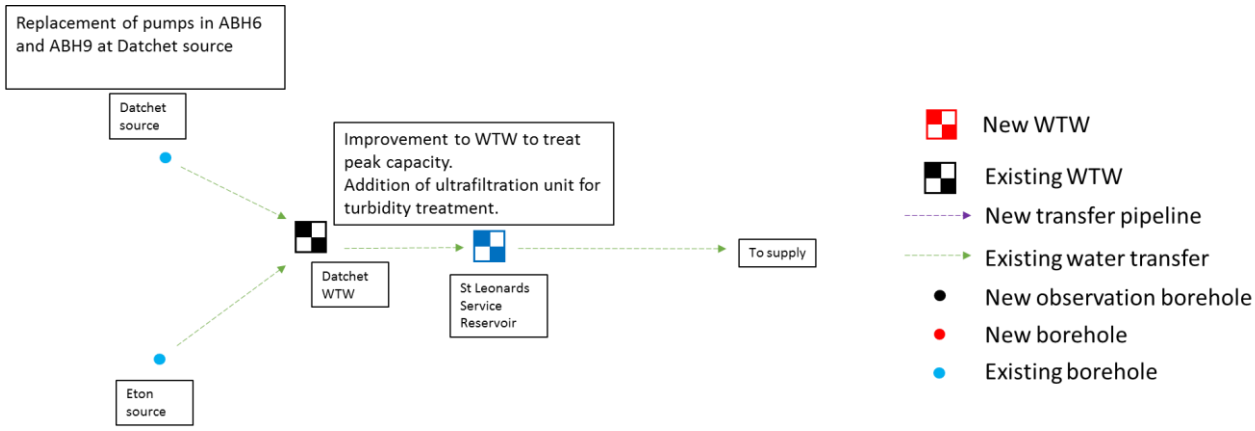
8.8 Dapdune Licence Disaggregation - RES-GW-DAP

Name	Dapdune licence disaggregation
WRMP19 Reference	RES-GW-DAP
Element Type	Resource
WRZ	Guildford
Engineering Scope	This option comprises the disaggregation of the group Dapdune – Ladymead – Millmead borehole abstraction licence group for peak licensed quantities only. No change to the average aggregate licence is proposed. The benefit from this option will provide an additional resource to the Guildford water resource zone. Test pumping to understand the potential impact of the change in peak abstraction rate on the River Wey is included as part of this option, for deliver in AMP7.
Engineering Components	No additional works will need to be performed. This option will require approval from the Environment Agency (EA).
Benefit	0 Ml/d average 2.2 Ml/d peak
Time Lead	1 Year
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is dependent on the delivery of the Dapdune Removal of Constraints (RES-RC-DAP) option and the Ladymead Removal of Constraints (RES-RC-LAD).



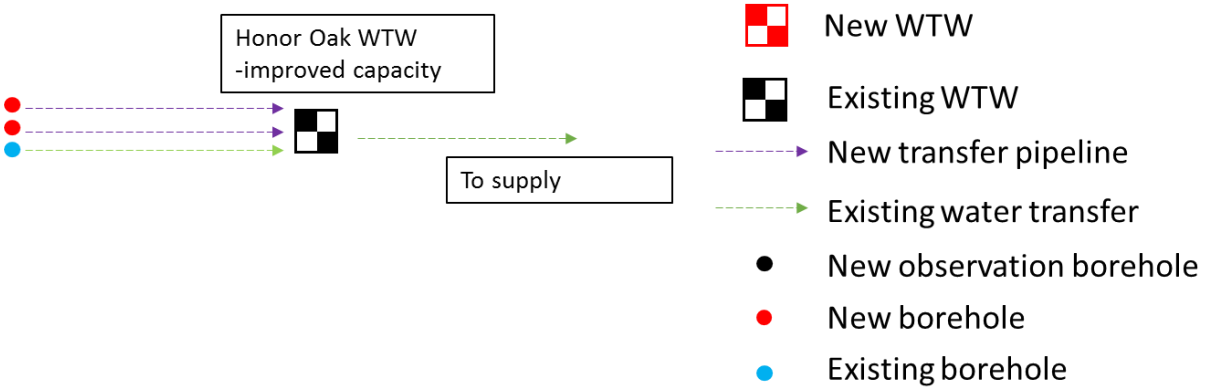
8.9 Datchet borehole rehabilitation and pump replacement - RES-GW-DAT

Name	Datchet borehole rehabilitation and pump replacement
WRMP19 Reference	RES-GW-DAT
Element Type	Resource
WRZ	SWA
Engineering Scope	The two submersible pumps in ABH 6 will be upgraded. The pump in ABH9 will be upgraded and set deeper in the borehole. Datchet WTW will be upgraded to treat the peak capacity of 31.4 Ml/d (combined peak licensed output from Datchet and Eton). Treated water will be delivered to Stoke Wood & St Leonards Reservoirs via the Slough & Windsor Ring mains.
Engineering Components	▪ Replacement of current pumps in the ABH6 boreholes with higher capacity units (13 Ml/d, installed at -43 mAOD) and smaller capacity standby units (4.5Ml/d at -33 mAOD). ▪ Replacement of the pump inat ABH9 with a 5 Ml/d capacity pump, with a setting depth of -48 mAOD. ▪ Improvement of the plug flow characteristics of the contact tank in the WTW by installing additional baffling. ▪ Ultra-filtration membrane plant to treat for elevated turbidity and Cryptosporidium risk. ▪ Temporary land requirements of 1600m^2 to facilitate construction.
Benefit	The deployable output (DO) benefit from this option is 5.4 Ml/d (peak) and 1.6. Ml/d (average), achieved through the removal of the constraints to DO at the source.
Time Lead	3.5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	There are no interdependencies for this option.



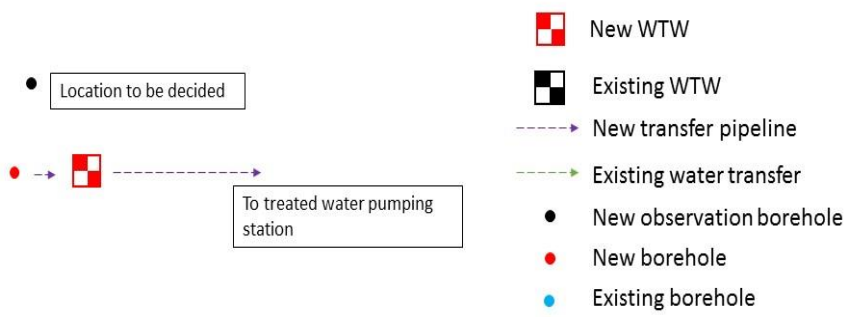
8.10 Honor Oak Groundwater– RES-GW-HON

Name	Honor Oak Groundwater Resource
WRMP19 Reference	RES-GW-HON
Element Type	Resource
WRZ	LONDON
Engineering Scope	This option comprises construction of one or two new abstraction boreholes close to the existing Honor Oak site to increase output within existing licence limits. The option also includes associated headworks and abstraction pumps, and the installation of a new pipeline to transfer the water from the new borehole(s) to the existing WTW. The water abstracted from the proposed borehole(s) will be treated at the existing WTW. The boreholes will be operated within the existing abstraction licence. The capacity of the existing WTW will be improved by installing new pressure sand filters for iron and manganese removal, and new GAC adsorbers for pesticide removal. The existing contact tanks have sufficient capacity to treat the total abstraction volume. The treated water will be used to provide additional resource for the London Water Resource Zone (WRZ).
Engineering Components	This option comprises the following engineering components: ▪ New abstraction borehole(s) with associated headworks. Boreholes will be 110m deep with 610mm diameter and will be cased to 55m. A second borehole will be constructed if the first does not provide sufficient yield. Run to waste facilities will be installed for the borehole(s). ▪ New abstraction pump in each new borehole. Pump sizing will be 4.58Ml/d (90kW) and 2.3Ml/d (45kW) for the two boreholes (if required). 250mm pipeline to transfer the water from the new borehole(s) to the existing WTW. The pipelines will be 216m for the first borehole and 23183m for the second (if constructed). Pressure sand filters and new GAC adsorbers at the existing WTW.
Benefit	1 Ml/d average 2.82 Ml/d peak
Lead Time	3 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	n/a



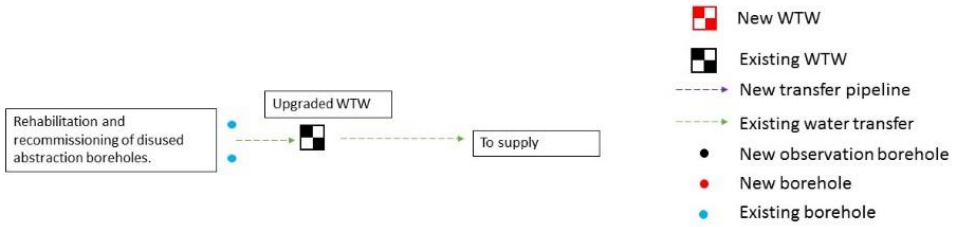
8.11 London Confined Chalk North option - RES-GW-LCC

Name	London confined Chalk north option
WRMP19 Reference	RES-GW-LCC
Element Type	Resource
WRZ	LONDON
Engineering Scope	Construction of one new abstraction borehole in the confined Chalk aquifer in London and one new water treatment works (WTW). Test pumping will be required to support the application for a new abstraction licence.
Engineering Components	▪ Construction of a new borehole (depth 100m, diameter 610mm, cased to 55m) and associated headworks. ▪ Construction of an observation borehole on-site (approximately 100m deep, diameter of 100mm). ▪ Construction of a new WTW with the following assumed treatment processes; Ultrafiltration, reverse osmosis, super-chlorination, dechlorination.
Benefit	2 Ml/d average and peak
Time Lead	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on any other option.



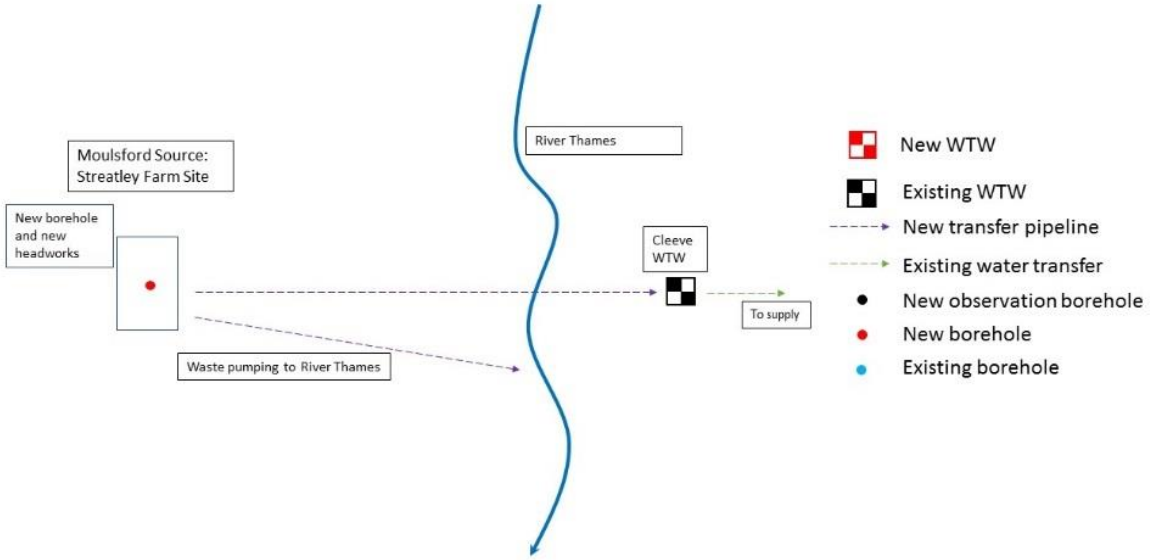
8.12 Mortimer Recommissioning - RES-GW-MOR1

Name	Mortimer Recommissioning
WRMP19 Reference	RES-GW-MOR1
Element Type	Resource
WRZ	Kennet Valley
Engineering Scope	Rehabilitation and recommissioning of two abstraction boreholes on the disused Mortimer water treatment works (WTW). The WTW will be upgraded to include treatment for ammonia and iron removal. Test pumping of the boreholes will be required to confirm groundwater quality. Treated water will provide an additional resource for the Kennet Valley Water Resource Zone. An investigation to understand the potential impacts of the proposed option on the Water Framework Directive staus of the water body will be carried out in AMP7.
Engineering Components	▪ Borehole A (the smaller and less efficient borehole) will be equipped with a variable speed drive (VSD) submersible pump and rated at 2.5 Ml/d at a maximum depth of 77m below ground level. ▪ Borehole B will be equipped with a VSD and rated at 3 Ml/d at a maximum depth of 75m. Both pumps A and B will work on duty/assist basis to achieve a maximum combined output of 4.46 Ml/d. ▪ Test pumping will be required to assess water quality and monitor water levels. ▪ A small volume of acid will be required to rehabilitate both boreholes. ▪ A permanent run to waste pipeline will be constructed to allow borehole water to be discharge to the Foudry Brook during future test pumping. ▪ Pressure filters will be added to the WTW treatment stream to facilitate iron removal. ▪ Additional land may be required for the addition of pressure filters at the WTW, estimated at 400m^2. ▪ It is assumed the existing SCADA and MEICA equipment will need replacement. ▪ It is anticipated that the existing pipeline linking the WTW to the distribution network will require recommissioning, including swabbing and cleaning. It is also possible that complex mains cleaning and rehabilitation may be required.
Benefit	Estimated to be 4.5 Ml/d average and peak.
Time Lead	2 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on other options.



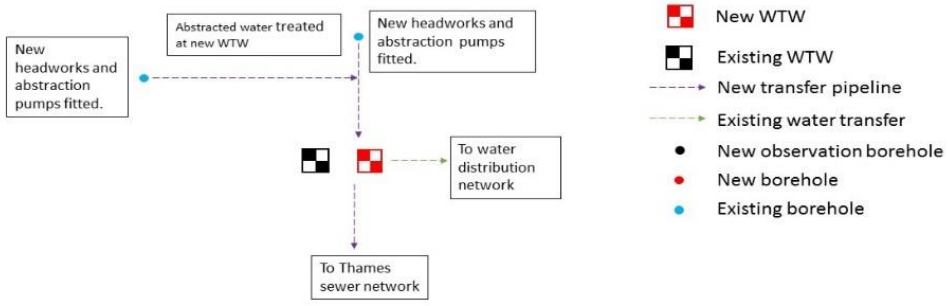
8.13 Moulsford groundwater option - RES-GW-MOU

Name	Moulsford 1 groundwater option
WRMP19 Reference	RES-GW-MOU
Element Type	Resource
WRZ	SWOX
Engineering Scope	Construction of an abstraction borehole in the unconfined Chalk north of Streatley, on the west bank of River Thames. Abstracted water will be treated at existing Cleeve WTW located on the east side of the River Thames. Test pumping to support the new abstraction licence will be carried out. Treated water will provide an additional resource for the Swindon and Oxford Water Resource Zone. An abstraction licence will be required. The potential impact of the Moulsford abstraction will be reviewed as part of any licence application, including a review of the impact of the Chiltrey Warren sustainability reduction in AMP7.
Engineering Components	▪ Construction of a 65m deep, 610mm diameter borehole in the unconfined Chalk. Steel lined casing to 20m deep. ▪ Construction of borehole headworks. ▪ Installation of pump, 2Ml/d average and 3.5 Ml/d peak set 25m below ground level. ▪ Potential construction of observation borehole (65m deep, 100mm diameter) if no suitable observation boreholes exist. ▪ Acidisation of abstraction borehole after drilling to improve yield. ▪ Test pumping of new abstraction borehole. ▪ Construction of new transfer pipeline between abstraction borehole and WTW. Estimated 1.25km length, 250mm diameter. Pipeline crosses under River Thames and main railway line. Environment Agency and Network Rail must be consulted before tunnelling. ▪ Construction of new raw water run to waste pipeline from borehole to River Thames. Estimated 0.5km length, 250mm diameter. ▪ Land purchase will be required for intended borehole site (241m^2).
Benefit	2 Ml/d average. 3.5 Ml/d peak.
Time Lead	3 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on other system elements.



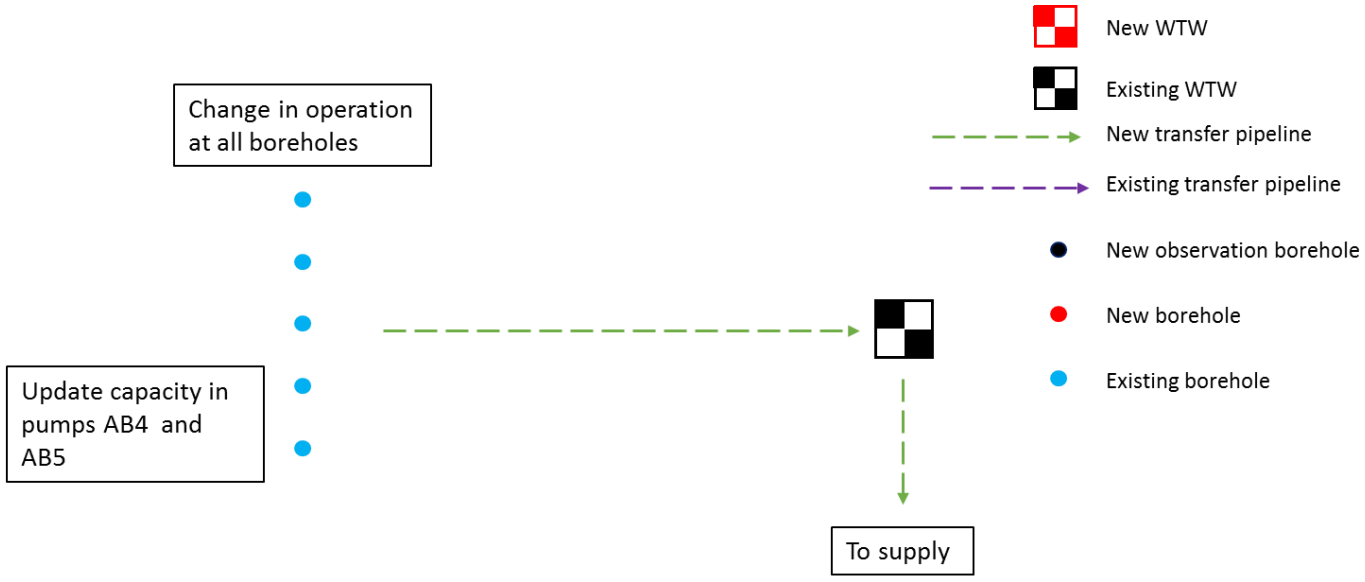
8.14 Southfleet/Greenhithe Licence Disaggregation - RES-GW-SOU

Name	Southfleet-Greenhithe Licence Disaggregation
WRMP19 Reference	RES-GW-SOU
Element Type	Resource
WRZ	LONDON
Engineering Scope	This option comprises the disaggregation of the group Bean-Southfleet-Greenhithe borehole abstraction licence to a group Southfleet-Greenhithe abstraction licence to allow operation of both sources as per their combined licence amounts. A new water treatment works (WTW) will be constructed at the existing Southfleet WTW. Abstracted water from the two boreholes (one at Southfleet and one at Greenhithe) will be treated at the new WTW. Treated water will provide an additional resource for the London Water Resource Zone. An investigation into potential water quality issues in the catchment will be carried out as part of the delivery of the option and the feasibility of mitigation measures such as catchment management will be investigated.
Engineering Components	▪ New headworks and abstraction pumps will be fitted to the existing boreholes. ▪ The pump at Greenhithe will be rated at 7.2 Ml/d and the pump at Southfleet will be rated at 4.1 Ml/d, in keeping with their respective individual licensed peaks. ▪ Construction of a new WTW in land adjacent to the existing Southfleet WTW, rated for maximum flow of 9Ml/d. The following treatments will occur at the new WTW; GAC adsorbers for trace organics, Nitrate removal via ion exchange and nitrate blending, Sodium hypochlorite disinfection, Plumbosolvency control. ▪ Raw water transfer mains will be constructed from the Greenhithe borehole (3.2km) and Southfleet borehole (0.8km). The two mains will combine into a single main north of the A2 road, and connect to the new Southfleet WTW (0.5km). ▪ A new 100mm diameter, 2.2km long wastewater pipe will connect Southfleet WTW to the local Thames Water sewer network in Bean. ▪ Demolition of a building on-site at the Southfield borehole location.
Benefit	8 Ml/d average 9 Ml/d peak
Time Lead	4 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on other system elements.



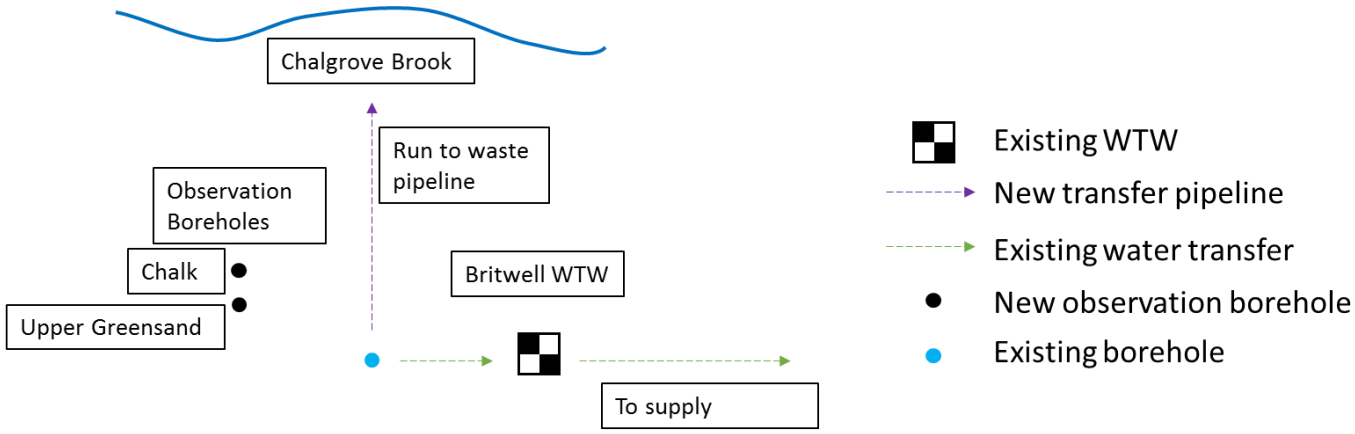
8.15 Ashton Keynes Removal of Constraints - RES-RC-ASH

Name	Ashton Keynes Removal of Constraints
WRMP19 Reference	RES-RC-ASH
Element Type	Resource
WRZ	SWOX
Engineering Scope	To replace two existing borehole pumps (ABH4 and ABH5) at Ashton Keynes with higher capacity pumps at a lower intake level to increase the peak abstraction from 10.1Ml/d to 11.0Ml/d. Change in operational abstraction philosophy to spread abstraction across the 5 boreholes to increase the peak abstraction to the licensed quantity of 11.6 Ml/d. An investigation to understand the potential impacts of the proposed option on the Water Framework Directive staus of the water body wil be carried out in AMP7.
Engineering Components	▪ New ABH4 pump; total installed power 110kW pumping at 4Ml/d. Increase in power requirement is 49kW. ▪ New ABH5 pump; total installed power 185kW pumping at 8Ml/d. Increase in power requirement is 71.5kW.
Benefit	0 Ml/d at average and 1.5 Ml/d at peak.
Time Lead	1 Year
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on any other options.



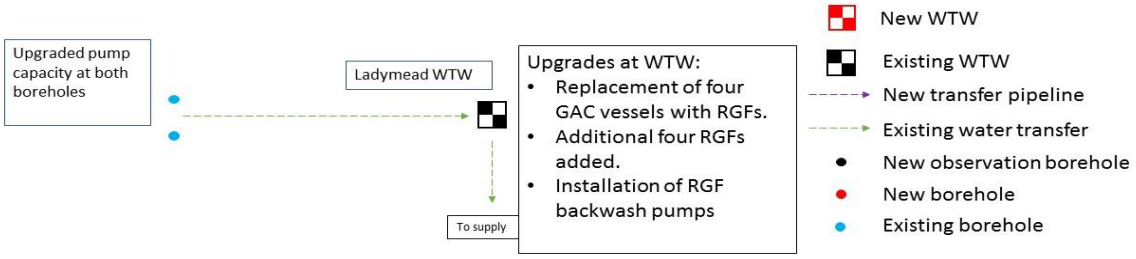
8.16 Britwell Removal of Constraints – RES-RC-BTW

Name	Britwell Removal of Constraints
WRMP19 Reference	RES-RC-BTW
Element Type	Resource
WRZ	SWOX
Engineering Scope	This option comprises the construction of a new run to waste pipeline from the existing Britwell borehole to the Chalgrove Brook. In addition, new borehole and booster pumps will be installed at the site. The borehole will be operated within the existing abstraction licence. The option includes the construction of two new observation boreholes, one in the Chalk and one in the Upper Greensand; and a low flows investigation to improve the understanding of the hydrogeology of the source. The capacity of the existing WTW will be improved by additional sodium hypochlorite and sodium bisulphate dosing capacity, along with addition of internal baffle walls to the contact tank to increase capacity.
Engineering Components	▪ New run to waste pipeline (2.3km length, 200mm diameter) from Britwell borehole site to Chalgrove Brook. ▪ Installation of new borehole pump at Britwell. Flow 1.31Ml/d and pump rating 15kW. ▪ Installation of booster pump from Britwell borehole WTW to Wallington Reservoir. Flow 1.31Ml/d and pump rating 11kW. ▪ Replacement of chlorine and sodium bisulphite dosing at Britwell WTW. Construction of two observation boreholes, one in the Upper Greensand Formation and the other in the Chalk Group.
Benefit	1.3 Ml/d at average and 1.3 Ml/d at peak.
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	n/a



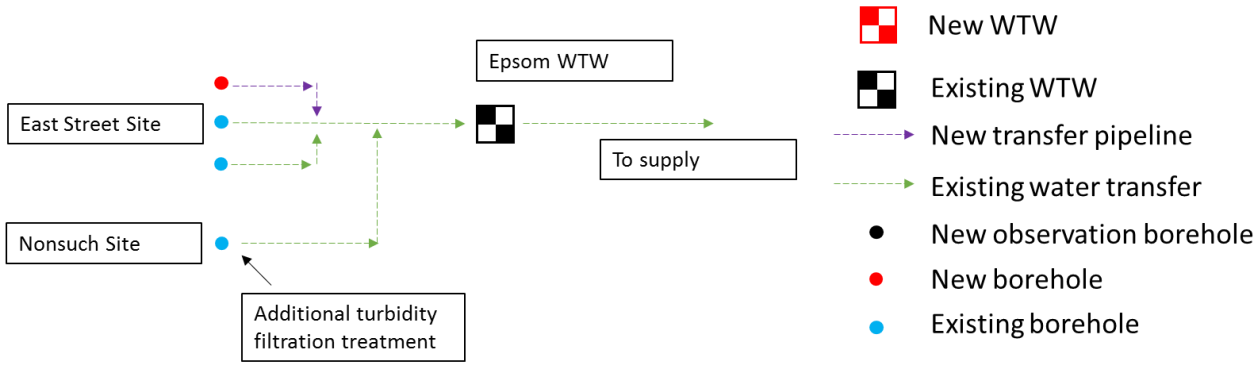
8.17 Dapdune removal of constraints - RES-RC-DAP

Name	Dapdune removal of constraints
WRMP19 Reference	RES-RC-DAP
Element Type	Resource
WRZ	Guildford
Engineering Scope	This option consists of the removal of the currents constraints on the deployable output (DO) at the Dapdune source. This groundwater source consists of two operational boreholes which abstract from a confined Chalk aquifer. Raw water is treated at Ladymead WTW. To remove the DO constraints pump capacity will be increased at the Dapdune boreholes and rapid gravity filters (RGF) will be used to treat the periodic microbial contamination at Ladymead WTW. Treated water will provide an additional resource for the Guildford Water Resource Zone.
Engineering Components	▪ Replacement of both borehole pumps at Dapdune with units capable of delivering 13.6 Ml/d. Total installed power 264kW. ▪ Replacement of four GAC vessels with RGFs by filling GAC vessels with pumice media. ▪ Additional four RGF vessels to meet TWUL standard of 10 $m^3/m^2/h$ for RGFs. ▪ Installation of RGF backwash pumps (9.6 Ml/d flow, and Total installed power of 66kW. ▪ One standby generator of 200kW required at Dapdune site.
Benefit	Average output cannot increase with this option as it is constrained by the aggregate abstraction licence to 8Ml/d. Peak deployable output benefit is likely to be 1Ml/d.
Time Lead	2 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Delivery of the Dapdune removal of constraints option is dependent on the delivery of the Ladymead removal of constraints option (RES-RC-LAD). Additionally, the delivery of the Dapdune licence disaggregation option (REC-GW-DAP) is dependent on the delivery of both the Ladymead WTW and Dapdune removal of constraints options.



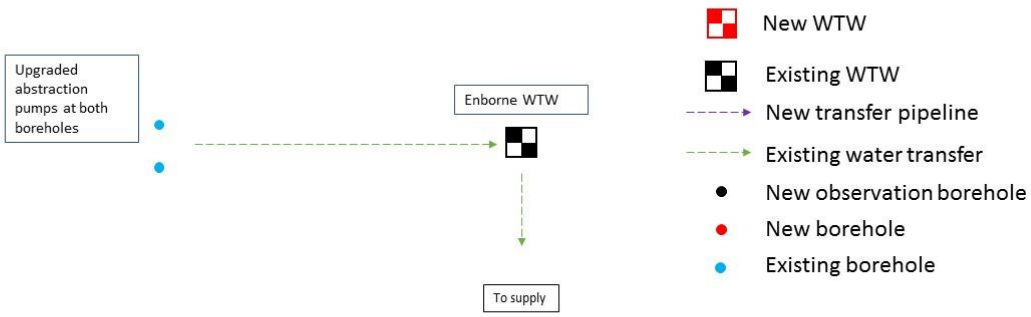
8.18 Epsom Removal of Constraints – RES-RC-EPS

Name	Epsom Removal of Constraints
WRMP19 Reference	RES-RC-EPS
Element Type	Resource
WRZ	LONDON
Engineering Scope	This option aims to remove the constraints on abstraction atthe Chalk aquifer at the existing Epsom Water Treatment Works (WTW) site. . The Epsom source has three boreholes; two at the East Street site and one at the Nonsuch site. Currently, abstraction is limited due to turbidity at both the Nonsuch borehole and the Railway borehole at the Epsom site. The option comprises treatment for turbidity in the form of filtration at the Nonsuch site and a new abstraction borehole, to replace the Railway borehole pump, at the Epsom site. There is an associated transfer pipe required to transfer water to the existing Water Treatment Works. Abstraction will be within the existing licence.
Engineering Components	This option comprises the following components: ▪ Construction of a new abstraction borehole (including associated headworks and rising main) within the existing East Street site. Borehole depth of 116m, steel cased to 36m. ▪ New abstraction pump for the new borehole to increase output within the existing licence limits. ▪ Security kiosk for the new borehole and associated MEICA. ▪ Instrumentation (turbidity and flow) and sample facilities. ▪ Run to waste facilities. ▪ Installation of a new pipeline to transfer water from the new borehole to the existing WTW. ▪ Installation of a new borehole pump and filtration at the Nonsuch borehole. ▪ An increase in the chemicals required for treatment at Epsom WTW will be necessary to treat the additional water reaching the WTW.
Benefit	Estimated most likely average output: 2Ml/d Estimated most likely peak output:0.8Ml/d
Lead Time	3 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	n/a



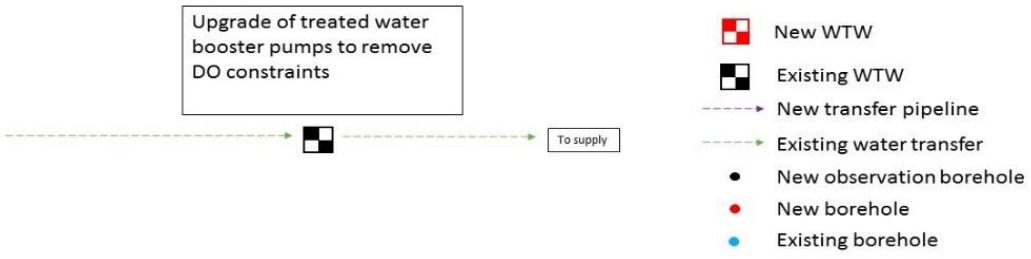
8.19 East Woodhay borehole pumps - RES-RC-EWO

Name	East Woodhay borehole pumps
WRMP19 Reference	RES-RC-EWO
Element Type	Resource
WRZ	Kennet Valley
Engineering Scope	Upgrade of the two borehole abstraction pumps to increase the peak abstraction within the existing licence limits (which is 13.5 Ml/d at peak). An investigation to understand the potential impacts of the proposed option on the Water Framework Directive staus of the water body will be carried out in AMP7.
Engineering Components	▪ Replacement of both existing borehole pumps with units capable of achieving 11.1 Ml/d with a pumping head of 50m. ▪ Potential upgrade of mains power distribution system after new pumps are installed.
Benefit	2.1 Ml/d peak 0 Ml/d average
Time Lead	2 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This option is not dependent on other system elements.



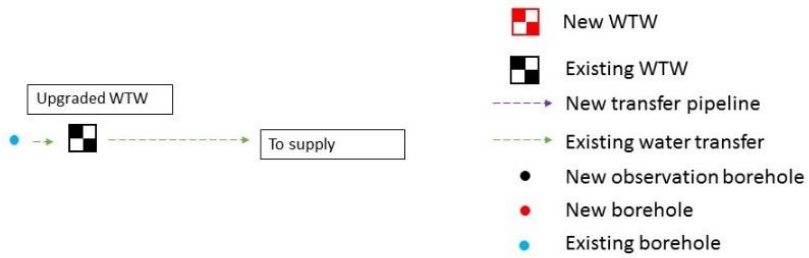
8.20 Ladymead WTW removal of constraints - RES-RC-LAD

Name	Ladymead WTW removal of constraints
WRMP19 Reference	RES-RC-LAD
Element Type	Resource
WRZ	Guildford
Engineering Scope	The deployable output (DO) of Ladymead WTW is constrained by the capacity of the treated water booster pumps and the capacity of the contact tank. An upgrade to the contact tank is planned for AMP6. Therefore, the proposed option for WRMP19 is to upgrade the capacity of the booster pumps. The Ladymead WTW treats raw water from both Dapdune and Ladymead groundwater sources. A total aggregate licence is applied to Dapdune, Ladymead and Milmead sources; with a total aggregate annual average licence of 20.46Ml/d and a peak of 29.55 Ml/d. A separate option (RES-GW-DAP) comprises the disaggregation of the group licence at peak licensed quantities only.
Engineering Components	▪ Installation of treated water booster pumps at Ladymead (27.2 Ml/d flow, Total power installed 900kW).
Benefit	Removal of this constraint will provide a benefit of 4.6 Ml/d at peak demand, which is constrained by the combined output from the Ladymead and Dapdune boreholes. The average DO is limited by the aggregate licence and as there are no plans to increase this, there will be no benefit to average DO.
Time Lead	2 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Delivery of the Dapdune removal of constraints option is dependent on the delivery of the Ladymead removal of constraints option (RES-RC-LAD). Additionally, the delivery of the Dapdune licence disaggregation option (REC-GW-DAP) is dependent on the delivery of both the Ladymead WTW and Dapdune removal of constraints options.



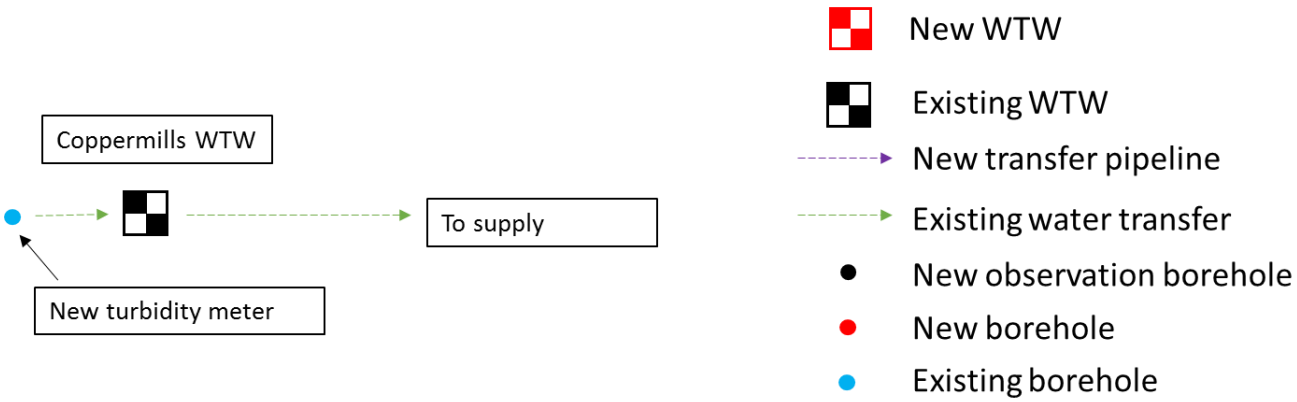
8.21 Merton Recommissioning - RES-RC-MTN

Name	Merton Recommissioning
WRMP19 Reference	RES-RC-MTN
Element Type	Resource
WRZ	LONDON
Engineering Scope	This option consists of the recommissioning of the currently disused Merton Abbey groundwater source and water treatment works (WTW). The WTW upgrade is designed to address water quality issues identified during testing in 2012.
Engineering Components	▪ This option assumes the well, abstraction pump, headworks and pipework are in serviceable condition at Merton Abbey and no rehabilitation or replacement of equipment is required. Further test pumping and water quality testing will need to be carried out before recommissioning. ▪ The following upgrades will be performed at the WTW: Removal of existing GAC adsorbers; installation of the coagulant dosing plant and flocculation retention tanks in the location of the removed GAC plant; replacement of the four existing pressure sand filter vessels with six new dual media filter vessels; replacement of the chlorine contact tanks with larger units capable of disinfecting up to 8 Ml/d; replacement of the dosing plant for sodium hypochlorite; replacement of the dosing plant for sodium bisulphate and orthophosphoric acid; replacement of the chemical storage facilities; upgrade of the electrical, motoring and control systems; upgrade of treated water pump station to pump into the local distribution mains.
Benefit	7.86 Ml/d peak 2 Ml/d average
Time Lead	2 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	The SLARS Merton option (RES-AR-SLARS3) is dependent on the delivery of this option as the former includes the adaptation of the well and WTW for a recharge and abstraction scheme. If the Merton Recommissioning option is deemed unfeasible, then the SLARS Merton option cannot go ahead.



8.22 New River Head Removal of Constraints – RES-RC-NRV

Name	New River Head Removal of Constraints
WRMP19 Reference	RES-RC-NRV
Element Type	Resource
WRZ	LONDON
Engineering Scope	The New River Head Source is currently non-operational. Implementation of proposed ground stabilisation works within the borehole will allow abstraction at the source up to the existing abstraction licence limit.
Engineering Components	This option comprises: ▪ Ground stabilisation around the New River Head borehole (comprising grouting of the potential voids created by sand migration). ▪ Installation of four near surface ground anchors (1m deep) at convenient locations around the borehole. ▪ Installation of a turbidity meter. ▪ Recommisisoning of the licensed but currently disused groundwater source. ▪ Installation of the 75kW borehole pump in the New River Head borehole.
Benefit	The most likely average and peak source output for this option are estimated as 3 Ml/d and 3.46 Ml/d, respectively. WARMS2 modelling carried out by TWUL in November 2016 has confirmed that the DO benefit to the London WRZ is 3.0 Ml/d.
Lead Time	1 Year
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	n/a



9 Reservoirs

9.1 New Abingdon Reservoir (100Mm3) - RES-RRR-ABI-100Mm3

Name	New Abingdon Reservoir 100 Mm3
WRMP19 Reference	RES-RRR-ABI-100Mm3
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Provision of a new fully bunded reservoir at Abingdon with live capacity of 100Mm^3. Associated conveyance tunnel and intake / discharge structure at Culham on the River Thames to (i) fill reservoir by abstracting raw water from the River Thames, and (ii) support flows in River Thames by discharging water stored within the reservoir.
Engineering Components	▪ Fully bunded pumped storage reservoir 100Mm^3 located 5 km to the south-west of Abingdon formed of balanced cut and fill excavation ▪ Inlet/outlet towers: 1 No primary, 2 No secondary. ▪ River intake and outfall ▪ Intake pumping station 1,000 Ml/d (34.1 m max. pumping head), total installed power 5.5 MW ▪ Tunnel from river to pumping station 3,340m long, 4.2m diameter. ▪ Tunnel from pumping station to main tower 440m long, 4.8m diameter including 2.5m diameter raw water pipework inside tunnel. For London/SWOX solution, this will also include a 700mm raw water pipeline to SWOX WTW. ▪ Shaft at intake 16m deep, 12.5m diameter ▪ Land requirements: 1,531 ha for reservoir and 43 ha for river intake/outfall and access road.
Benefit	Overall deployable output benefit for supply to multiple zones is 210Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 190 Ml/d.
Time Lead	15 Years
Mutual exclusivities	This option is mutually exclusive with all other Reservoir options, namely: RES-RRR-ABI-150Mm3, RES-RRR-ABI-125Mm3, RES-RRR-ABI-30+100Mm3, RES-RRR-ABI-75Mm3, RES-RRR-ABI-80+42Mm3
Interdependencies/ Exclusivity	This is the only element required for the new Abingdon Reservoir option for the London-only solution. For a SWOX solution, an additional element required is: ▪ New WTW (WTW-SWOX-ABI). For a SWA solution, the additional elements required are: ▪ New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM); or ▪ Abingdon WTW (24Ml/d) (WTW-SWOX-ABI-SWA) and SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48) To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems; ▪ Additional treatment capacity at Kempton WTW; ▪ Additional capacity in the Thames Water ring main.


Flood Compensation Storage
Proposed Reservoir
Settlement Ponds
Water Treatment Works (WTW)
Pumping Station
underground pipeline to Reservoir
Abingdon
Sutton Wick
River Thames
Drayton
Landscaping & Woodlands
Screening Mounds
East Hanney
Screening Mounds
Proposed new road
Steventon
A34
Didcot Parkway
A4130

9.2 New Abingdon Reservoir (125Mm3) - RES-RRR-ABI-125Mm3

Name	New Abingdon Reservoir 125 Mm3
WRMP19 Reference	RES-RRR-ABI-125Mm3
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Provision of a new fully bunded reservoir at Abingdon with live capacity of 125Mm^3. Associated conveyance tunnel and intake / discharge structure at Culham on the River Thames to (i) fill reservoir by abstracting raw water from the River Thames, and (ii) support flows in River Thames by discharging water stored within the reservoir.
Engineering Components	▪ Fully bunded pumped storage reservoir 125Mm^3 located 5 km to the south-west of Abingdon formed of balanced cut and fill excavation ▪ Inlet/outlet towers: 1 No primary, 2 No secondary. ▪ River intake and outfall ▪ Intake pumping station 1,000 Ml/d (34.1 m max. pumping head), total installed power 5.5 MW ▪ Tunnel from river to pumping station 3,340m long, 4.2m diameter. ▪ Tunnel from pumping station to main tower 440m long, 4.8m diameter including 2.5m diameter raw water pipework inside tunnel. For London/SWOX solution, this will also include a 700mm raw water pipeline to SWOX WTW. ▪ Shaft at intake 16m deep, 12.5m diameter ▪ Land requirements: 1,606 ha for reservoir and 43 ha for river intake/outfall and access road.
Benefit	Overall deployable output benefit for supply to multiple zones is 253 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 234 Ml/d.
Time Lead	15 Years
Mutual exclusivities	This option is mutually exclusive with all other Reservoir options, namely: RES-RRR-ABI-150Mm3, RES-RRR-ABI-100Mm3, RES-RRR-ABI-75Mm3, RES-RRR-ABI-80+42Mm3
Interdependencies/ Exclusivity	This is the only element required for the new Abingdon Reservoir option for the London-only solution. For a SWOX solution, an additional element required is: ▪ New WTW (WTW-SWOX-ABI). For a SWA solution, the additional elements required are: ▪ New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM); or ▪ Abingdon WTW (24Ml/d) (WTW-SWOX-ABI-SWA) and SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48) To provide an additional resource to London or SWOX WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems; ▪ Additional treatment capacity at Kempton WTW; ▪ Additional capacity in the Thames Water ring main.


Flood Compensation Storage
Proposed Reservoir
Settlement Ponds
Water Treatment Works (WTW)
Pumping Station
underground pipeline to Reservoir
Abingdon
Sutton Wick
River Thames
Drayton
Landscaping & Woodlands
Screening Mounds
East Hanney
Screening Mounds
Proposed new road
Steventon
A34
Didcot Parkway
A4130

9.3 New Abingdon Reservoir (150Mm3) - RES-RRR-ABI-150Mm3

Name	New Abingdon Reservoir 150 Mm3
WRMP19 Reference	RES-RRR-ABI-150Mm3
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Provision of a new fully bunded reservoir at Abingdon with live capacity of 150Mm^3. Associated conveyance tunnel and intake / discharge structure at Culham on the River Thames to (i) fill reservoir by abstracting raw water from the River Thames, and (ii) support flows in River Thames by discharging water stored within the reservoir.
Engineering Components	▪ Fully bunded pumped storage reservoir 150Mm^3 located 5 km to the south-west of Abingdon formed of balanced cut and fill excavation ▪ Inlet/outlet towers: 1 No primary, 2 No secondary. ▪ River intake and outfall ▪ Intake pumping station 1,000 Ml/d (34.1 m max. pumping head), total installed power 5.5 MW ▪ Tunnel from river to pumping station 3,340m long, 4.2m diameter. ▪ Tunnel from pumping station to main tower 440m long, 4.8m diameter including 2.5m diameter raw water pipework inside tunnel. For London/SWOX solution, this will also include a 700mm raw water pipeline to SWOX WTW. ▪ Shaft at intake 16m deep, 12.5m diameter ▪ Land requirements: 1,643 ha for reservoir and 43 ha for river intake/outfall and access road.
Benefit	Overall deployable output benefit for supply to multiple zones is 294 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 275 Ml/d.
Time Lead	15 Years
Mutual exclusivities	This option is mutually exclusive with all other Reservoir options, namely: RES-RRR-ABI-125Mm3, RES-RRR-ABI-100Mm3, RES-RRR-ABI-30+100Mm3, RES-RRR-ABI-75Mm3, RES-RRR-ABI-80+42Mm3
Interdependencies/ Exclusivity	This is the only element required for the new Abingdon Reservoir option for the London-only solution. For a SWOX solution, an additional element required is: ▪ New WTW (WTW-SWOX-ABI) For a SWA solution, the additional elements required are: ▪ New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM); or ▪ Abingdon WTW (24Ml/d) (WTW-SWOX-ABI-SWA) and SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48) To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems; ▪ Additional treatment capacity at Kempton WTW; ▪ Additional capacity in the Thames Water ring main;


Flood Compensation Storage
Proposed Reservoir
Settlement Ponds
Water Treatment Works (WTW)
Pumping Station
underground pipeline to Reservoir
Abingdon
Sutton Wick
River Thames
Drayton
Landscaping & Woodlands
Screening Mounds
East Hanney
Screening Mounds
Proposed new road
Steventon
A34
Didcot Parkway
A4130

9.4 New Abingdon Reservoir 30+100Mm3 - RES-RRR-ABI-30+100Mm3-P1 and RES-RRR-ABI-30+100Mm3-P2

Name	New Abingdon Reservoir 30+100 Mm3
WRMP19 Reference	RES-RRR-ABI-30+100Mm3-P1 and RES-RRR-ABI-30+100Mm3-P2
Element Type	Reservoir
WRZ	LONDON / SWOX / SWA
Engineering Scope	Provision of a new fully bunded dual phase reservoir at Abingdon with live capacity of 30Mm^3 in the first phase and 100Mm^3 in the second phase. Associated conveyance tunnel and intake / discharge structure at Culham on the River Thames to (i) fill reservoir by abstracting raw water from the River Thames, and (ii) support flows in River Thames by discharging water stored within the reservoir.
Engineering Components	▪ Fully bunded dual phase pumped storage reservoir 30Mm^3 in the first phase and 100Mm^3 in the second phase located 5 km to the south-west of Abingdon, formed of balanced cut and fill excavation ▪ Inlet/outlet towers: 3 No primary, 2 No secondary. ▪ River intake and outfall ▪ Intake pumping station 1,000 Ml/d (34.1 m max. pumping head), total installed power 5.5 MW ▪ Tunnel from river to pumping station 3,340m long, 4.2m diameter. ▪ Tunnel from pumping station to main tower 440m long, 4.8m diameter including 2.5m diameter raw water pipework inside tunnel. For London/SWOX solution, this will also include a 700mm raw water pipeline to SWOX WTW. ▪ Shaft at intake 16m deep, 12.5m diameter ▪ Land requirements: 1,643 ha for reservoir and 43 ha for river intake/outfall and access road.
Benefit	Phase 1 : Overall deployable output benefit for supply to multiple zones is 69 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 49 Ml/d Phase 2 : Overall deployable output benefit for supply to multiple zones is 199 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 199 Ml/d.
Time Lead	15 Years Phase 1 15 Years Phase 2
Mutual exclusivities	This option is mutually exclusive with all other Reservoir options, namely: RES-RRR-ABI-150Mm3, RES-RRR-ABI-125Mm3, RES-RRR-ABI-100Mm3, RES-RRR-ABI-75Mm3, RES-RRR-ABI-80+42Mm3
Interdependencies/ Exclusivity	This is the only element required for the new Abingdon Reservoir option for the London-only solution. For the SWOX solution, an additional element required is: ▪ New WTW (WTW-SWOX-ABI). For a SWA solution, the additional elements required are: ▪ New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM); or ▪ Abingdon WTW (24Ml/d) (WTW-SWOX-ABI-SWA) and SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48) To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems; ▪ Additional treatment capacity at Kempton WTW; ▪ Additional capacity in the Thames Water ring main;


Flood Compensation Storage
Proposed Reservoir
Settlement Ponds
Water Treatment Works (WTW)
Pumping Station
underground pipeline to Reservoir
Abingdon
Sutton Wick
River Thames
Drayton
Landscaping & Woodlands
Screening Mounds
East Hanney
Screening Mounds
Proposed new road
Steventon
A34
Didcot Parkway
A4130

9.5 New Abingdon Reservoir 75Mm3 - RES-RRR-ABI-75Mm3

Name	New Abingdon Reservoir 75 Mm3
WRMP19 Reference	RES-RRR-ABI-75Mm3
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Provision of a new fully bunded reservoir at Abingdon with live capacity of 75Mm^3. Associated conveyance tunnel and intake / discharge structure at Culham on the River Thames to (i) fill reservoir by abstracting raw water from the River Thames, and (ii) support flows in River Thames by discharging water stored within the reservoir.
Engineering Components	▪ Fully bunded pumped storage reservoir 75Mm^3 located 5 km to the south-west of Abingdon formed of balanced cut and fill excavation ▪ Inlet/outlet towers: 1 No primary, 2 No secondary. ▪ River intake and outfall ▪ Intake pumping station 1,000 Ml/d (34.1 m max. pumping head), total installed power 5.5 MW ▪ Tunnel from river to pumping station 3,340m long, 4.2m diameter. ▪ Tunnel from pumping station to main tower 440m long, 4.8m diameter including 2.5m diameter raw water pipework inside tunnel. For London/SWOX solution, this will also include a 700mm raw water pipeline to SWOX WTW. ▪ Shaft at intake 16m deep, 12.5m diameter ▪ Land requirements: 1,414 ha for reservoir and 43 ha for river intake/outfall and access road.
Benefit	Overall deployable output benefit for supply to multiple zones is 161 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 142 Ml/d
Time Lead	15 Years
Mutual exclusivities	This option is mutually exclusive with all other Reservoir options, namely: RES-RRR-ABI-150Mm3, RES-RRR-ABI-125Mm3, RES-RRR-ABI-100Mm3, RES-RRR-ABI-30+100Mm3, RES-RRR-ABI-80+42Mm3
Interdependencies/ Exclusivity	This is the only element required for the new Abingdon Reservoir option for the London-only solution. For a SWOX solution, an additional element required is: ▪ New WTW (WTW-SWOX-ABI). For a SWA solution, the additional elements required are: ▪ New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM); or ▪ Abingdon WTW (24Ml/d) (WTW-SWOX-ABI-SWA) and SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48) To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems; ▪ Additional treatment capacity at Kempton WTW; ▪ Additional capacity in the Thames Water ring main.


Flood Compensation Storage
Proposed Reservoir
Settlement Ponds
Water Treatment Works (WTW)
Pumping Station
underground pipeline to Reservoir
Abingdon
Sutton Wick
River Thames
Drayton
Landscaping & Woodlands
Screening Mounds
East Hanney
Screening Mounds
Proposed new road
Steventon
A34
Didcot Parkway
A4130

9.6 New Abingdon Reservoir 80+42 Mm3 - RES-RRR-ABI-80+42Mm3-P1 and RES-RRR-ABI-80+42Mm3-P2

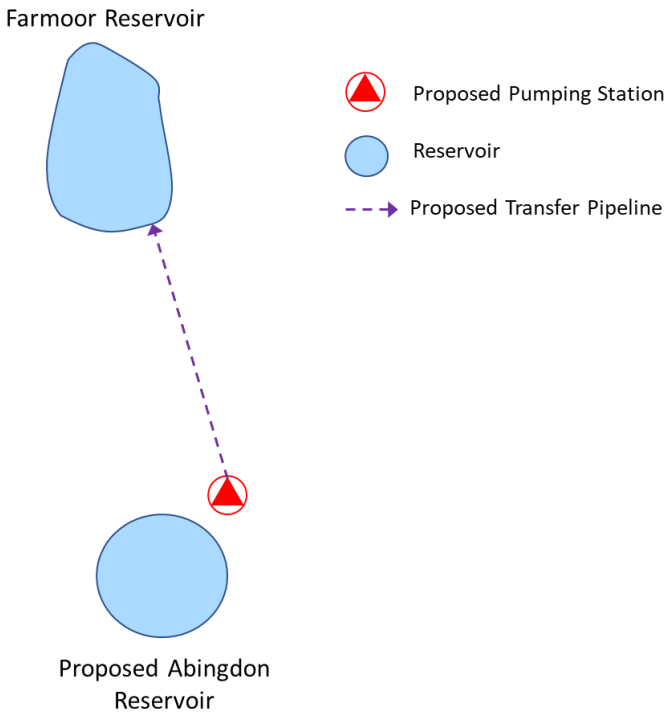
Name	New Abingdon Reservoir 80+42 Mm3
WRMP19 Reference	RES-RRR-ABI-80+42Mm3-P1 and RES-RRR-ABI-80+42Mm3-P2
Element Type	Resource
WRZ	LONDON / SWOX / SWA
Engineering Scope	Provision of a new fully bunded dual phase reservoir at Abingdon with live capacity of 80Mm^3 in the first phase and 42Mm^3 in the second phase. Associated conveyance tunnel and intake / discharge structure at Culham on the River Thames to (i) fill reservoir by abstracting raw water from the River Thames, and (ii) support flows in River Thames by discharging water stored within the reservoir.
Engineering Components	▪ Fully bunded dual phase pumped storage reservoir 80Mm^3 in the first phase and 42Mm^3 in the second phase located 5 km to the south-west of Abingdon formed of balanced cut and fill excavation ▪ Inlet/outlet towers: 3 No primary, 1 No secondary. ▪ River intake and outfall ▪ Intake pumping station 1,000 Ml/d (34.1 m max. pumping head), total installed power 5.5 MW ▪ Tunnel from river to pumping station 3,340m long, 4.2m diameter. ▪ Tunnel from pumping station to main tower 440m long, 4.8m diameter including 2.5m diameter raw water pipework inside tunnel. For London/SWOX solution, this will also include a 700mm raw water pipeline to SWOX WTW. ▪ Shaft at intake 16m deep, 12.5m diameter ▪ Land requirements: 1,643 ha for reservoir and 43 ha for river intake/outfall and access road.
Benefit	Phase 1 : Overall deployable output benefit for supply to multiple zones is 161 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 151 Ml/d Phase 2 : Overall deployable output benefit for supply to multiple zones is 83 Ml/d DO [DYAA and ADPW], maximum benefit for London WRZ is 83 Ml/d
Time Lead	15 Years Phase 1 15 Years Phase 2
Mutual exclusivities	This option is mutually exclusive with all other Reservoir options, namely: RES-RRR-ABI-150Mm3, RES-RRR-ABI-125Mm3, RES-RRR-ABI-100Mm3, RES-RRR-ABI-30+100Mm3, RES-RRR-ABI-75Mm3
Interdependencies/ Exclusivity	This is the only element required for the new Abingdon Reservoir option for the London-only solution. For a SWOX solution, an additional element required is: ▪ New WTW (WTW-SWOX-ABI). For a SWA solution, the additional elements required are: ▪ New Medmenham Intake (CON-RWS-MMM-80 or CON-RWS-MMM-53) and Medmenham WTW (WTW-SWA-MMM); or ▪ Abingdon WTW (24Ml/d) (WTW-SWOX-ABI-SWA) and SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48) To provide an additional resource to London or SWOX WRZ the following system elements are also required: ▪ Additional capacity in the raw water; ▪ Additional treatment capacity at Kempton WTW; ▪ Additional capacity in the Thames Water ring main;


Flood Compensation Storage
Proposed Reservoir
Settlement Ponds
Water Treatment Works (WTW)
Pumping Station
underground pipeline to Reservoir
Abingdon
Sutton Wick
River Thames
Drayton
Landscaping & Woodlands
Screening Mounds
East Hanney
A34
Screening Mounds
Proposed new road
Steventon
Didcot Parkway
A4130

10 Raw Water Conveyance

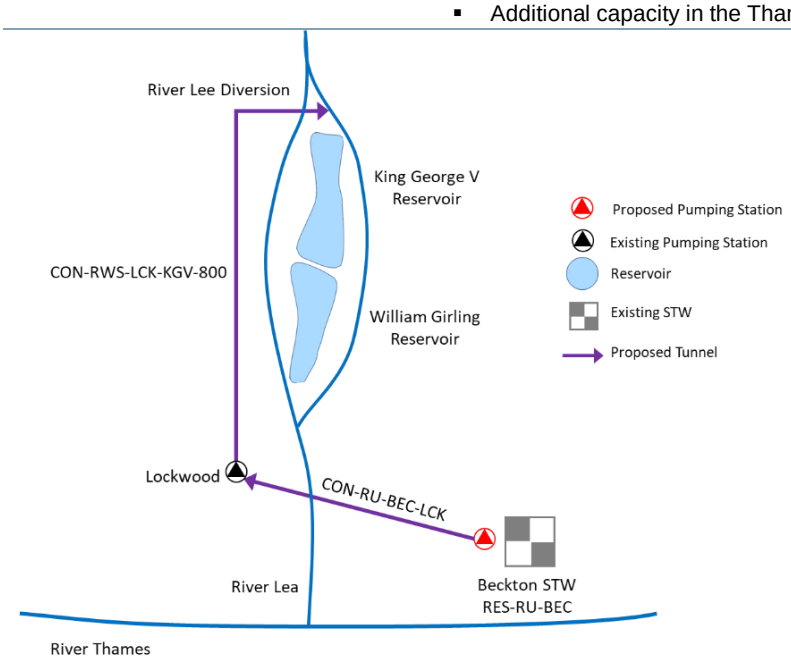
10.1 Abingdon to Farmoor – CON-RWS-ABI-FMR

Name	Abingdon to Farmoor – 24 Ml/d
WRMP19 Reference	CON-RWS-ABI-FMR
Element Type	Conveyance
WRZ	SWOX
Engineering Scope	Construction of a transfer pipeline to convey 24 Ml/d of raw water between a proposed reservoir at Abingdon and the existing Farmoor reservoir, in the SWOX WRZ. The engineering scope includes the provision of a booster pump station at the proposed Abingdon Reservoir site to facilitate the transfer.
Engineering Components	▪ 500mm raw water pipeline from proposed reservoir at Abingdon to Farmoor Reservoir, 13.1km long ▪ Raw water pumping station 600 kW (2 Nr 200 kW duty pumps, 1 Nr 200 kW standby pump) ▪ Raw water screens at Abingdon Reservoir intake ▪ 70 m^3 break pressure tank at or near high point of transfer route.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This element would transfer raw water from the new Abingdon Reservoir resource elements to the existing Farmoor reservoir. Treatment would be provided at the existing WTW.



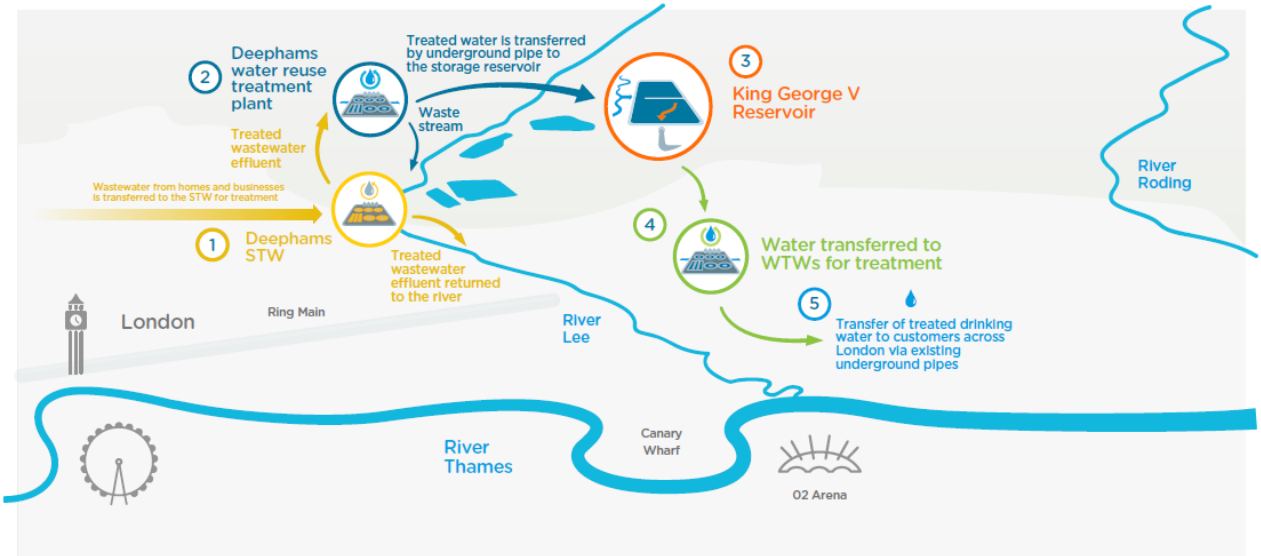
10.2 Beckton to Lockwood Conveyance (300Ml/d) – CON-RU-BEC-LCK

Name	Beckton to Lockwood Conveyance - 300 Ml/d
WRMP19 Reference	CON-RU-BEC-LCK
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	A portion of the Beckton STW final effluent is to be subjected to an advanced treatment process and pumped to a proposed discharge location on the River Lee Diversion, above the inlet for King George V Reservoir, to supplement raw water supply to the Lee Valley reservoirs. Conveyance will be via two raw water tunnels one from Beckton to Lockwood and the other an extension of the Thames Lee Tunnel from Lockwood to the River Lee Diversion. The reuse treatment site will be either, within the Beckton STW boundary to the north of the operational area or at a Thames Water site at Gascoigne Way on the north bank of Barking Creek.
Engineering Components	▪ Treated water to Lockwood is conveyed via a 3.5m diameter tunnel from north of Beckton STW to Lockwood pumping station. The total tunnel chainage is approximately 14.5 km. ▪ 1 No drive shaft at Beckton Reuse plant 12.5m diameter, 29m depth ▪ 5 No 10.5m diameter intermediate shafts of 24.3, 35.6, 36.2, 26.4, 27.7m depth respectively. ▪ 1 No 10.5m diameter reception shaft at Tottenham Marshes of 29.1m depth ▪ Permanent land requirements: 200 m^2 per shaft ▪ Temporary land requirements: 2,500 m2 per shaft
Benefit	n/a
Lead Time	8 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	The Beckton Reuse option comprises treatment and conveyance elements. The conveyance elements are a tunnel to Lockwood (CON-RU-BEC-LCK) and connection to the raw water system extension to the River Lee Diversion (CON-RWS-LCK-KGV-800). Treatment can be phased via two capacities 100 and 150 Ml/d (RES-RU-BEC-100) or (RES-RU-BEC-150). To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Lee Diversion into the Lee Valley Reservoirs and from there conveyed to a Water Treatment Works in East London ▪ Additional treatment in East London ▪ Additional capacity in the Thames Water ring main



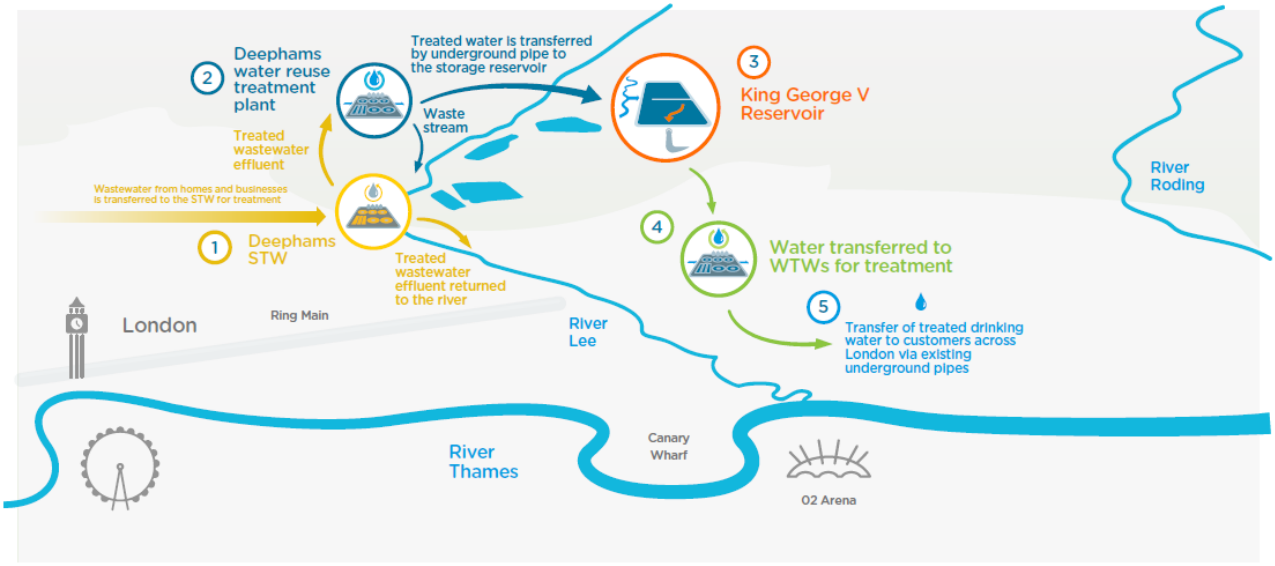
10.3 Deephams to KGV Conveyance – CON_RU-DPH-KGV

Name	Deephams to KGV Conveyance
WRMP19 Reference	CON-RU-DPH-KGV
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	A portion of the Deephams STW final effluent is to be subjected to an advanced treatment process and pumped to a proposed discharge location on the River Lee Diversion, above the inlet for King George V Reservoir, to supplement raw water supply to the Lee Valley reservoirs. Conveyance of the treated water will be via a pipeline to the River Lee Diversion. The reuse treatment site will be within the Deephams STW boundary.
Engineering Components	▪ Treated water pumping station 180 kW adjacent to Deephams Reuse plant ▪ A 5.3km 800mm diameter water pipeline from Deephams Reuse plant to the discharge location at KGV intake including a 140m 1000mm diameter section. ▪ Land requirement of 2,500 m^2 for the pumping station at Deephams Reuse plant and the outfall arrangement at KGV. ▪ Outfall structure building at KGV discharge location (500 m^2 area)
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	This conveyance is mutually exclusive with conveyance element CON-RU-DPH-TLTEX, which conveys treated water from the Deephams Reuse plant to a discharge location at a shaft on the TLT Extension. CON-RU-DPH-TLTEX, which conveys treated water from the Deephams Reuse plant to a discharge location at a shaft on the TLT Extension. Use of the conveyance to the TLT extension requires the TLT extension to the River Lee Diversion (CON-RWS-LCK-KGV-800) to have already been built, as part of the raw water systems. CON-RWS-LCK-KGV-800) to have already been built, as part of the raw water systems.
Interdependencies/ Exclusivity	This element is interdependent with the RES-RU-DPH element (New 46.5 Ml/d water reuse plant at Deephams) To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Lee Diversion into Lee Valley Reservoirs and from there conveyed to a Water Treatment Works in east London ▪ Additional treatment in east London ▪ Additional capacity in the Thames Water ring main



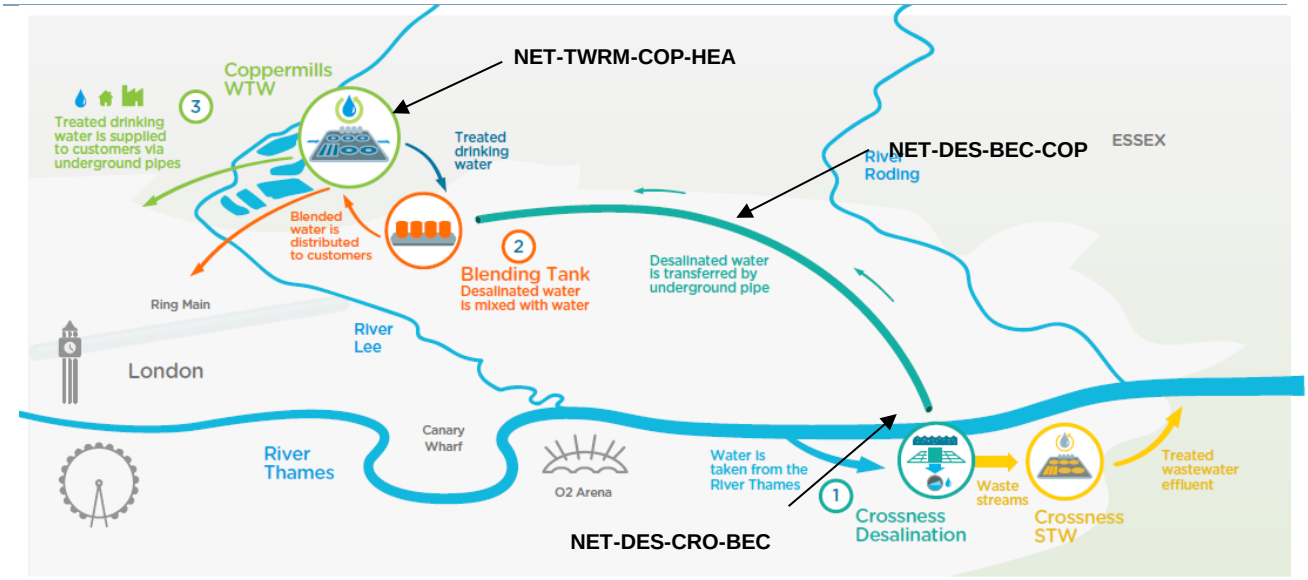
10.4 Deephams to TLT extension Conveyance – CON-RU-DPH-TLTEX

Name	Deephams to TLT extension Conveyance
WRMP19 Reference	CON-RU-DPH-TLTEX
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	A portion of the Deephams STW final effluent is to be subjected to an advanced treatment process and pumped to a proposed discharge location on the River Lee Diversion, above the inlet for King George V Reservoir, to supplement raw water supply to the Lee Valley reservoirs. Conveyance of treated effluent from the Deephams Reuse plant into a shaft on the Thames Lee Tunnel (TLT) Extension. The TLT extension is from a PS location at Lockwood Reservoir to the River Lee Diversion upstream of the King George V Reservoir intake.
Engineering Components	▪ Treated water pumping station 150 kW adjacent to Deephams Reuse plant. ▪ 600m of 800mm diameter water pipeline from Deephams Reuse plant to the TLT Extension shaft.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	This conveyance element is mutually exclusive with the dedicated treated raw water pipeline from the Deephams Reuse plant to a discharge location on the River Lee Diversion upstream of the KGV intake (CON-RU-DPH-KGV).
Interdependencies/ Exclusivity	This element is interdependent with the RES-RU-DPH element (46.5 Ml/d water reuse plant at Deephams) To provide an additional resource to London WRZ the following system elements are also required: ▪ The TLT extension to the River Lee Diversion (CON-RWS-LCK-KGV-800) ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Lee Diversion into the Lee Valley Reservoirs and from there conveyed to a Water Treatment Works in east London. ▪ Additional treatment in east London. ▪ Additional capacity in the Thames Water ring main.



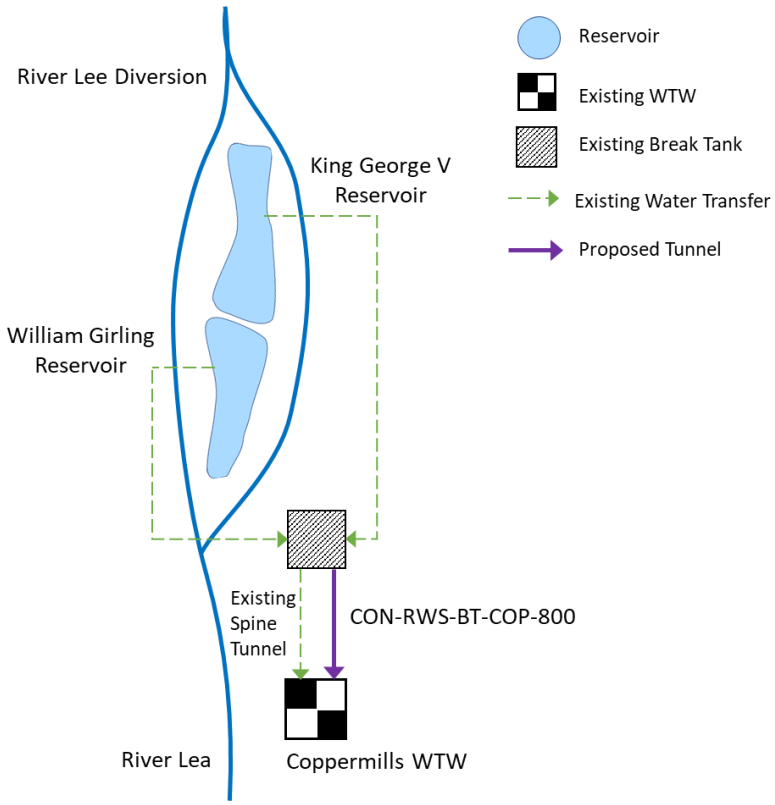
10.5 Desalination – Beckton to Crossness tunnel – CON-RWS-BEC-CRO-300

Name	Desalination – Beckton to Crossness tunnel
WRMP19 Reference	CON-RWS-BEC-CRO-300
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Raw estuarine Thames River water is to be abstracted at Beckton for Crossness desalination treatment plant. The estuarine water is to be conveyed under the River Thames via a tunnel to the Crossness desalination treatment site.
Engineering Components	▪ The tunnel under the River Thames to the Crossness desalination plant is to be 3.5m diameter and a length of 4.2km. ▪ 1 No drive shaft 12.5m diameter of 35m depth ▪ 1 No 10.5m diameter intermediate shaft of 40m depth ▪ 1 No 10.5m diameter reception shaft of 38m depth ▪ High Integrity Gate valves ▪ Permanent land area per shaft is 200m^2 ▪ Temporary land for shafts of 12,500m^2
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	The Crossness Desalination option comprises conveyance, treatment and treated water network reinforcement. Treatment is phased in 100Ml/d increments (RES-DES-CRO-100). The conveyance elements (required for first phase of desalination) include: ▪ raw water abstraction tunnel to Crossness (CON-RWS-BEC-CRO-300)CON-RWS-BEC-CRO-300) ▪ treated water conveyance from Crossness to Beckton (NET-DES-CRO-BEC) ▪ treated water network reinforcement from Beckton to Coppermills (NET-DES-BEC-COP). To provide an additional resource to London WRZ the following system elements are also required: ▪ Additional blending capacity at Coppermills WTW and capacity to discharge into /the local water supply network or into the TWRM, (NET-TWRM-COP-HEA). ▪ Pumping station from Coppermills contact tank to the blending / header tank (NET-TWRM-COP-PS) ▪ Additional capacity in the Thames Water ring main.



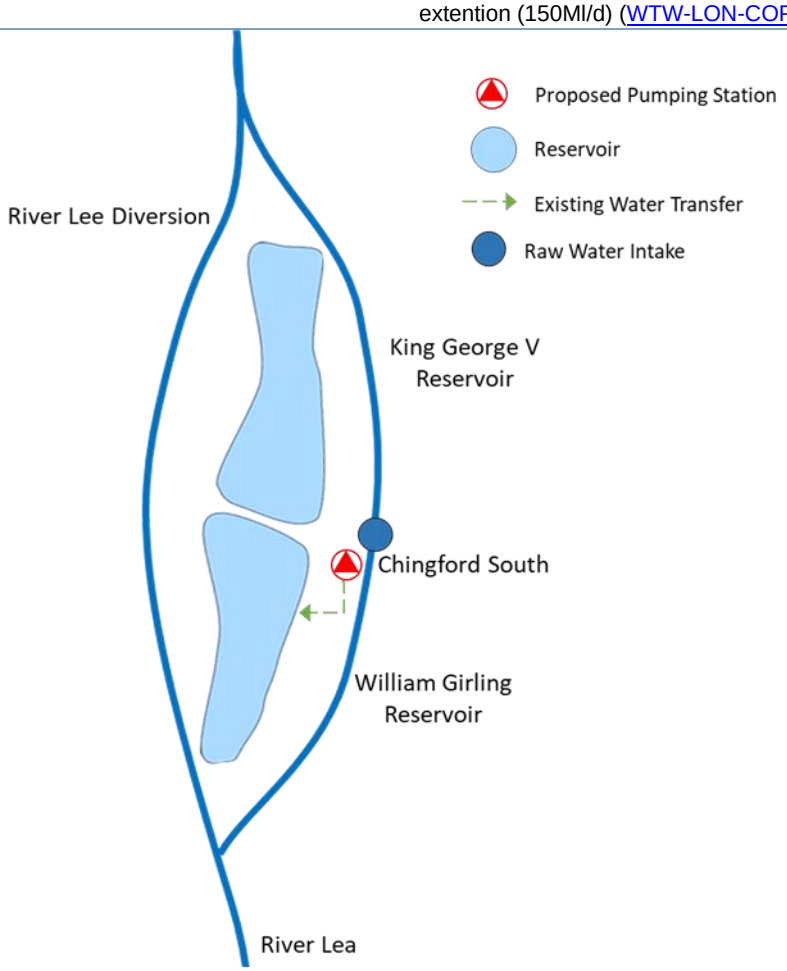
10.6 Raw Water System – Conveyance from Break Tank to Coppermills – CON-RWS-BT-COP-800

Name	Raw Water System – Conveyance from Break Tank to Coppermills
WRMP19 Reference	CON-RWS-BT-COP-800
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Transfer of raw water from the break tank in the east London raw water system to Coppermills WTW.
Engineering Components	▪ Tunnel from Break Tank to Coppermills WTW via Reservoir 5 at a diameter of 3.5m for a distance of 4.7km. ▪ 1 No drive shaft 12.5m diameter of 25m depth ▪ 1 No 10.5m diameter intermediate shafts of 25m depth ▪ 1 No 10.5m diameter reception shaft of 25m depth ▪ High Integrity Gate Valves (2 per intermediate shaft) ▪ Permanent Land 600m^2 ▪ Temporary land - 3 parcel of temporary land around the shafts during construction - 1 of 5000m^2 and 2 of 2500m^2; total of 10,000m^2
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in East London: Beckton reuse (100Ml/d) (RES-RU-BEC-100), Beckton Reuse (150Ml/d) (RES-RU-BEC-150), Deephams reuse (46.5Ml/d) (RES-RU-DPH), Chingford Raw Water Purchase (RES-RWP-CHD) and transfer additional water to new treatment at Coppermills WTW extention (100Ml/d) (WTW-LON-COP-100), Coppermills WTW extention (150Ml/d) (WTW-LON-COP-150).



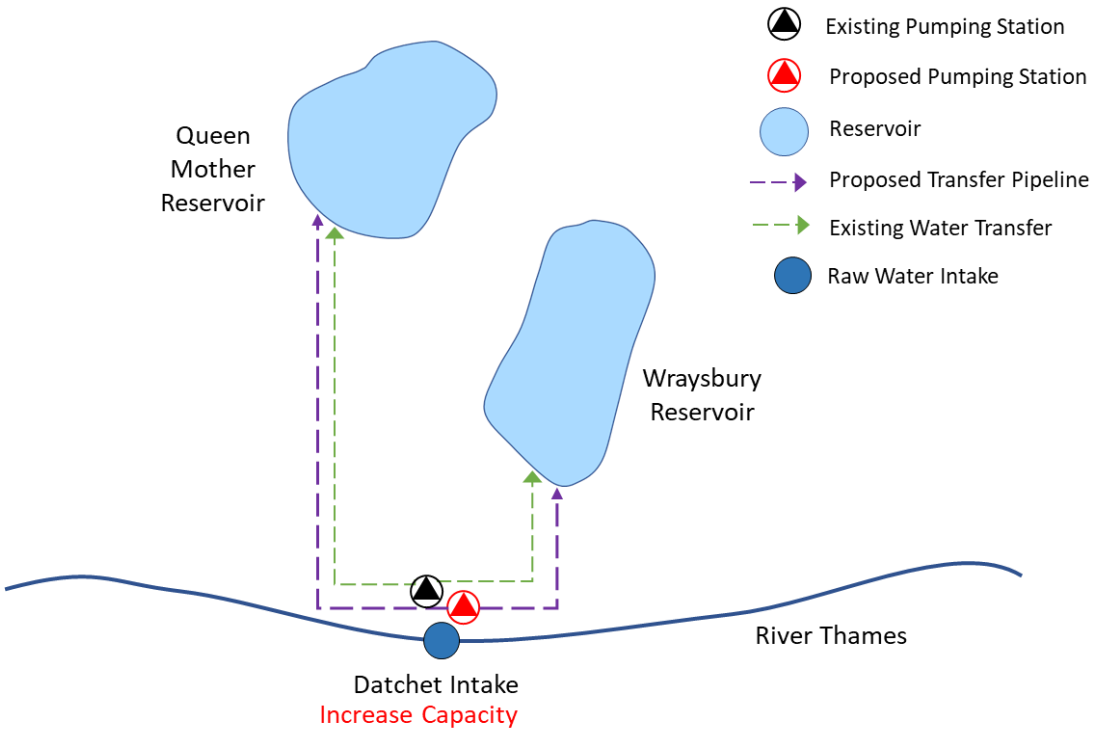
10.7 Raw Water System – Chingford South intake increase – CON-RWS-CHS-100

Name	Raw Water System – Chingford South intake increase
WRMP19 Reference	CON-RWS-CHS-100
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Increase capacity of the Chingford south intake by 100 Ml/d
Engineering Components	▪ New pumping station ▪ 2no 280kW pumps ▪ Screens ▪ Permanent Land for the pumping station increase of 1,500m^2
Benefit	n/a
Lead Time	4 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in East London: Beckton reuse (100Ml/d) (RES-RU-BEC-100), Beckton Reuse (150Ml/d) (RES-RU-BEC-150), Deephams reuse (46.5Ml/d) (RES-RU-DPH), Chingford Raw Water Purchase (RES-RWP-CHD) and transfer additional water to new treatment at Coppermills WTW extention (100Ml/d) (WTW-LON-COP-100), Coppermills WTW extention (150Ml/d) (WTW-LON-COP-150).



10.8 Raw Water System – Datchet intake increase – CON-RWS-CHS-100

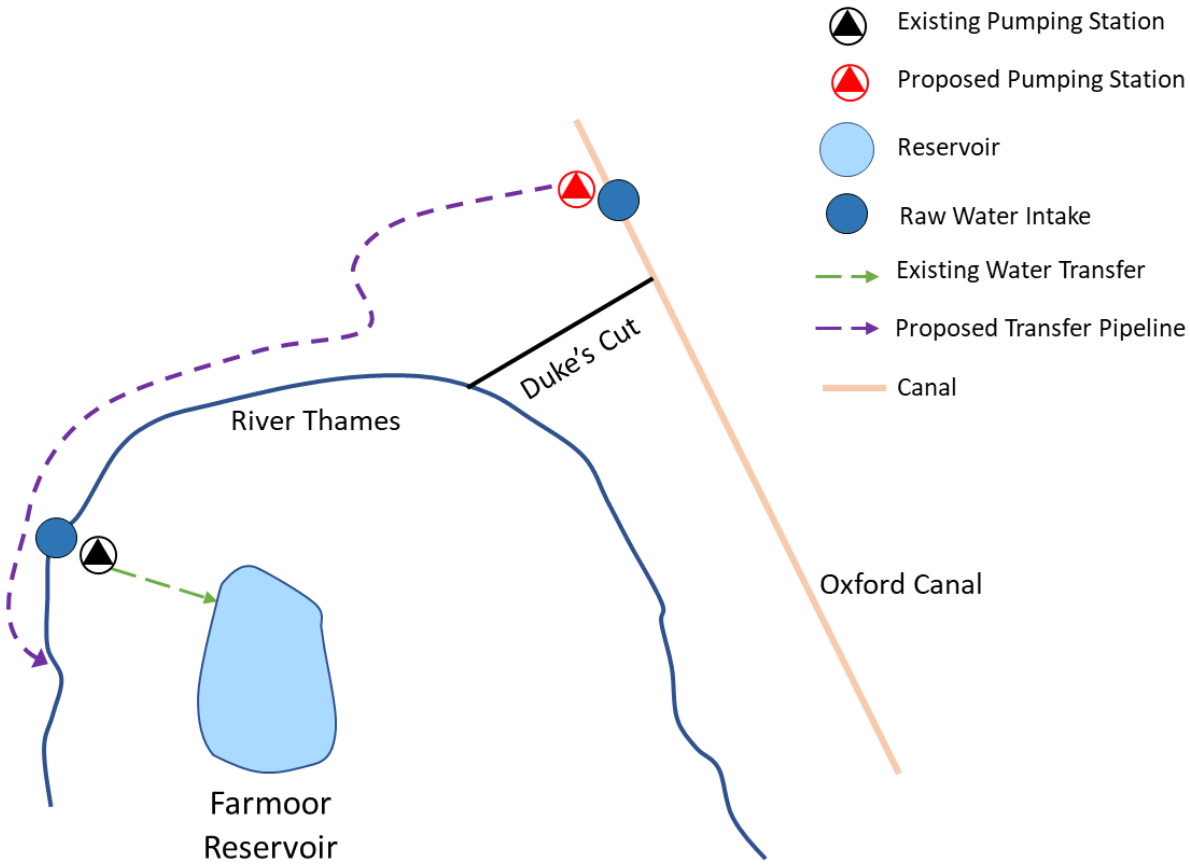
Name	Raw Water System – Datchet intake increase
WRMP19 Reference	CON-RWS-DAT-300
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Increase capacity of the Datchet intake by 300 Ml/d
Engineering Components	▪ New Pumping Station ▪ Permanent plot for the pumping station of 5,000m^2 ▪ 1000mm DI pipe to Queen Mother 1500m long ▪ 1000mm DI pipe to Wraysbury 3500m long ▪ Above ground pipelines to feed into Wraysbury and Queen Mother - twin 1000mm pipes 150m long at each reservoir
Engineering Components	▪ New Pumping Station ▪ Permanent plot for the pumping station of 5,000m^2 ▪ 1000mm DI pipe to Queen Mother 1500m long ▪ 1000mm DI pipe to Wraysbury 3500m long ▪ Above ground pipelines to feed into Wraysbury and Queen Mother - twin 1000mm pipes 150m long at each reservoir
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a



Interdependencies/ Exclusivity	Required to support additional raw water resources in West London (Abingdon Reservoir (RES-RRR-ABI-100Mm3), Severn Thames Transfer (CON-RWT-DEH-CLM-300),) and transfer additional water to new treatment at Kempton WTW (WTW-LON-KEM-100).

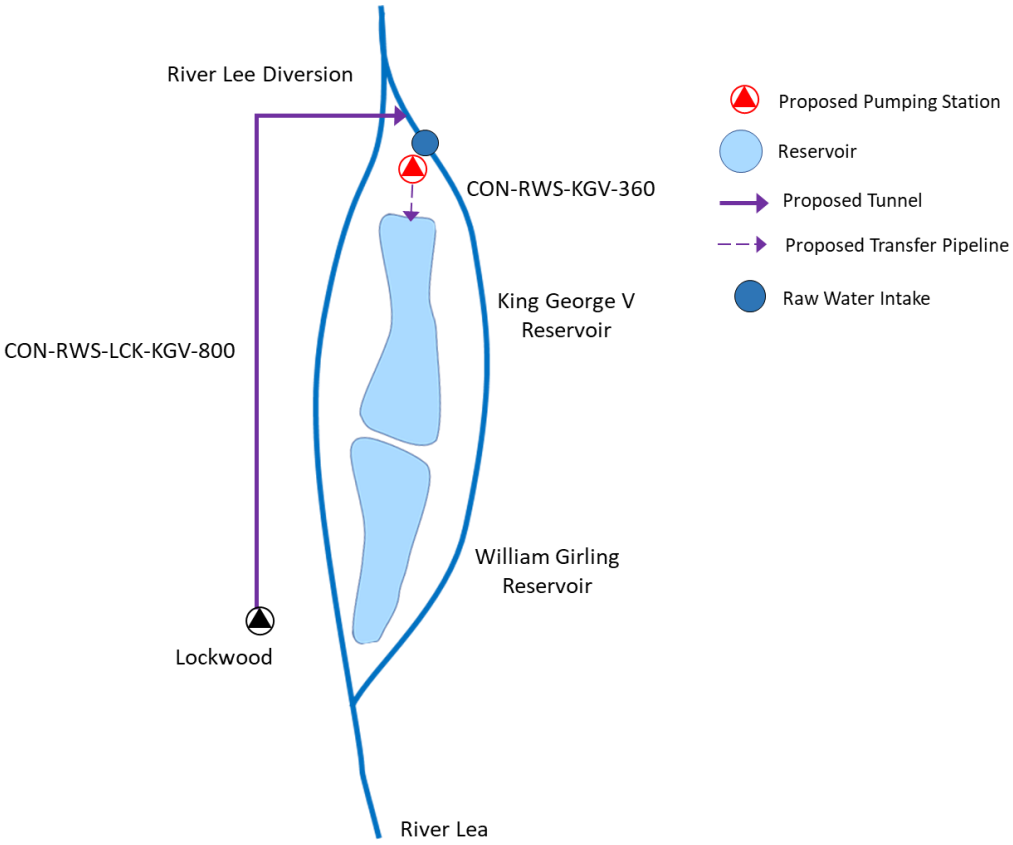
10.9 Raw Water System- Oxford Canal – Duke's Cut to Farmoor 15Ml/d Pipeline – CON-RWS-DKC-FMR

Name	Oxford Canal – Duke's Cut to Farmoor 15 Ml/d Pipeline
WRMP19 Reference	CON-RWS-DKC-FMR
Element Type	Conveyance
WRZ	SWOX
Engineering Scope	A supported conveyance pipeline option from Duke's Cut on the Oxford Canal to the River Thames upstream of the existing Farmoor intake with a 15 Ml/d capacity and a total length 9.06km. The element includes all engineering works required to transfer the flow to the River Thames.
Engineering Components	▪ A river intake structure at Duke's Cut with inlet screens ▪ A raw water low lift pump station ▪ A 9.06 km long, 400mm diameter rising main; ▪ An outfall to the River Thames just upstream of the existing Farmoor intake.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	RES-RWTS-OXC-CRP-15
Interdependencies/ Exclusivity	This element is dependent on surplus in the canal network that will be provided by 3rd parties (Canal and River Trust) as well as Oxford Canal to Dukes Cut (RES-RWTS-OXC-DKC-15)



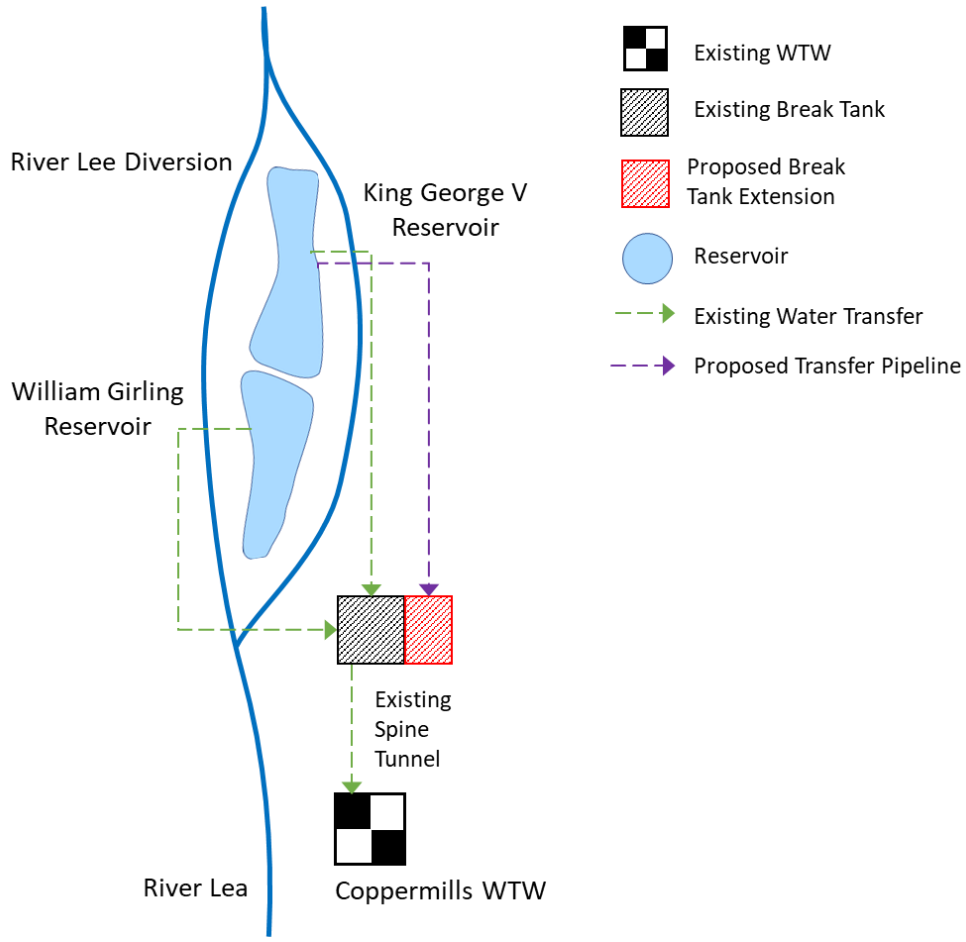
10.10 Raw Water System – KGV Reservoir intake increase- CON-RWS-KGV-360

Name	Raw Water System – KGV Reservoir intake increase
WRMP19 Reference	CON-RWS-KGV-360
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Increase capacity of the KGV Reservoir intake by 360Ml/d.
Engineering Components	▪ New Pumping Station ▪ Above ground pipelines to KGV - assume 3Nr 1200mm pipe, 300m long ▪ Permanent Plot size assumed 100x50 = 5000m^2 for the pumping station
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in East London: Becton Reuse 100Ml/d – RES-RU-BEC-100; Becton Reuse 150Ml/d – RES-RU-BEC-150; Deephams Reuse – RES-RU-DPH; and transfer additional water to new treatment at Coppermills WTW – WTW-LON-COP-100, WTW-LON-COP-150.



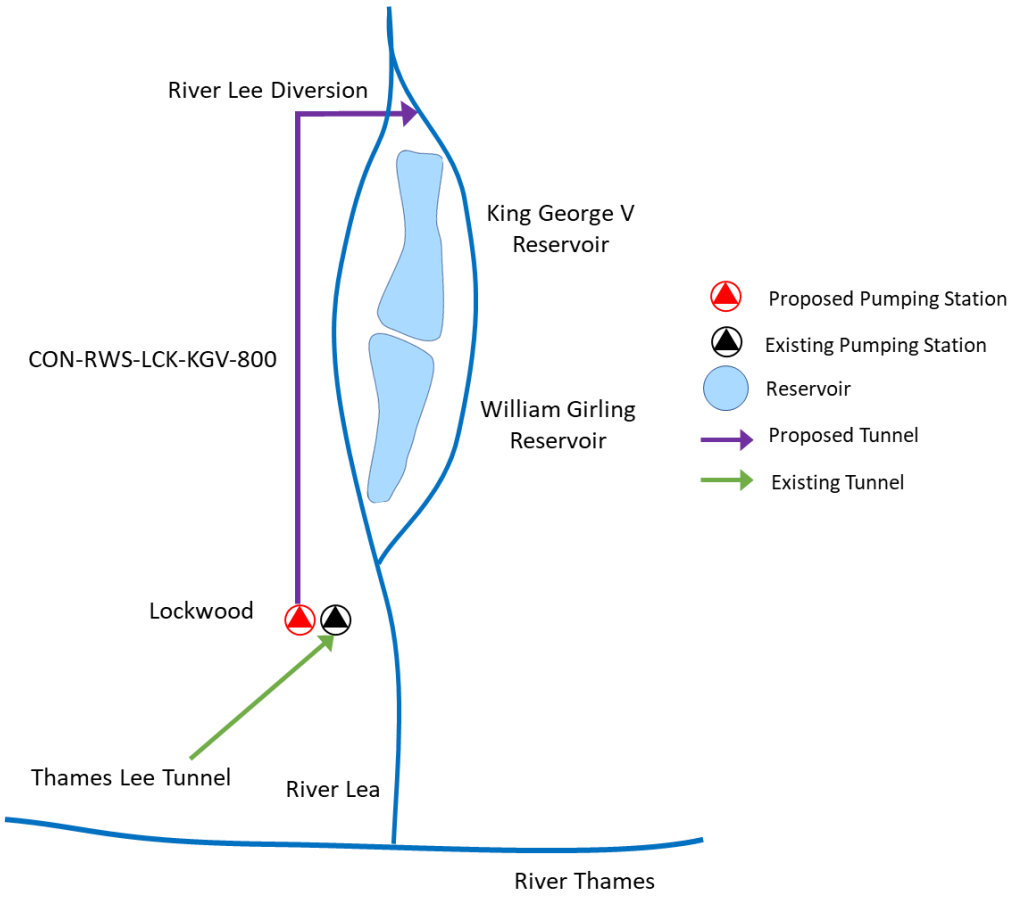
10.11 Raw Water System – KGV Reservoir to Break Tank – CON-RWS-KGV-BT-300

Name	Raw Water System – KGV Reservoir to Break Tank
WRMP19 Reference	CON-RWS-KGV-BT-300
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Transfer of raw water from KGV reservoir to the Break Tank.
Engineering Components	▪ Pipeline from KGV reservoir to the break tank at the south of William Girling reservoir at a diameter of 1.4m for a distance of 3km ▪ New/increased capacity of the break tank include valves and fittings ▪ 3,600 m² for new break tank
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in East London: Becton Reuse 100Ml/d – RES-RU-BEC-100; Becton Reuse 150Ml/d – RES-RU-BEC-150; Deephams Reuse – RES-RU-DPH; Chingford Raw Water Purchase – RES-RWP-CHD ; and transfer additional water to new treatment at Coppermills WTW – WTW-LON-COP-100, WTW-LON-COP-150.



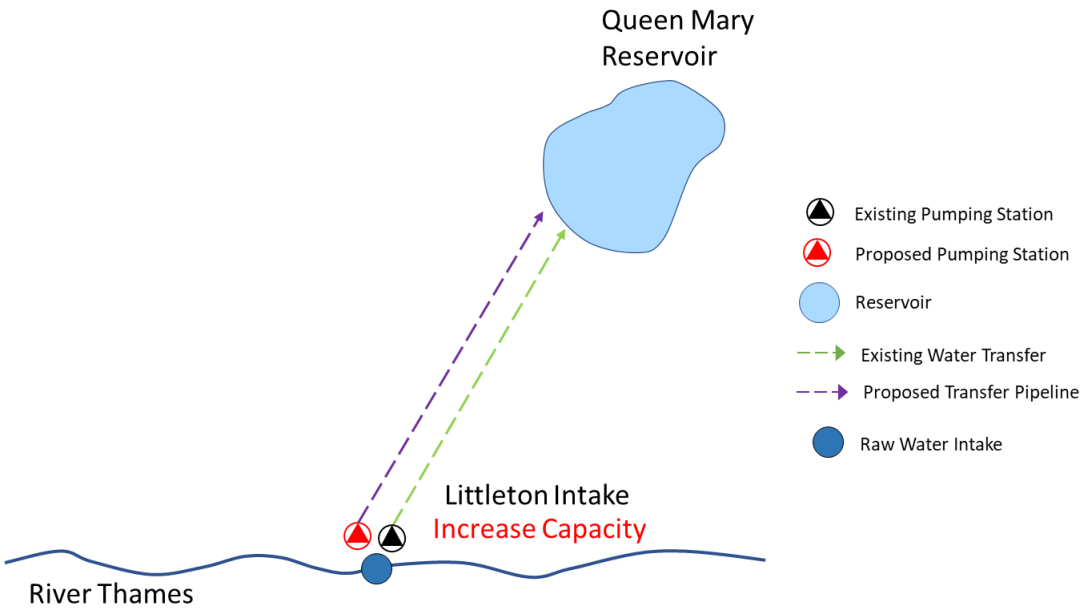
10.12 Raw Water System - Lockwood PS to KGV Reservoir Intake – CON-RWS-LCK-KGV-800

Name	Raw Water System – Lockwood PS to KGV Reservoir intake
WRMP19 Reference	CON-RWS-LCK-KGV-800
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Transfer of raw water via a tunnel from Lockwood pumping station to River Lee Diversion at King George V Reservoir intake.
Engineering Components	▪ Tunnel from Lockwood to KGV at a diameter of 3.5m for a distance of 9km. ▪ 1 No drive shaft 12.5m diameter of 25m depth ▪ 3 No 10.5m diameter intermediate shafts of 25m depth ▪ 1 No 10.5m diameter reception shaft of 25m depth ▪ Pumps with shaft to transport the water - 3 pumps 2 duty and 1 standby with total installed power of 825kW ▪ High Integrity Gate Valve; 2 per intermediate shaft ▪ Permanent land – 1,000m^2 ▪ Temporary land - total of 30,500m^2
Benefit	n/a
Lead Time	8 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in East London: Becton Reuse 100Ml/d – RES-RU-BEC-100; Becton Reuse 150Ml/d – RES-RU-BEC-150; Deephams Reuse – RES-RU-DPH; and transfer additional water to new treatment at Coppermills WTW – WTW-LON-COP-100, WTW-LON-COP-150.



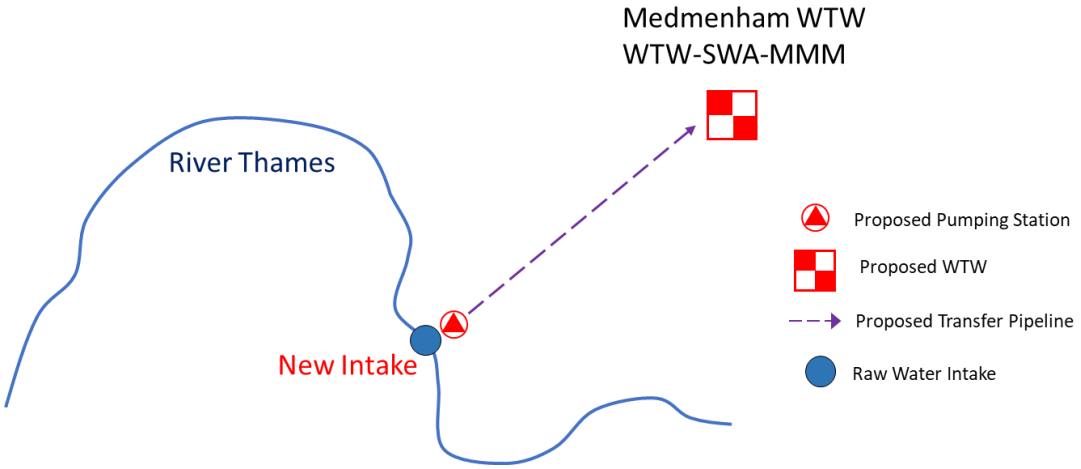
10.13 Raw Water System – Increase capacity of Littleton intake PS – CON-RWS-LTN-300

Name	Raw Water System – Increase capacity of Littleton intake PS
WRMP19 Reference	CON-RWS-LTN-300
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Increase capacity of Littleton intake PS site by 300Ml/d capacity
Engineering Components	▪ New Pumping station located at Littleton intake ▪ Above ground pipelines to reservoir ▪ Permanent land requirements 5000m^2
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Requires the increase in raw water within the west London system from resource options.



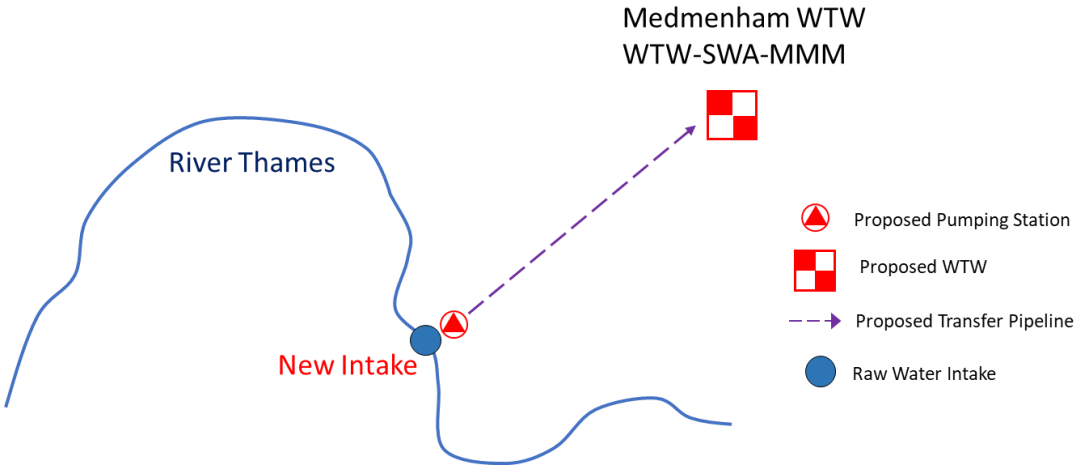
10.14 Raw Water System – New Medmenham Intake – CON-RWS-MMM-80

Name	Medmenham Intake – 80 Ml/d
WRMP19 Reference	CON-RWS-MMM-80
Element Type	Conveyance
WRZ	SWA
Engineering Scope	Construction of an 80 Ml/d intake near Medmenham to abstract water from the River Thames including an 80 Ml/d raw water pumping station to the new Medmenham WTW and raw water pipeline to transfer the water from the intake to the WTW.
Engineering Components	▪ New 80 Ml/d Raw water intake and screens ▪ 1000mm, 0.35km long gravity pipeline between intake and raw water pumping station ▪ Raw water pumping station 1,420 kW (3 Nr 355 kW duty pumps, 1 Nr 355 kW standby pump) ▪ 900mm raw water pipeline 0.75 km long from abstraction point to new Medmenham WTW, 900 mm diameter.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	Medmenham Intake 53 Ml/d (CON-RWS-MMM-53)
Interdependencies/ Exclusivity	Dependent on new Medmenham WTW and treated water pipeline to new Widdenton SR (WTW-SWA-MMM) The intake will abstract from the River Thames, supported by one or more of the following elements: ▪ Didcot Raw Water Purchase - RES-RWP-DID ▪ New Abingdon Reservoir - RES-RRR-ABI ▪ Severn Thames Transfer – Deerhurst to Culham pipeline- CON-RWT-DEH-CLM ▪ Oxford Canal to Cropredy - RES-RWTS-OXC-CRO-15



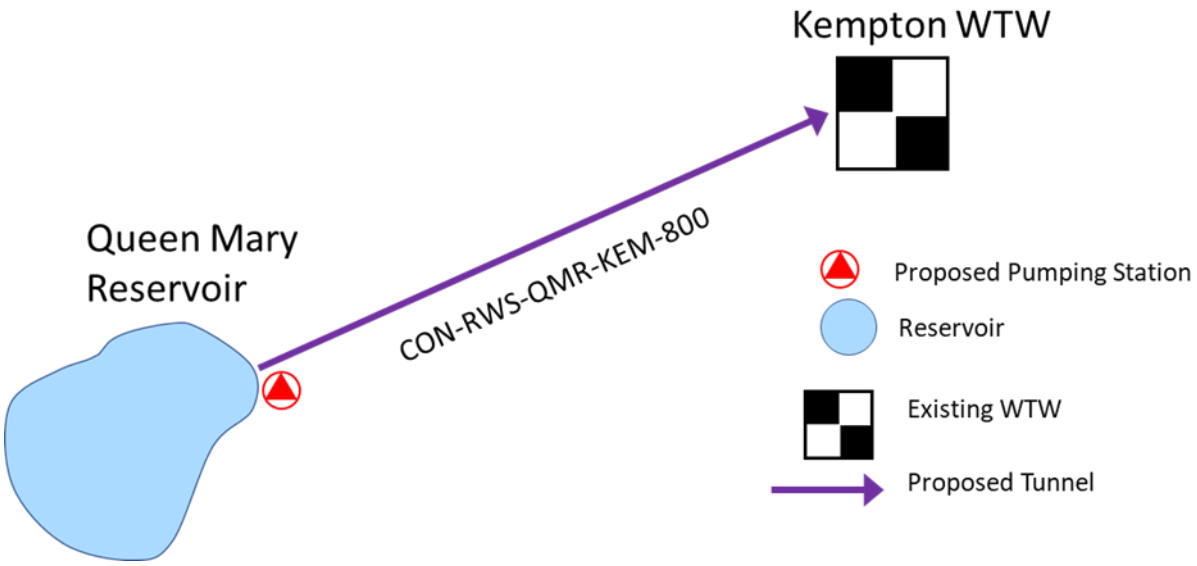
10.15 Raw Water System – New Medmenham Intake – CON-RWS-MMM-53

Name	Medmenham Intake – 53 Ml/d
WRMP19 Reference	CON-RWS-MMM-53
Element Type	Conveyance
WRZ	SWA
Engineering Scope	Construction of a 53 Ml/d intake near Medmenham to abstract water from the River Thames including a 53 Ml/d raw water pumping station to the new Medmenham WTW and raw water pipeline to transfer the water from the intake to the WTW.
Engineering Components	▪ New 53 Ml/d Raw water intake and screens ▪ Raw water pumping station 1065 kW (2 Nr 355 kW duty pumps, 1 Nr 355 kW standby pump) ▪ 900mm, 0.35km long gravity pipeline between intake and raw water pumping station ▪ 800mm raw water pipeline 0.75 km long from abstraction point to new Medmenham WTW, 900 mm diameter.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	Medmenham Intake 80 Ml/d (CON-RWS-MMM-80)
Interdependencies/ Exclusivity	Dependent on new Medmenham WTW and treated water pipeline to new Widdenton SR (WTW-SWA-MMM) The intake will abstract from the River Thames, supported by one or more of the following elements: ▪ Didcot Raw Water Purchase - RES-RWP-DID ▪ New Abingdon Reservoir - RES-RRR-ABI ▪ Severn Thames Transfer – Deerhurst to Culham pipeline- CON-RWT-DEH-CLM ▪ Oxford Canal to Cropredy - RES-RWTS-OXC-CRP-15



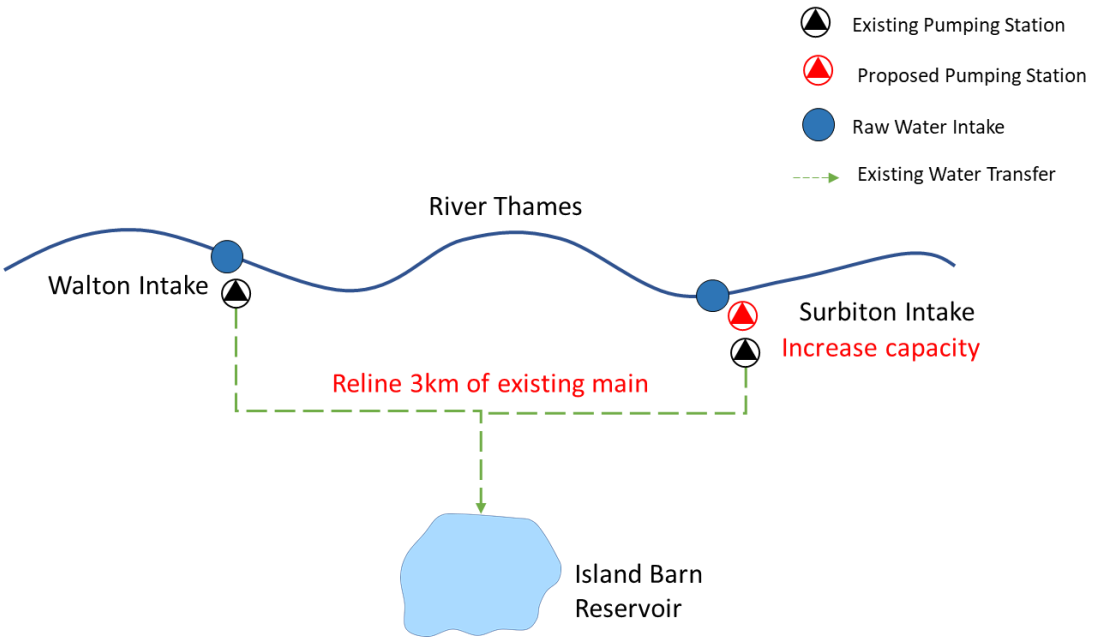
10.16 Raw Water System – Queen Mary Reservoir to Kempton WTW site – CON-RWS-QMR-KEM-800

Name	Raw Water System – Queen Mary Reservoir to Kempton WTW site
WRMP19 Reference	CON-RWS-QMR-KEM-800
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	New conveyance of raw water from Queen Mary Reservoir to Kempton WTW new site
Engineering Components	▪ Tunnel from Queen Mary to Kempton at a diameter of 3.5m for a distance of 3.6km ▪ 1 No drive shaft 12.5m diameter of 25m depth ▪ 1 No 10.5m diameter intermediate shafts of 25m depth ▪ 1 No 10.5m diameter reception shaft of 25m depth ▪ High Integrity Gate Valve; 2 at the intermediate shaft ▪ Installation of jetty - to carry pipes from pump station to tunnel and allow access to pumps and safe operation / maintenance and removal of pumps ▪ Pumps installed in the reservoir including housing and control room for the pumps ▪ Permanent land at shaft locations – 600m^2 ▪ Temporary land at shaft locations - 3 parcel of temporary land around the shafts during construction - 1 of 5,000m^2 and 2 of 2,500m^2; total of 10,000m^2
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in West London (Abingdon Reservoir (RES-RRR-ABI-100Mm3), Severn Thames Transfer (CON-RWT-DEH-CLM-300)) and transfer additional water to new treatment at Kempton WTW (WTW-LON-KEM-100).



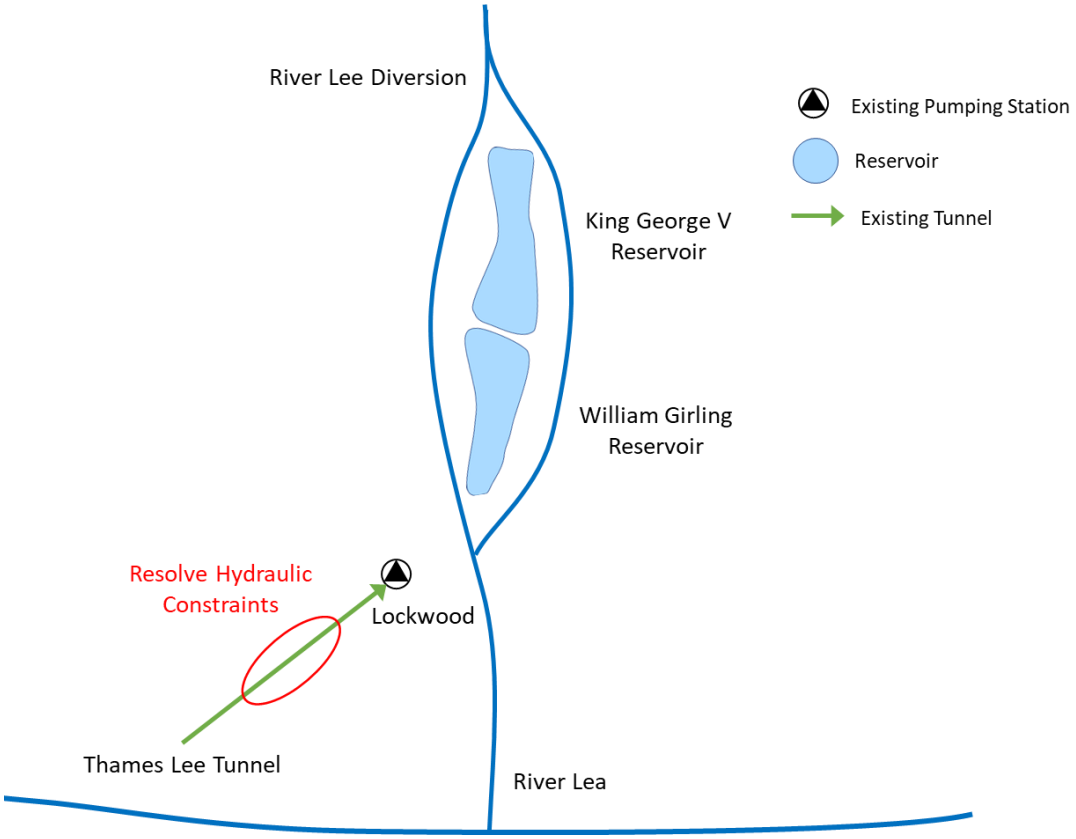
10.17 Raw Water System – Increase capacity of Surbiton intake – CON-RWS-MMM-80

Name	Raw Water System – Increase capacity of Surbiton intake
WRMP19 Reference	CON-RWS-SUR-100
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Increase capacity of Surbiton intake by 100Ml/d
Engineering Components	▪ Installation of an extra pump within the Surbiton Pumping station intake ▪ Upgrade screens at Surbiton ▪ Reline 3km of the existing 48" main
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Required to support additional raw water resources in West London (Abingdon Reservoir (RES-RRR-ABI-100Mm3), Severn Thames Transfer (CON-RWT-DEH-CLM-300)) and transfer additional water to new treatment at Kempton WTW (WTW-LON-KEM-100).



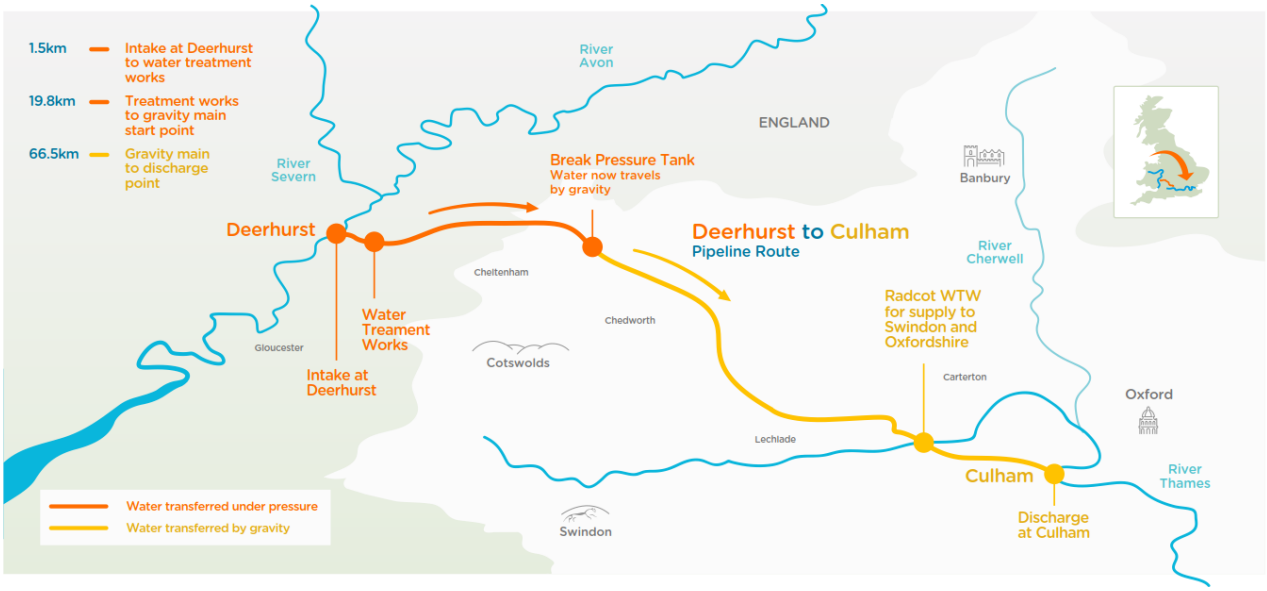
10.18 Raw Water System - TLT upgrade – CON-RWS-TLT-UPG-450

Name	Raw Water System – TLT upgrade
WRMP19 Reference	CON-RWS-TLT-UPG-450
Element Type	Conveyance
WRZ	LONDON
Engineering Scope	Thames Lee Tunnel reinforcement for a section of the tunnel, a new shaft 6m diameter at a depth of 30m and a new air valve
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Not dependent on other elements



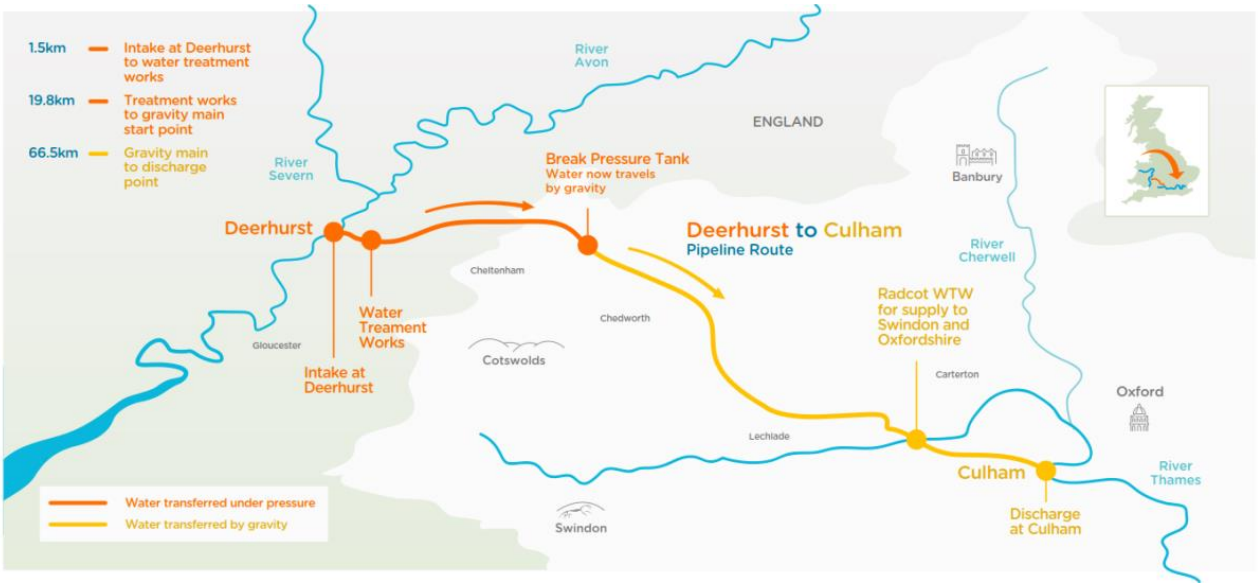
10.19 Severn Thames Transfer – Deerhurst to Culham (300Ml/d) pipeline – CON-RWT-DEH-CLM-300

Name	Severn Thames Transfer – Deerhurst to Culham 300 Ml/d Pipeline
WRMP19 Reference	CON-RWT-DEH-CLM-300
Element Type	Conveyance
WRZ	LONDON / SWOX / SWA
Engineering Scope	A supported conveyance pipeline option from Deerhurst on the River Severn to Culham on the River Thames with a 300 Ml/d capacity and a total length 88km. The element includes all engineering works required to transfer the flow to the River Thames.
Engineering Components	▪ A river intake structure at Deerhurst including inlet screens and a twin 400m long, 1.8m diameter pipeline to a low lift pump station; ▪ A raw water low lift pump station (31.5m max. pumping head, total installed power 2000 kW) and a twin 1.1 km long, 1.8m diameter pipeline to treatment works; ▪ Treatment works including inlet screens, coagulation and lamella clarifiers, rapid gravity filtration and sludge and washwater treatment; ▪ A treated water high lift pump station (247m max. pumping head, total installed power 12500 kW); ▪ A 19.8 km long, 1.6m diameter rising main; ▪ A break pressure tank at the high point; ▪ A 66.6 km long, 1.5/1.4m diameter gravity main to discharge; ▪ An outfall at Culham with an actuated valve and an aeration cascade; ▪ Washouts along the route provided with permanent discharge pipework to adjacent watercourses where possible; ▪ A tee off the main pipeline for SWOX supply currently proposed at Radcot.
Benefit	The independent unsupported River Severn resource option was rejected at feasibility stage and is not included in the Constrained List; however unsupported River Severn water will be abstracted for transfer in the Deerhurst pipeline when available. Stochastic modelling allowing for climate change and other abstractors indicates a benefit of 80 Ml/d from the River Severn for the 300 Ml/d pipeline option.
Lead Time	10 Years
Mutual exclusivities	CON-RWT-DEH-CLM-400, CON-RWT-DEH-CLM-500
Interdependencies/ Exclusivity	This element is dependent on River Severn support elements that will be provided by 3rd parties (Severn Trent Water, United Utilities and Welsh Water). To provide an additional resource to London WRZ the following elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Thames and conveyed to Kempton Water Treatment Works – WTW-LON-KEM-100; ▪ Additional capacity in the Thames Water ring main; For the London/SWOX solution only: New SWOX WTW.


1.5km
Intake at Deerhurst to water treatment works
19.8km
Treatment works to gravity main start point
66.5km
Gravity main to discharge point
River Avon
ENGLAND
River Severn
Break Pressure Tank
Water now travels by gravity
Deerhurst
Deerhurst to Culham
Pipeline Route
Banbury
River Cherwell
Cheltenham
Water Treament Works
Chedworth
Radcot WTW for supply to Swindon and Oxfordshire
Gloucester
Cotswolds
Intake at Deerhurst
Carterton
Oxford
Lechlade
Culham
River Thames
Discharge at Culham
Swindon
Water transferred under pressure
Water transferred by gravity

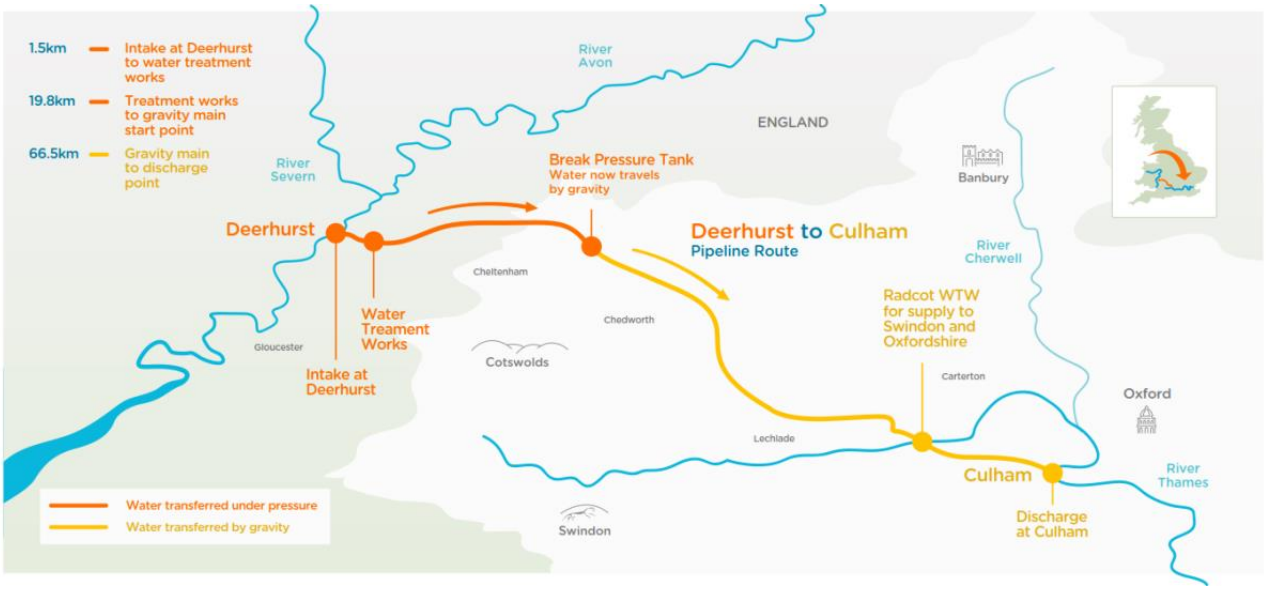
10.20 Severn Thames Transfer – Deerhurst to Culham (400Ml/d) pipeline – CON-RWT-DEH-CLM-400

Name	Severn Thames Transfer – Deerhurst to Culham 400 Ml/d Pipeline
WRMP19 Reference	CON-RWT-DEH-CLM-400
Element Type	Conveyance
WRZ	LONDON / SWOX / SWA
Engineering Scope	A supported conveyance pipeline option from Deerhurst on the River Severn to Culham on the River Thames with a 400 Ml/d capacity and a total length 88km. The element includes all engineering works required to transfer the flow to the River Thames.
Engineering Components	▪ A river intake structure at Deerhurst including inlet screens and a twin 400m long 1.8m diameter pipeline to a low lift pump station; ▪ A raw water low lift pump station (31.5m max pumping head, total installed power 2650 kW) and a twin 1.1 km long, 1.8m diameter pipeline to treatment works; ▪ Treatment works including inlet screens, coagulation and lamella clarifiers, rapid gravity filtration and sludge and washwater treatment; ▪ A treated water high lift pump station (247m max. pumping head, total installed power 21250 kW); ▪ A 19.8 km long, 1.8m diameter rising main; ▪ A break pressure tank at the high point; ▪ A 66.6 km long, 1.8/1.6m diameter gravity main to discharge; ▪ An outfall at Culham with an actuated valve and an aeration cascade; ▪ Washouts along the route provided with permanent discharge pipework to adjacent watercourses where possible; ▪ A tee off the main pipeline for SWOX supply currently proposed at Radcot.
Benefit	The independent unsupported River Severn resource option was rejected at feasibility stage and is not included in the Constrained List; however unsupported River Severn water will be abstracted for transfer in the Deerhurst pipeline when available. Stochastic modelling allowing for climate change and other abstractors indicates a benefit of 95 Ml/d from the River Severn for the 400 Ml/d pipeline option.
Mutual exclusivities	CON-RWT-DEH-CLM-300, CON-RWT-DEH-CLM-500
Lead Time	10 Years
Interdependencies/ Exclusivity	This element is dependent on River Severn support elements that will be provided by 3rd parties (Severn Trent Water, United Utilities and Welsh Water). To provide an additional resource to London WRZ the following elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Thames and conveyed to Kempton Water Treatment Works – WTW-LON-KEM-100; ▪ Additional capacity in the Thames Water ring main; ▪ For the London/SWOX solution only: New SWOX WTW.


1.5km
Intake at Deerhurst to water treatment works
19.8km
Treatment works to gravity main start point
66.5km
Gravity main to discharge point
River Avon
ENGLAND
River Severn
Break Pressure Tank
Water now travels by gravity
Deerhurst
Deerhurst to Culham
Pipeline Route
Banbury
River Cherwell
Cheltenham
Chedworth
Water Treament Works
Radcot WTW for supply to Swindon and Oxfordshire
Gloucester
Cotswolds
Intake at Deerhurst
Carterton
Oxford
Lechlade
Culham
River Thames
Discharge at Culham
Swindon
Water transferred under pressure
Water transferred by gravity

10.21 Severn Thames Transfer – Deerhurst to Culham (500Ml/d) pipeline – CON-RWT-DEH-CLM-500

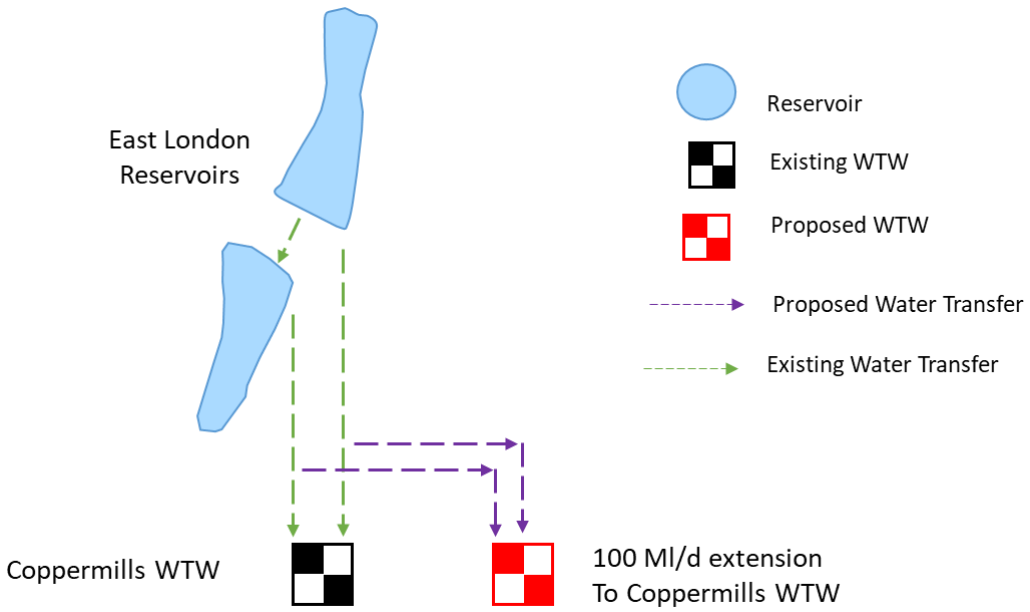
Name	Severn Thames Transfer – Deerhurst to Culham 500 Ml/d Pipeline
WRMP19 Reference	CON-RWT-DEH-CLM-500
Element Type	Conveyance
WRZ	LONDON / SWOX / SWA
Engineering Scope	A supported conveyance pipeline option from Deerhurst on the River Severn to Culham on the River Thames with a 500 Ml/d capacity and a total length 88km. The element includes all engineering works required to transfer the flow to the River Thames.
Engineering Components	▪ A river intake structure at Deerhurst including inlet screens and a twin 400m long 1.8m diameter pipeline to a low lift pump station; ▪ A raw water low lift pump station (31.5m max. pumping head, total installed power 3750 kW) and a twin 1.1 km long, 1.8m diameter pipeline to treatment works; ▪ Treatment works including inlet screens, coagulation and lamella clarifiers, rapid gravity filtration and sludge and washwater treatment; ▪ A treated water high lift pump station (247m max. pumping head, total installed power 21250 kW); ▪ A 19.8 km long, 2m diameter rising main; ▪ A break pressure tank at the high point; ▪ A 66.6 km long, 2/1.8m diameter gravity main to discharge; ▪ An outfall at Culham with an actuated valve and an aeration cascade; ▪ Washouts along the route provided with permanent discharge pipework to adjacent watercourses where possible; ▪ A tee off the main pipeline for SWOX supply currently proposed at Radcot.
Benefit	The independent unsupported River Severn resource option was rejected at feasibility stage and is not included in the Constrained List; however unsupported River Severn water will be abstracted for transfer in the Deerhurst pipeline when available. Stochastic modelling allowing for climate change and other abstractors indicates a benefit of 110 Ml/d from the River Severn for the 500 Ml/d pipeline option.
Mutual exclusivities	CON-RWT-DEH-CLM-300, CON-RWT-DEH-CLM-400
Lead Time	10 Years
Interdependencies/ Exclusivity	This element is dependent on River Severn support elements that will be provided by 3rd parties (Severn Trent Water, United Utilities and Welsh Water). To provide an additional resource to London WRZ the following elements are also required: ▪ Additional capacity in the raw water systems to allow the water to be abstracted from the River Thames and conveyed to Kempton Water Treatment Works – WTW-LON-KEM-100; ▪ Additional capacity in the Thames Water ring main; ▪ For the London/SWOX solution only: New SWOX WTW


1.5km
Intake at Deerhurst to water treatment works
19.8km
Treatment works to gravity main start point
66.5km
Gravity main to discharge point
River Avon
ENGLAND
River Severn
Break Pressure Tank
Water now travels by gravity
Deerhurst
Deerhurst to Culham
Pipeline Route
Banbury
River Cherwell
Cheltenham
Chedworth
Radcot WTW for supply to Swindon and Oxfordshire
Water Treament Works
Gloucester
Cotswolds
Intake at Deerhurst
Carterton
Oxford
Lechlade
Culham
River Thames
Discharge at Culham
Swindon
Water transferred under pressure
Water transferred by gravity

11 Water Treatment Works

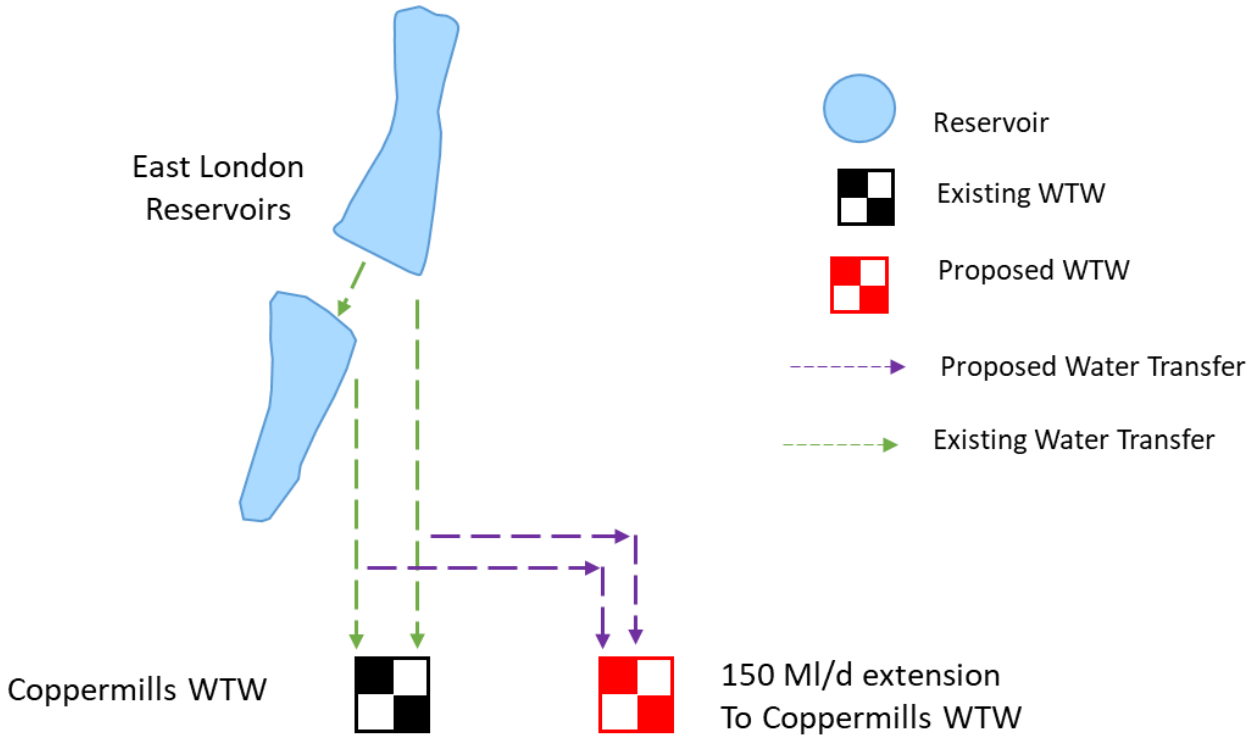
11.1 Coppermills WTW extension (100Ml/d) - WTW-LON-COP-100

Name	Coppermills Water Treatment Works extension 100 Ml/d
WRMP19 Reference	WTW-LON-COP-100
Element Type	Water Treatment
WRZ	LONDON
Engineering Scope	Treatment to drinking water standards of 184 Ml/d (inclusive of compensation for decommissioning 4 existing slow sand filters of 84 Ml/d) of raw water from the East London reservoirs.
Engineering Components	▪ Raw water pumping station ▪ New 184 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation Granular Activated Carbon (GAC) adsorption, disinfection and final water chemical dosing and washwater recovery and sludge treatment. ▪ Interstage pumping station ▪ Treated water pumping station
Benefit	n/a
Time Lead	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	▪ This WTW would treat water resources in East London: Becton Reuse 100Ml/d – RES-RU-BEC-100; Becton Reuse 150Ml/d – RES-RU-BEC-150; Deephams Reuse – RES-RU-DPH; Chingford Raw Water Purchase – RES-RWP-CHD ; and transfer additional water to new treatment at Coppermills WTW – WTW-LON-COP-100, WTW-LON-COP-150. ▪ Raw water system upgrades will be required to convey the raw water to the new WTW. ▪ Thames Water Ring Main extensions may be required to transfer the treated water.



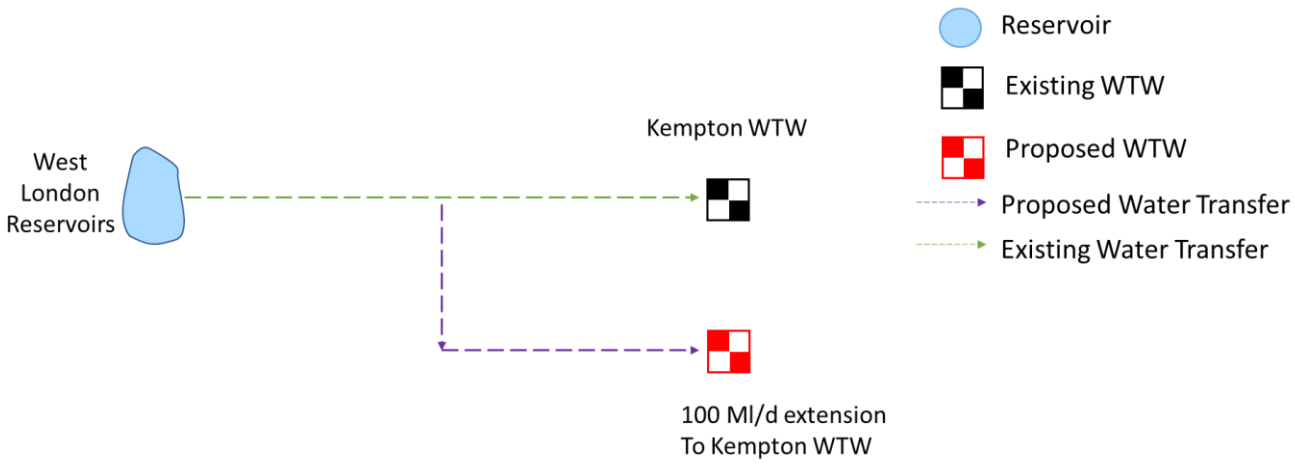
11.2Coppermills WTW extension (150Ml/d) - WTW-LON-COP-150

Name	Coppermills Water Treatment Works extension 150 Ml/d
WRMP19 Reference	WTW-LON-COP-150
Element Type	Water Treatment
WRZ	LONDON
Engineering Scope	Treatment to drinking water standards of 276 Ml/d (inclusive of compensation for decommissioning 6 existing Slow sand filters of 126 Ml/d) of raw water from the East London reservoirs.
Engineering Components	▪ Raw water pumping station ▪ New 276 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation Granular Activated Carbon (GAC) adsorption, disinfection and final water chemical dosing and washwater recovery and sludge treatment. ▪ Interstage pumping station ▪ Treated water pumping station
Benefit	n/a
Time Lead	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	▪ This would treat water at in East London: Becton Reuse 100Ml/d – RES-RU-BEC-100; Becton Reuse 150Ml/d – RES-RU-BEC-150; Deephams Reuse – RES-RU-DPH; Chingford Raw Water Purchase – RES-RWP-CHD ▪ Raw water system upgrades will be required to convey the raw water to the new WTW. ▪ Thames Water Ring Main extensions may be required to transfer the treated water.



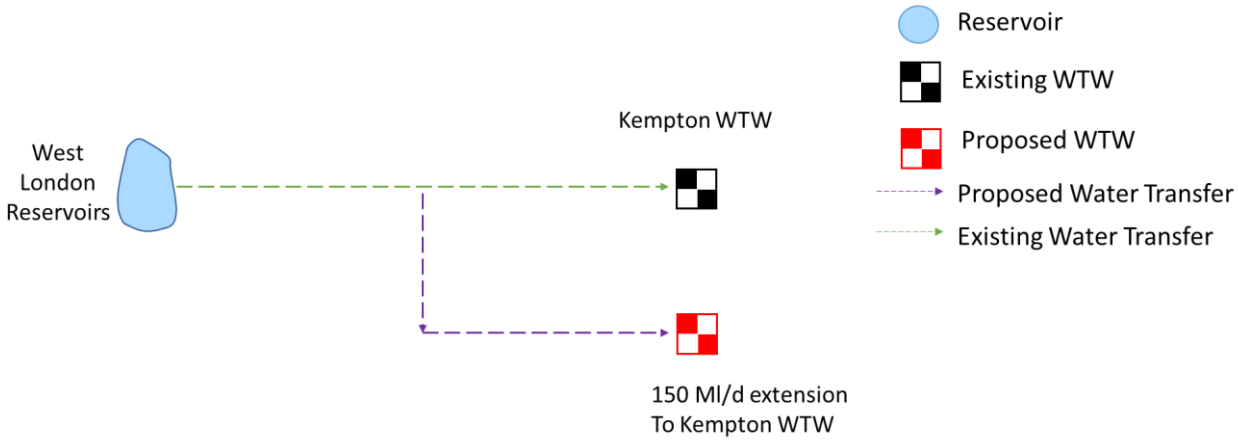
11.3Kempton WTW expansion (100Ml/d) - WTW-LON-KEM-100

Name	Kempton Water Treatment Works expansion 100 Ml/d
WRMP19 Reference	WTW-LON-KEM-100
Element Type	Water Treatment
WRZ	LONDON
Engineering Scope	Treatment to drinking water standards of 100 Ml/d of raw water from the West London reservoirs.
Engineering Components	▪ Raw water pumping station 555 kW (2 Nr 185 kW duty pumps, 1 Nr 185 kW standby pump) ▪ New 100 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation Granular Activated Carbon (GAC) adsorption disinfection, final water chemical dosing, and washwater recovery and sludge treatment. ▪ Interstage pumping station 225 kW (4 Nr 45 kW duty pumps, 1 Nr 45 kW standby pump) ▪ Treated water pumping station 450 kW (4 Nr 90 kW duty pumps, 1 Nr 90 kW standby pump)
Benefit	n/a
Time Lead	6 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Dependent on New Shaft at Kempton NET-TWRM-KEM) ▪ This WTW would treat new water resources in west London (Abingdon Reservoir, Severn Thames Transfer). ▪ Raw water system upgrades will be required to convey the raw water to the new WTW. ▪ Thames Water Ring Main extentions may be required to transfer the treated water.



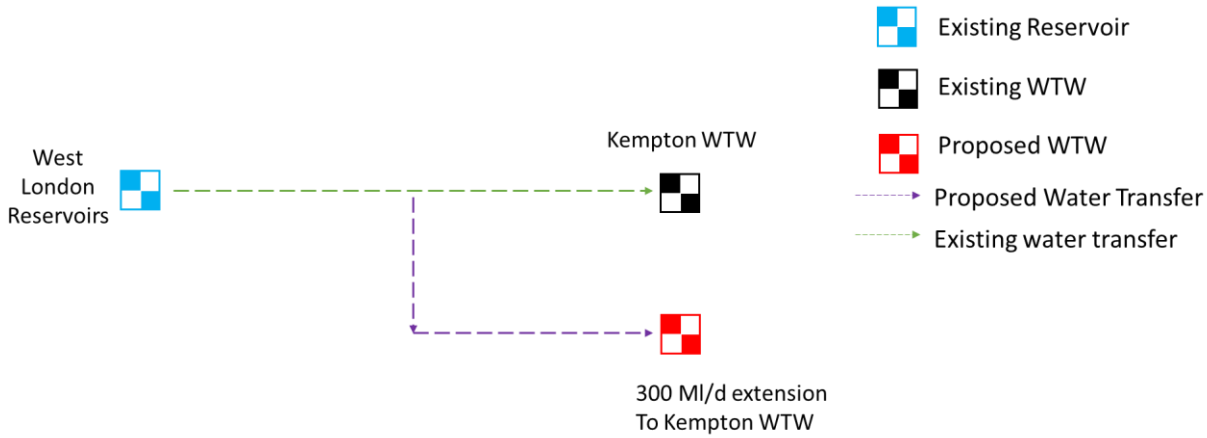
11.4Kempton WTW expansion (150Ml/d) - WTW-LON-KEM-150

Name	Kempton Water Treatment Works expansion 150 Ml/d
WRMP19 Reference	WTW-LON-KEM-150
Element Type	Water Treatment
WRZ	LONDON
Engineering Scope	Treatment to drinking water standards of 150 Ml/d of raw water from the West London reservoirs.
Engineering Components	▪ Raw water pumping station 840 kW (2 Nr 280 kW duty pumps, 1 Nr 280 kW standby pump) ▪ New 150 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation, Granular Activated Carbon (GAC) adsorption, disinfection, final water chemical dosing, and washwater recovery and sludge treatment. ▪ Interstage pumping station 375 kW (4 Nr 75 kW duty pumps, 1 Nr 75 kW standby pump) ▪ Treated water distributed by gravity into London Ring Main shaft
Benefit	n/a
Time Lead	6 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Dependent on New Shaft at Kempton (NET-TWRM-KEM) ▪ This WTW would treat new water resources in west London (Abingdon Reservoir, Severn Thames Transfer). ▪ Raw water system upgrades will be required to convey the raw water to the new WTW. ▪ Thames Water Ring Main extensions may be required to transfer the treated water.



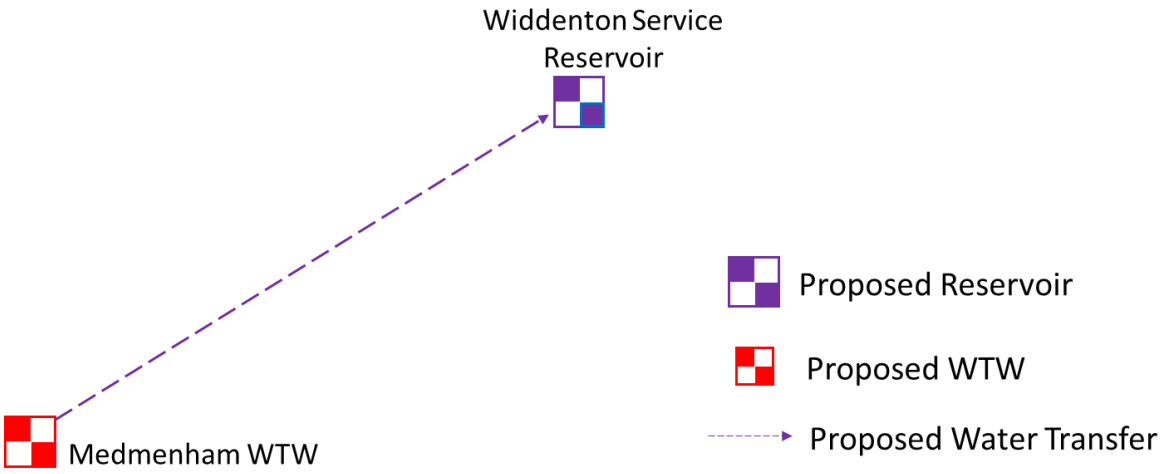
11.5Kempton WTW expansion (300Ml/d) - WTW-LON-KEM-300

Name	Kempton Water Treatment Works expansion 300 Ml/d
WRMP19 Reference	WTW-LON-KEM-300
Element Type	Water Treatment
WRZ	LONDON
Engineering Scope	Treatment to drinking water standards of 300 Ml/d of raw water from the West London reservoirs.
Engineering Components	▪ Raw water pumping station 1,590 kW (2 Nr 530 kW duty pumps, 1 Nr 530 kW standby pump) ▪ New 300 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation, Granular Activated Carbon (GAC) adsorption, disinfection, final water chemical dosing, and washwater recovery and sludge treatment. ▪ Interstage pumping station 660 kW (4 Nr 132 kW duty pumps, 1 Nr 132 kW standby pump) ▪ Treated water distributed by gravity into London Ring Main shaft
Benefit	n/a
Time Lead	6 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Dependent on New Shaft at Kempton (NET-TWRM-KEM) ▪ This WTW would treat new water resources in west London (Abingdon Reservoir, Severn Thames Transfer). ▪ Raw water system upgrades will be required to convey the raw water to the new WTW. ▪ Thames Water Ring Main extensions may be required to transfer the treated water.



11.6 Medmenham WTW (24Ml/d) - WTW-SWA-MMM

Name	Medmenham Water Treatment Works – 24 Ml/d
WRMP19 Reference	WTW-SWA-MMM
Element Type	Water Treatment
WRZ	SWA
Engineering Scope	Construction of a 24 Ml/d water treatment works near Medmenham to treat water from the River Thames including a 24 Ml/d treated water pipeline to Widdenton where a new treated water reservoir will also be constructed.
Engineering Components	▪ New 24 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation, Granular Activated Carbon (GAC) adsorption, disinfection, final water chemical dosing, washwater recovery and sludge treatment. ▪ Interstage pumping station 27.5kW (4 Nr 5.5 kW duty pumps, 1 Nr 5.5 kW standby pump) ▪ Treated water pumping station 840 750 kW (2 Nr 280 250 kW duty pumps, 1 Nr 2580 kW standby pump) ▪ New 24 Ml Service Reservoir near Widdenton ▪ Treated water pipeline 7.8 km length from WTW to new Widdenton Service Reservoir, 500 mm diameter.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	Dependent on new intake near Medmenham and raw water pipeline (CON-RWS-MMM-80 or CON-RWS-MMM-53) This WTW would treat water abstracted from the River Thames, supported by one or more of the following elements: • Didcot Raw Water Purchase - RES-RWP-DID • New Abingdon Reservoir - RES-RRR-ABI • Severn Thames Transfer – Deerhurst to Culham pipeline- CON-RWT-DEH-CLM • Oxford Canal to Cropedy - RES-RWTS-OXC-CRO-15

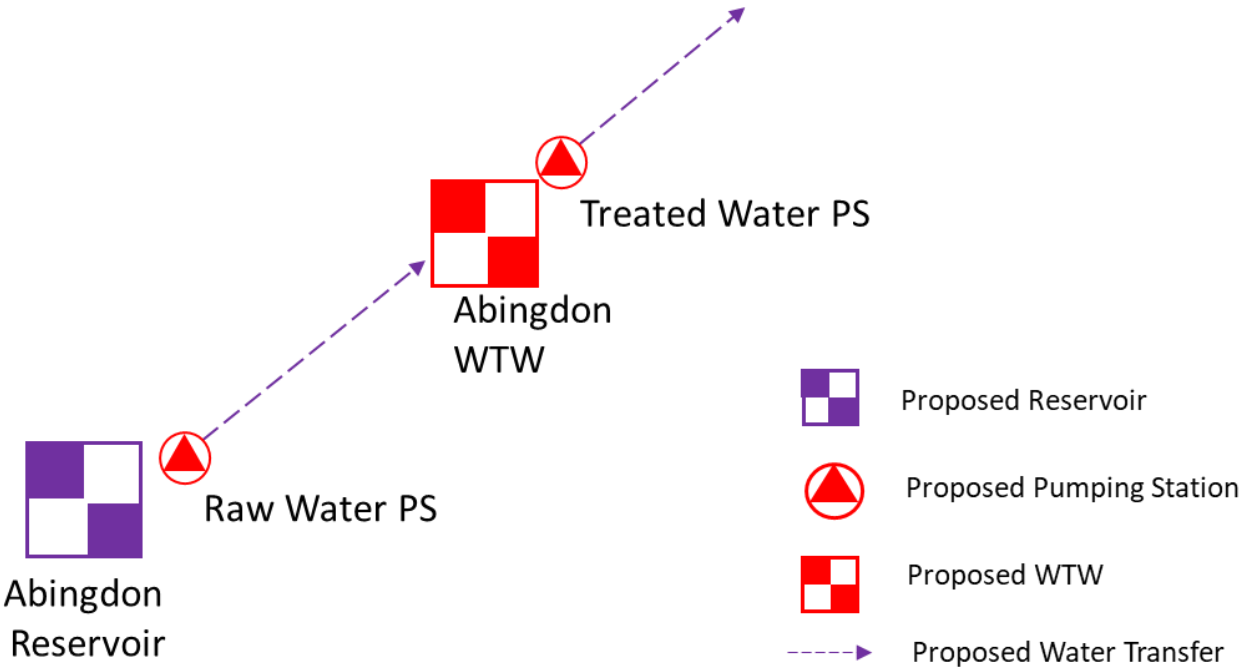


11.7Abingdon WTW (24Ml/d) - WTW-SWOX-ABI

Name	Abingdon Water Treatment Works – 24 Ml/d
WRMP19 Reference	WTW-SWOX-ABI
Element Type	Water Treatment
WRZ	SWOX
Engineering Scope	Construction of a 24 Ml/d water treatment works adjacent to and supplied by the new Abingdon reservoir to supply parts of the SWOX WRZ. The Engineering scope includes the raw water pipeline from the reservoir to the treatment works and the treated water pipeline from the treatment works to Beacon Hill Service Reservoir.
Engineering Components	▪ Raw water pipeline from reservoir to water treatment works 0.5 km length. 700mm diameter for first 440m inside reservoir tunnel (covered in Reservoir element), 600mm diameter for remaining connection from tunnel to WTW. ▪ Raw water pumping station 55 kW (4 Nr 11 kW duty pumps, 1 Nr 11 kW standby pump) ▪ New 24 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation, Granular Activated Carbon (GAC) adsorption, disinfection, final water chemical dosing, washwater recovery and sludge treatment. ▪ Interstage pumping station 27.5kW (4 Nr 5.5 kW duty pumps, 1 Nr 5.5 kW standby pump) ▪ Treated water pumping station 750 kW (2 Nr 250 kW duty pumps, 1 Nr 250 kW standby pump) ▪ Treated water pipeline 15.7 km length from WTW to Beacon Hill Service Reservoir, 600 mm diameter.
Benefit	n/a
Time Lead	5 Years
Mutual exclusivities	This element is not mutually exclusive with the Radcot WTW element as they serve two different options that may both be implemented. If both options were to be implemented including the treatment elements, then consideration would be needed around the timeframe in which the two treatment works would be built and this timeframe would mainly be driven by the SWOX WRZ supply/demand balance.
Interdependencies/ Exclusivity	This WTW would treat water from Abingdon Reservoir (RES-RRR-ABI) to supply the SWOX WRZ

11.8Abingdon WTW (24Ml/d) - WTW-SWOX-ABI-SWA

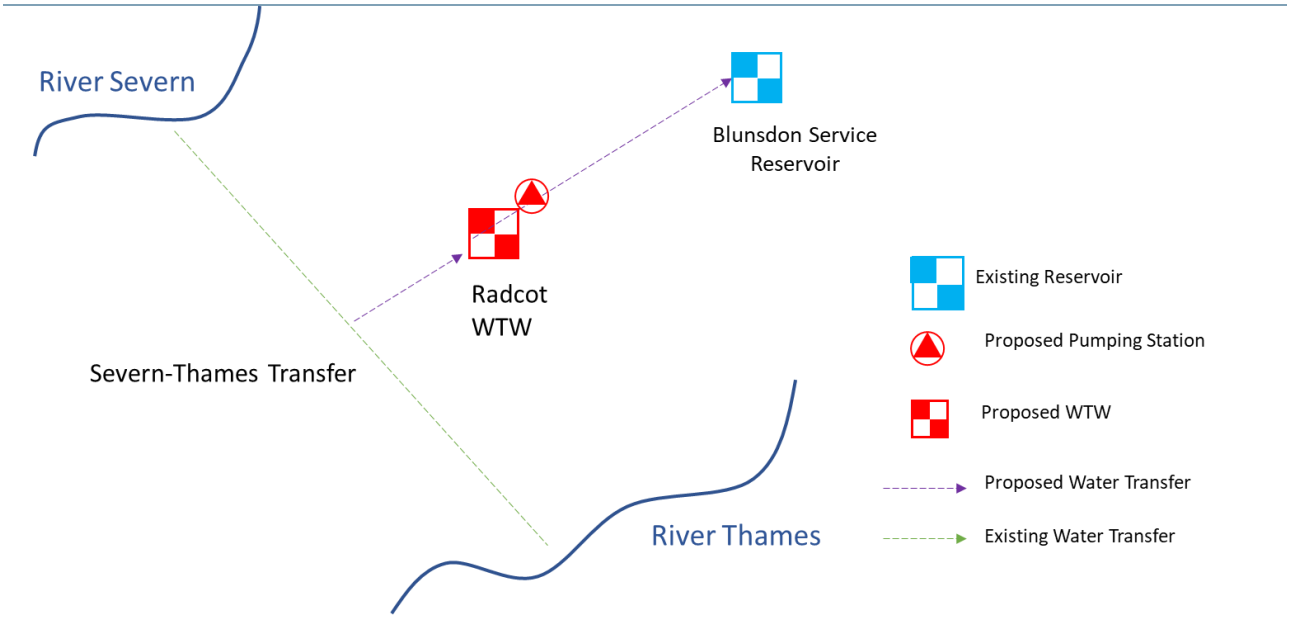
Name	Abingdon WTW (24Ml/d) - WTW-SWOX-ABI-SWA
WRMP19 Reference	WTW-SWOX-ABI-SWA
Element Type	Water Treatment
WRZ	SWA
Engineering Scope	Construction of a 24 Ml/d water treatment works adjacent to and supplied by the new Abingdon reservoir to supply parts of the SWA WRZ. The engineering scope includes a 24 Ml/d raw water pipeline from the reservoir to the treatment works. Up to two further phases of 24Ml/d WTW may be developed as required.
Engineering Components	▪ Raw water pipeline from reservoir to water treatment works 0.5 km length. 700mm diameter for first 440m inside reservoir tunnel (covered in Reservoir element), 600mm diameter for remaining connection from tunnel to WTW. ▪ Raw water pumping station 55 kW (4 Nr 11 kW duty pumps, 1 Nr 11 kW standby pump) ▪ New 24 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, clarification (coagulation / flocculation and Dissolved Air Floatation), Rapid Gravity Filtration, main ozonation, Granular Activated Carbon (GAC) adsorption, disinfection, final water chemical dosing, washwater recovery and sludge treatment. ▪ Interstage pumping station 27.5kW (4 Nr 5.5 kW duty pumps, 1 Nr 5.5 kW standby pump) ▪ Treated water pumping station 750 kW (2 Nr 250 kW duty pumps, 1 Nr 250 kW standby pump)
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	This element is interdependent with the Interzonal transfer element from SWOX to SWA (NET-IZT-AB-LC-72 or NET-IZT-AB-LC-48). The WTW would treat water from Abingdon Reservoir[1] (RES-RRR-ABI) to supply the SWA WRZ.



[1] The works could also treat water from the Severn Thames transfer option. In this case a different raw water connection would be needed. There may also be differences in the treatment process.

11.9Radcot WTW (24Ml/d) - WTW-SWOX-RAD

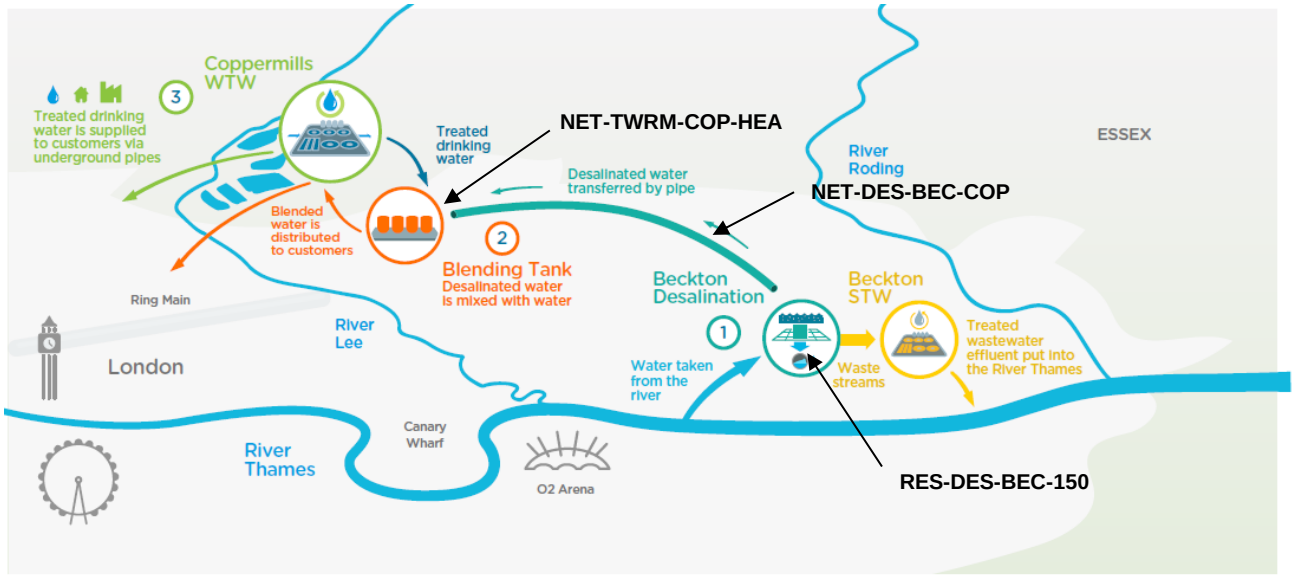
Name	Radcot Water Treatment Works – 24 Ml/d
WRMP19 Reference	WTW-SWOX-RAD
Element Type	Water Treatment
WRZ	SWOX
Engineering Scope	Construction of a 24 Ml/d water treatment works adjacent to a tee off the new main Severn Thames transfer pipeline to supply parts of the SWOX WRZ. The Engineering scope includes the tee off from the pipeline to the treatment works and the treated water pipeline from the treatment works to Blunsdon Service Reservoir.
Engineering Components	▪ Raw water pipeline from tee-off from the main pipeline to water treatment works 1 km length. 600mm diameter. ▪ New 24 Ml/d Water Treatment Works comprising the following treatment steps: pre-ozonation, coagulation / flocculation, Rapid Gravity Filtration, main ozonation, Granular Activated Carbon (GAC) adsorption, disinfection, final water chemical dosing, and washwater recovery and sludge treatment. ▪ Interstage pumping station 75kW (3 Nr 15 kW duty pumps, 2 Nr 15 kW standby pump) ▪ Treated water pumping station 660 kW (3 Nr 132 kW duty pumps, 2 Nr 132 kW standby pump) ▪ Treated water pipeline 15.2 km length from WTW to Blunsdon Service Reservoir, 600 mm diameter.
Benefit	n/a
Time Lead	5 Years
Mutual exclusivities	This element is not mutually exclusive with the Abingdon WTW element as they serve two different options that may both be implemented. If both options were to be implemented including the treatment elements, then consideration would be needed around the timeframe in which the two treatment works would be built and this timeframe would mainly be driven by the SWOX WRZ supply/demand balance.
Interdependencies/ Exclusivity	This WTW would treat water from the Severn Thames Transfer (CON-RWT-DEH-CLM) to supply the SWOX WRZ



12 Network reinforcement

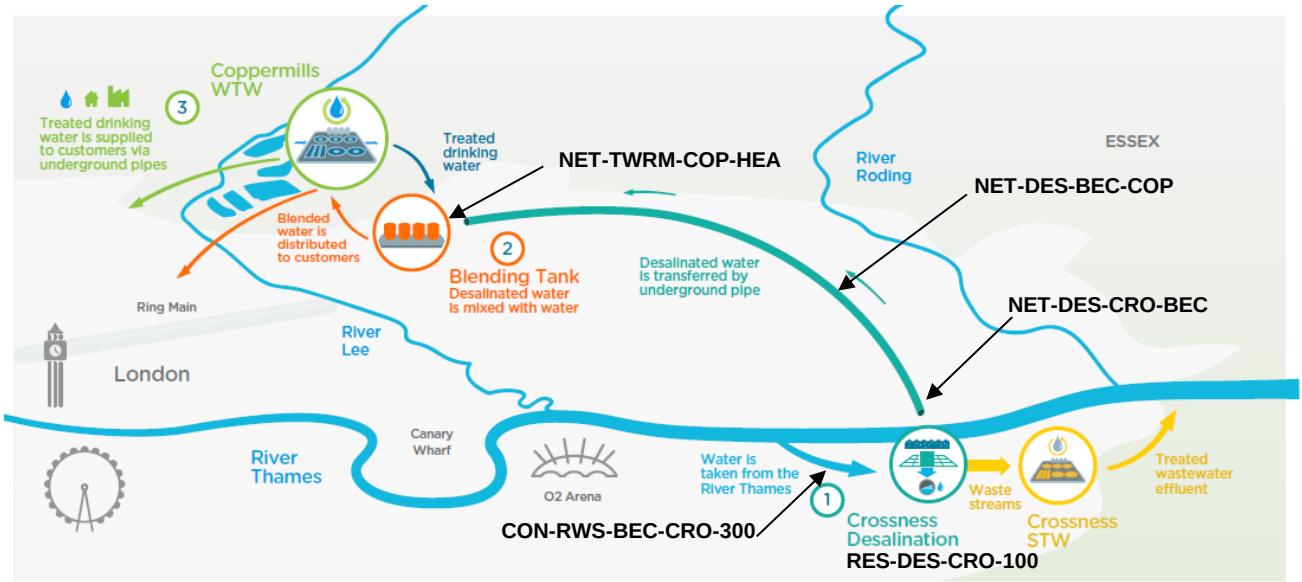
12.1 Desalination Beckton to Coppermills tunnel - NET-DES-BEC-COP

Name	Desalination – Beckton to Coppermills tunnel
WRMP19 Reference	NET-DES-BEC-COP
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	Desalination plants are proposed at Beckton and Crossness. The treated desalination water is to be conveyed via tunnel from both Beckton and Crossness desalination works to Coppermills WTW for blending and distribution. This tunnel conveyance between Beckton desalination plant and Coppermills WTW has the capacity of over 450 Ml/d (the combined Beckton and Crossness desalination plants output).
Engineering Components	▪ The treated water will be conveyed via a 3.5m diameter tunnel from Beckton STW site to Coppermills site. The total length of the tunnel route is approximately 11.5km. ▪ 6 shaft locations ▪ Paths / access for the permanent area for the 6 shafts. ▪ Permanent land for the 6 shafts - 200m^2 each ▪ Temporary land for the shafts - 2,500m^2 each.
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	To provide an additional resource to London WRZ the following system elements are also required: ▪ Desalination plant at Beckton (RES-DES-BEC-150) or Crossness (RES-DES-CRO-100) ▪ A desalination plant at Crossness requires the associated raw (CON-RWS-BEC-CRO-300) and treated water (NET-DES-CRO-BEC) conveyance between Crossness and Beckton. ▪ Additional blending capacity at Coppermills WTW (NET-TWRM-COP-HEA and NET-TWRM-COP-PS) and capacity to discharge into the local water supply network or into the Thames Water Ring Main. ▪ Additional capacity in the Thames Water Ring Main.



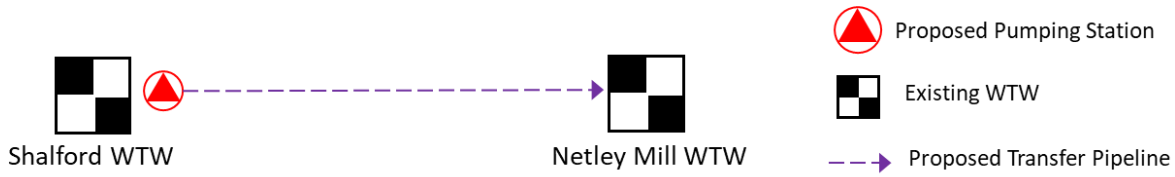
12.2Desalination – Crossness to Beckton tunnel - NET-DES-CRO-BEC

Name	Desalination – Crossness to Beckton tunnel
WRMP19 Reference	NET-DES-CRO-BEC
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	A desalination plant is proposed at Crossness. The treated desalination water is to be conveyed via tunnel from the Crossness plant to the Beckton desalination plant and then via the Beckton to Coppermills tunnel for blending and distribution at Coppermills WTW.
Engineering Components	▪ The treated water will be conveyed via a 3.5m diameter tunnel from the Crossness desalination site to Beckton. The total length of the tunnel route is approximately 4.8km. ▪ 3 shaft locations ▪ Paths /access for the permanent area for the 3 shafts. ▪ Permanent land for the 3 shafts - 200m^2 each ▪ Temporary land for the shafts - 2,500m^2 each.
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	To provide an additional resource to London WRZ the following system elements are also required: ▪ Desalination plant at Crossness (RES-DES-CRO-100) and associated raw water conveyance between Beckton and Crossness (CON-RWS-BEC-CRO-300) ▪ Treated water transmission from Beckton to Coppermills for blending (NET-DES-BEC-COP) ▪ Additional blending capacity at Coppermills WTW (NET-TWRM-COP-HEA and NET-TWRM-COP-PS) and capacity to discharge into the local water supply network or into the TWRM ▪ Additional capacity in the Thames Water ring main.



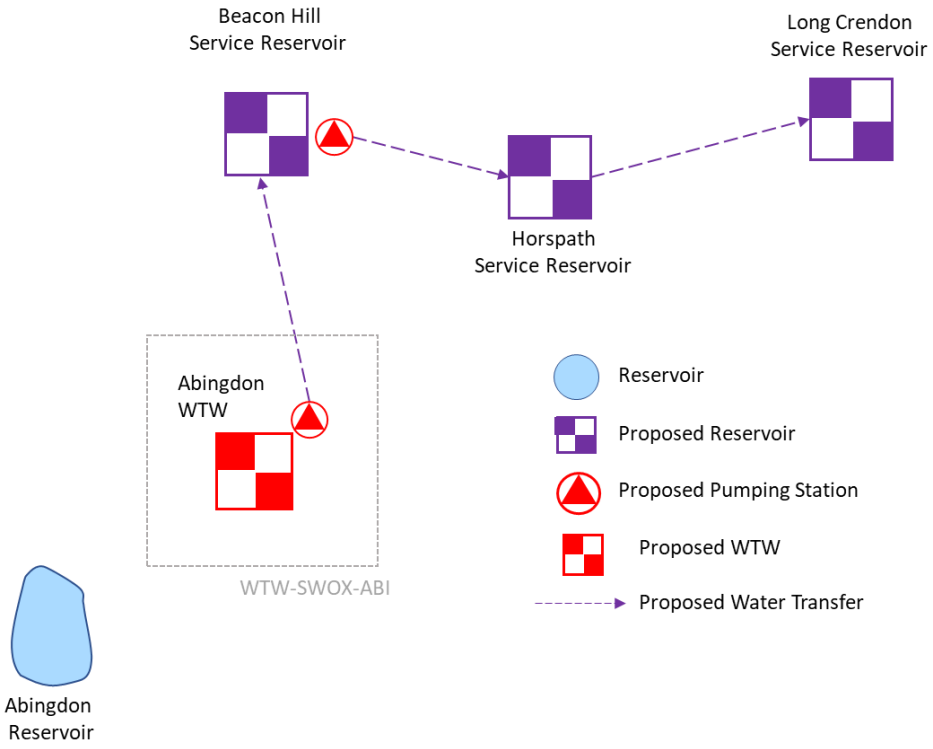
12.3Shalford to Netley Mill – NET-GUI-SFD-NML

Name	Shalford to Netley Mill – 13.8 Ml/d
WRMP19 Reference	NET-GUI-SFD-NML
Element Type	Network Reinforcement
WRZ	Guildford
Engineering Scope	Construction of a transfer pipeline to convey 13.8 Ml/d of treated water between Shalford WTW and Netley Mill WTW, both of which are existing assets, in the Guildford WRZ. The engineering scope includes the provision of a booster pump station at Shalford WTW to facilitate the transfer.
Engineering Components	▪ 400mm, 9.36km long treated water pipeline from Shalford WTW to the contact tank at Netley Mill WTW. ▪ Treated water pumping station ▪ 30 m^3 break pressure tank at or near high point of transfer route.
Benefit	n/a
Lead Time	5 years
Mutual exclusivities	n/a
Interdependencies/ Exclusivity	n/a



12.4SWOX to SWA (72 Ml/d) - NET-IZT-AB-LC-72

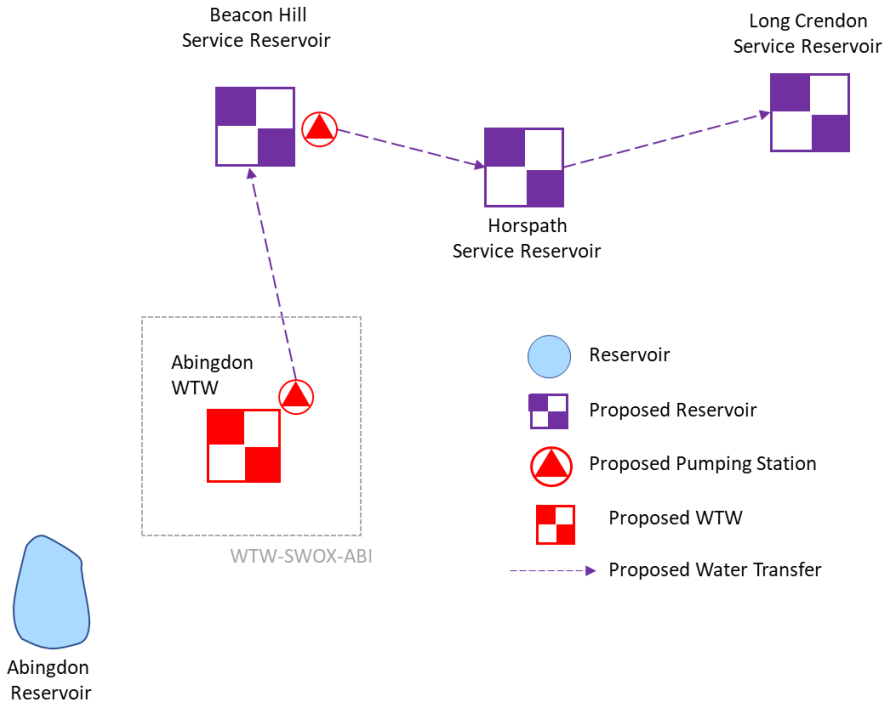
Name	SWOX to SWA (72 Ml/d) - NET-IZT-AB-LC-72
WRMP19 Reference	NET-IZT-AB-LC-72
Element Type	Network Reinforcement
WRZ	SWA
Engineering Scope	The engineering scope includes a 72 Ml/d treated water pipeline from the new Abingdon WTWs first to Beacon Hill, then to Horspath and finally to Long Crendon Service Reservoirs, as well as 3 new 72 Ml/d service reservoirs.
Engineering Components	▪ Treated water pipeline 15.7 km length from the new Abingdon WTW to new Beacon Hill Service Reservoir, 800 mm diameter. ▪ Treated water pipeline 20 km length from new Beacon Hill Service Reservoir to new Horspath Service Reservoir, 800 mm diameter. ▪ Treated water pipeline 12.9 km length from new Horspath Service Reservoir to new Long Crendon Service Reservoir, 1000 mm diameter. ▪ Treated water pumping station 825 kW (2 Nr 250 kW duty pumps, 1 Nr 250 kW standby pump) for pumping water from Beacon Hill SR to Horspath SR. ▪ A new service reservoir at each of Beacon Hill, Horspath and Long Crendon (3 in total). Each reservoir having 24 hr storage (72 Ml) and an area of 18,000 m^2 at 5m depth
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	The element is mutually exclusive with NET-IZT-AB-BS-48
Interdependencies/ Exclusivity	This element is interdependent with the Abingdon 24 Ml/d Water Treatment Works element (WTW-SWOX-ABI-SWA) which would treat water from Abingdon Reservoir[2] (RES-RRR-ABI) to supply the SWA WRZ.



[2] The works could also treat water from the Severn Thames transfer option. In this case a different raw water connection would be needed. There may also be differences in the treatment process.

12.5SWOX to SWA (48 Ml/d) - NET-IZT-AB-LC-48

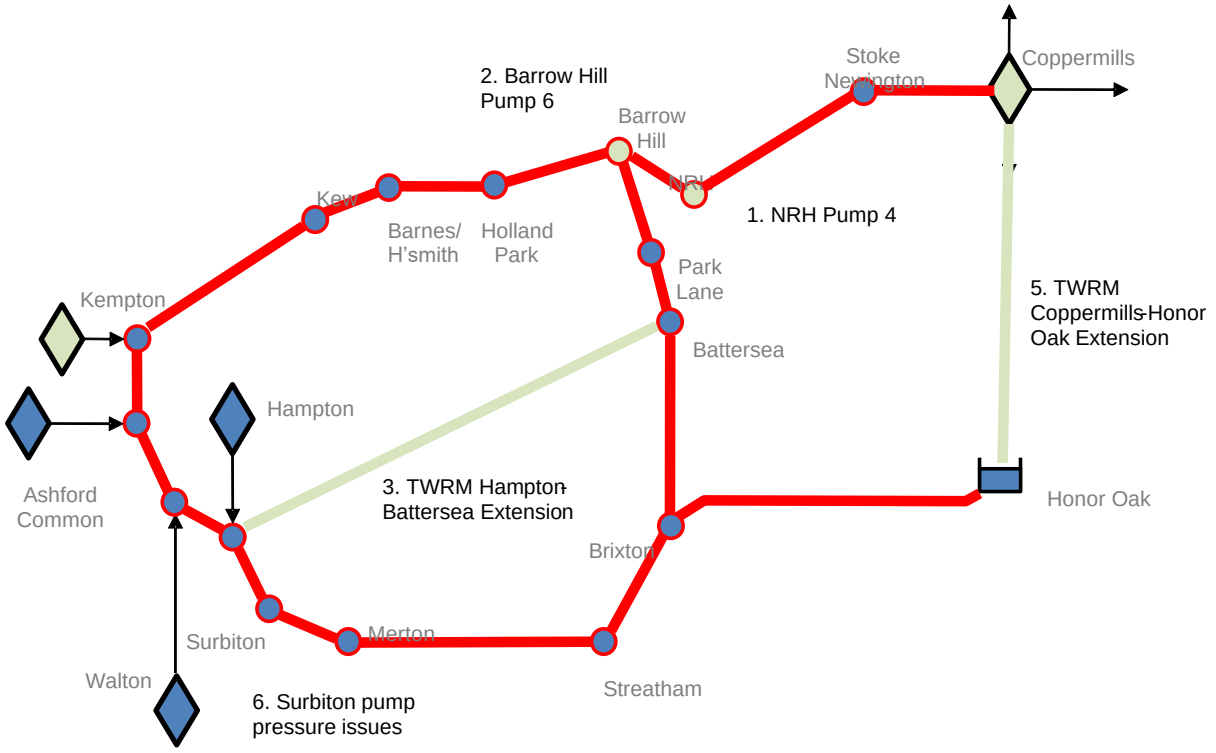
Name	SWOX to SWA – 48 Ml/d
WRMP19 Reference	NET-IZT-AB-BS-48
Element Type	Network Reinforcement
WRZ	SWA
Engineering Scope	The engineering scope includes a 48 Ml/d treated water pipeline from the new Abingdon WTWs first to Beacon Hill, then to Horspath and finally to Long Crendon Service Reservoirs, as well as 3 new 48 Ml/d service reservoirs.
Engineering Components	▪ Treated water pipeline, 16 km in length, from the new Abingdon WTW to the new Beacon Hill service reservoir, 700 mm diameter. ▪ Treated water pipeline, 20.3 km in length, from the new Beacon Hill service reservoir to the new Horspath service reservoir, 700 mm diameter. ▪ Treated water pipeline, 13.1 km in length, from the new Horspath service reservoir to the new Long Crendon service reservoir, 900 mm diameter. ▪ Treated water pumping station for pumping water from Beacon Hill SR to Horspath SR. ▪ A new service reservoir at each of Beacon Hill, Horspath and Long Crendon (3 in total). Each reservoir having 24 hr storage (48 Ml) and an area of 14,000 m^2 at 5m depth
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	This element is mutually exclusive with NET-IZT-AB-LC-72
Interdependencies/ Exclusivity	This element is interdependent with the Abingdon 24 Ml/d Water Treatment Works element (WTW-SWOX-ABI-SWA) which would treat water from Abingdon Reservoir[3] (RES-RRR-ABI) to supply the SWA WRZ.



[3] The works could also treat water from the Severn Thames transfer option. In this case a different raw water connection would be needed. There may also be differences in the treatment process.

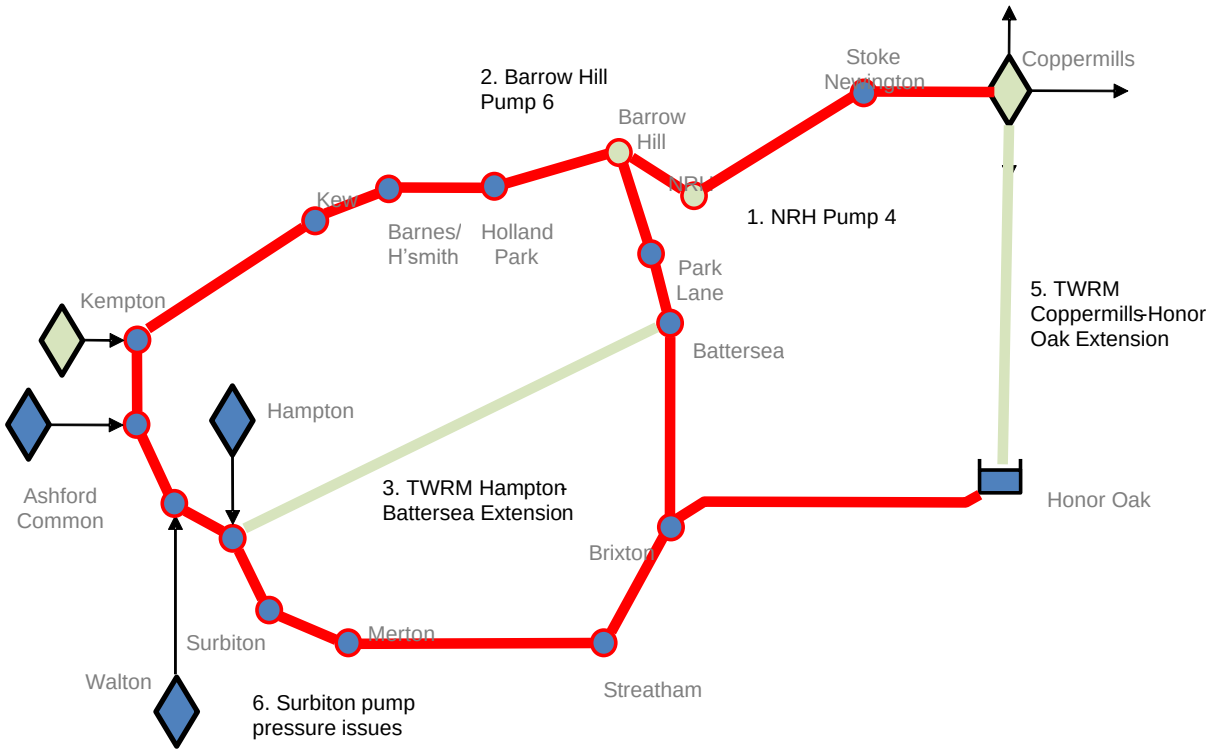
12.6 Network Reinforcement – Barrow Hill Pump 6 replacement - NET-TWRM-BAR-PUM

Name	Network Reinforcement - Barrow Hill Pump 6 replacement
WRMP19 Reference	NET-TWRM-BAR-PUM
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	The element will be required when additional resources from the west and/or east of the London water resource zone (WRZ) are increased reach a trigger value.
Engineering Components	▪ Replacement of existing 30 Ml/d pump (465 kW) with 45 Ml/d pump (600 kW)
Benefit	n/a
Lead Time	1 Year
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	The network reinforcement is required as new water resources are developed and treated for delivery into the London WRZ to meet demand growth. Additional treated water will be supplied from new WTW at Coppermills and/or Kempton, depending on the resource options developed



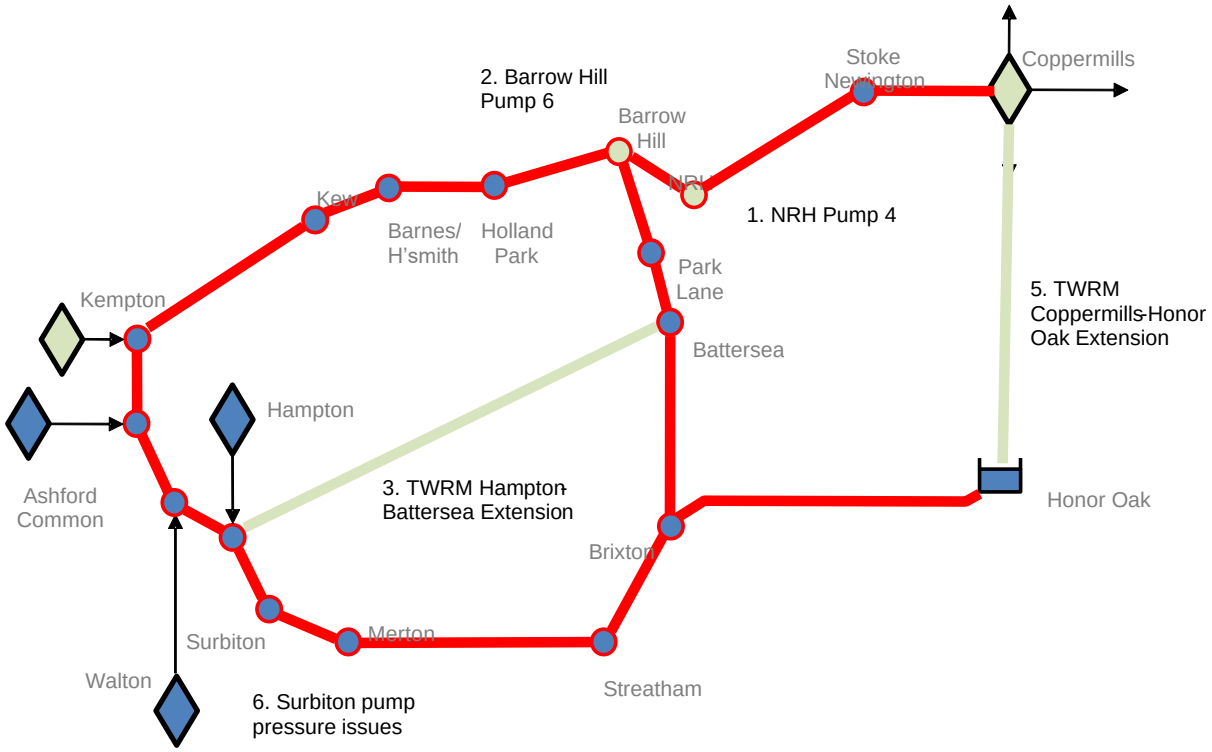
12.7 Network Reinforcement New Header tank at Coppermills WTW - NET-TWRM-COP-HEA

Name	Network Reinforcement - New header tank at Coppermills WTW
WRMP19 Reference	NET-TWRM-COP-HEA
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	The element will be required when additional resources from the west and/or east of the London water resource zone (WRZ) are increased reach a trigger value. The tank minimum water level will be 8mAOD and provide 1 hour storage.
Engineering Components	▪ New header tank at 8m AOD, 1 hr storage volume (25,000 m^3) ▪ Land area requirement: 14,000 m^2
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	Pumping station is required to pump from existing Coppermills contact tank into the new header tank (NET-TWRM-COP-PS) The network reinforcement is required as new water resources are developed and treated for delivery into the London WRZ to meet demand growth. Additional treated water will be supplied from new WTW at Coppermills and/or Kempton, depending on the resource options developed



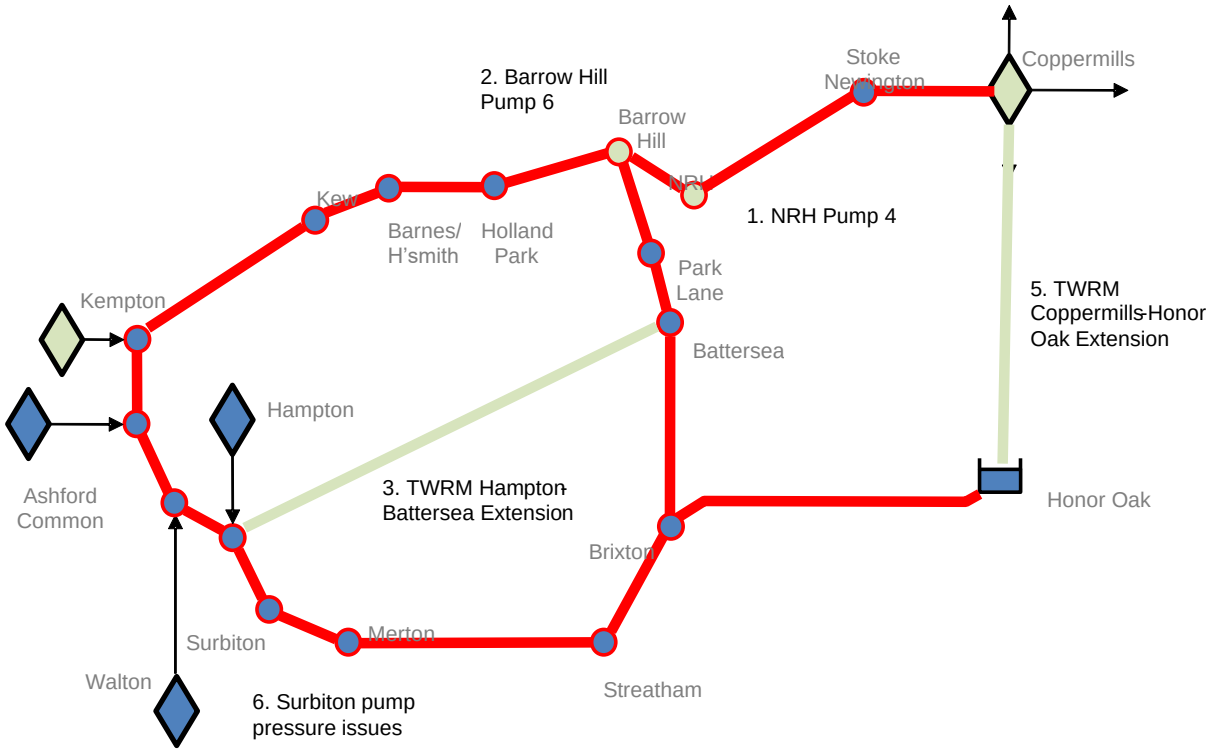
12.8Coppermills WTW to New Honor Oak Service Reservoir TWRM Extension - NET-TWRM-COP-HON

Name	Coppermills WTW to New Honor Oak Service Reservoir TWRM Extension
WRMP19 Reference	NET-TWRM-COP-HON
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	The Coppermills to Honor Oak TWRM extension will be required when additional resources from the west and/or east of the London water resource zone (WRZ) are increased reach a trigger value. The extension tunnel will connect to the existing shafts at Coppermills WTW and New Honor Oak.
Engineering Components	▪ Tunnel from Coppermills to Honor Oak at a diameter of 3.5m for a distance of 14km ▪ 2 No drive shafts (1 No. 12.5m diameter 29m deep shaft, 1 No. 12.5m diameter 57m deep shaft) ▪ 5 No 10.5m diameter intermediate shafts with depths of 25 to 34m ▪ Tunnel connections to existing TW Ring Main at Coppermills and Honor Oak ▪ High Integrity Gate Valves (2 per intermediate shaft) ▪ Permanent Land 1,400m^2 ▪ Temporary land; total of 30,500m^2
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	The network reinforcement is required as new water resources are developed and treated for delivery into the London WRZ to meet demand growth. Additional treated water will be supplied from new WTW at Coppermills and/or Kempton, depending on the resource options developed



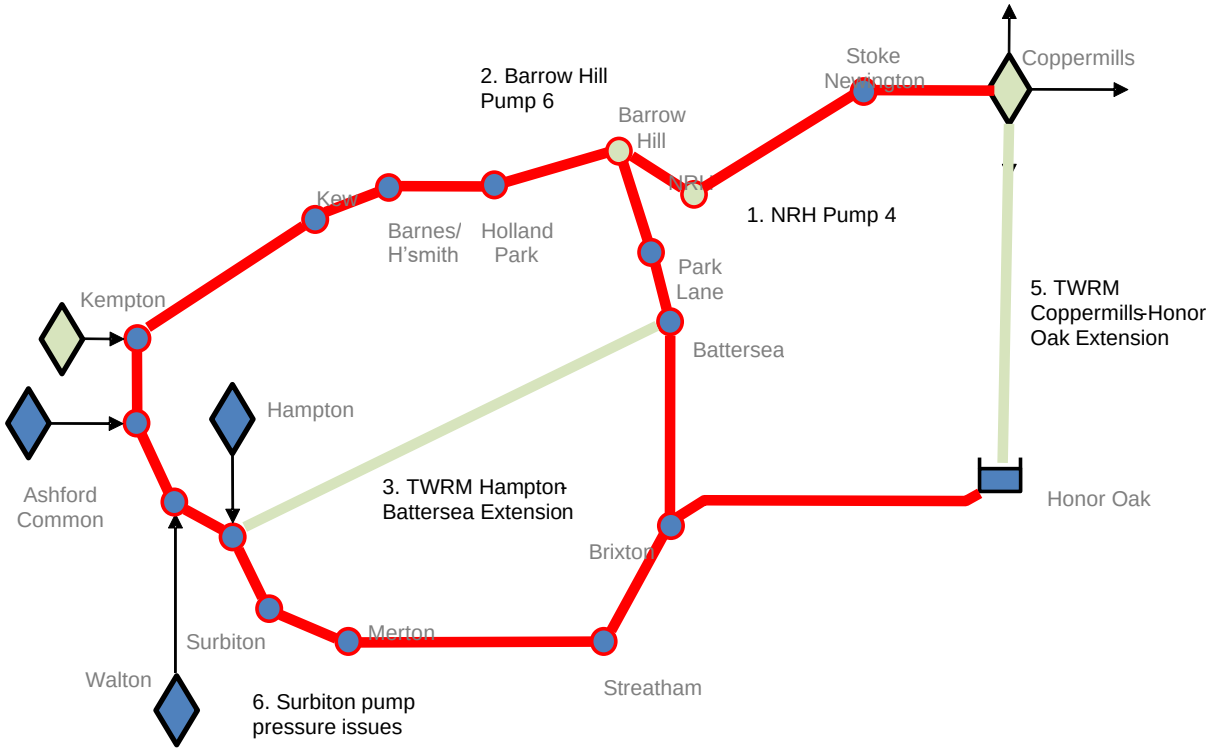
12.9New Coppermills pumping station for new header tank - NET-TWRM-COP-PS

Name	New Coppermills pumping station for new header tank
WRMP19 Reference	NET-TWRM-COP-PS
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	The element will be required when additional resources from the west and/or east of the London water resource zone (WRZ) are increased reach a trigger value. New low lift pump station to pump treated water from the existing Coppermills WTW contact tanks to the new blending / header tank.
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	This element is interdependent with the following element: ▪ NET-TWRM-COP-HEA (New header tank at Coppermills WTW. The network reinforcement is required as new water resources are developed and treated for delivery into the London WRZ to meet demand growth. Additional treated water will be supplied from new WTW at Coppermills treating new resources in east London (Beckton reuse, Deephams reuse).



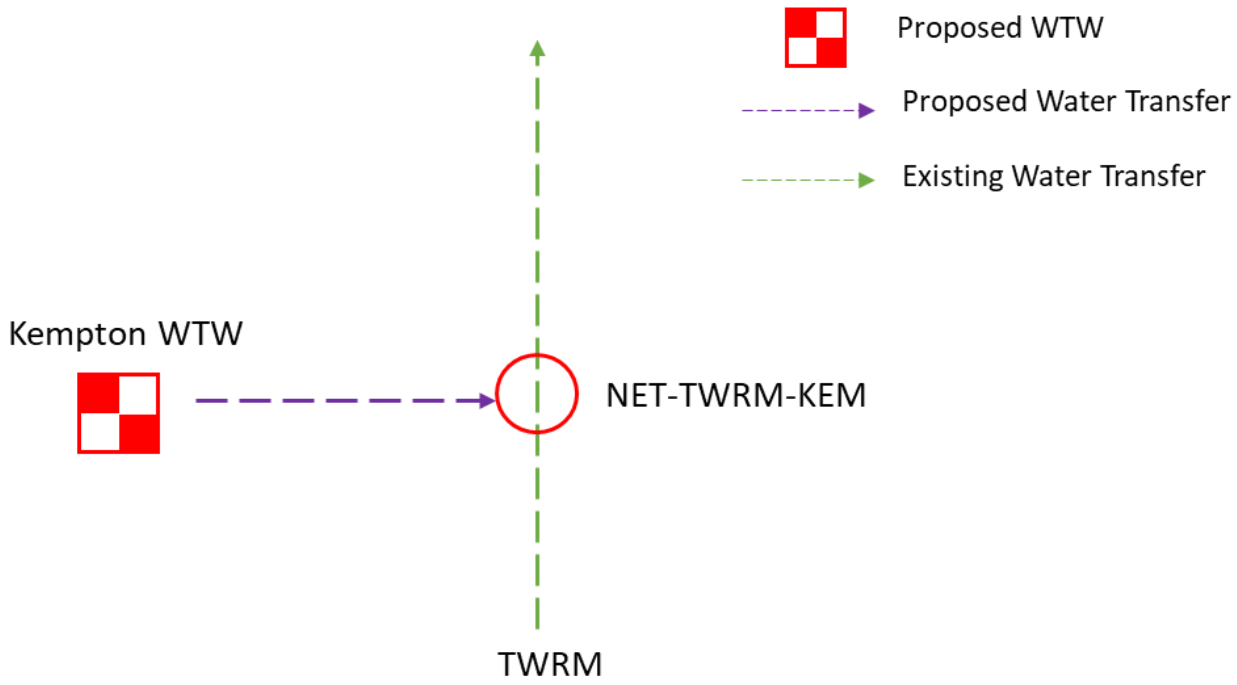
12.10 Hampton WTW to Battersea Extension - NET-TWRM-HAM-BAT

Name	Hampton WTW to Battersea Extension
WRMP19 Reference	NET-TWRM-HAM-BAT
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	The Hampton Battersea TWRM extension will be required when additional resources from the west and/or east of the London water resource zone (WRZ) are increased reach a trigger value. The extension tunnel will connect to the existing shafts at Hampton WTW and Battersea.
Engineering Components	▪ Tunnel from Hampton to Battersea at a diameter of 3.5m for a distance of 20km ▪ 2 No drive shafts (1 No. 12.5m diameter 33m deep shaft, 1 No. 12.5m diameter 40m deep shaft) ▪ 8 No 10.5m diameter intermediate shafts with depths of 30 to 70m ▪ Tunnel connections to existing TW Ring Main at Hampton and Battersea ▪ High Integrity Gate Valves (2 per intermediate shaft) ▪ Permanent land requirement of 2,000 m^2 for shafts ▪ Temporary land requirement 30,000m^2
Benefit	n/a
Lead Time	7 Years
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	The network reinforcement is required as new water resources are developed and treated for delivery into the London WRZ to meet demand growth. Additional treated water will be supplied from new WTW at Coppermills and/or Kempton, depending on the resource options developed



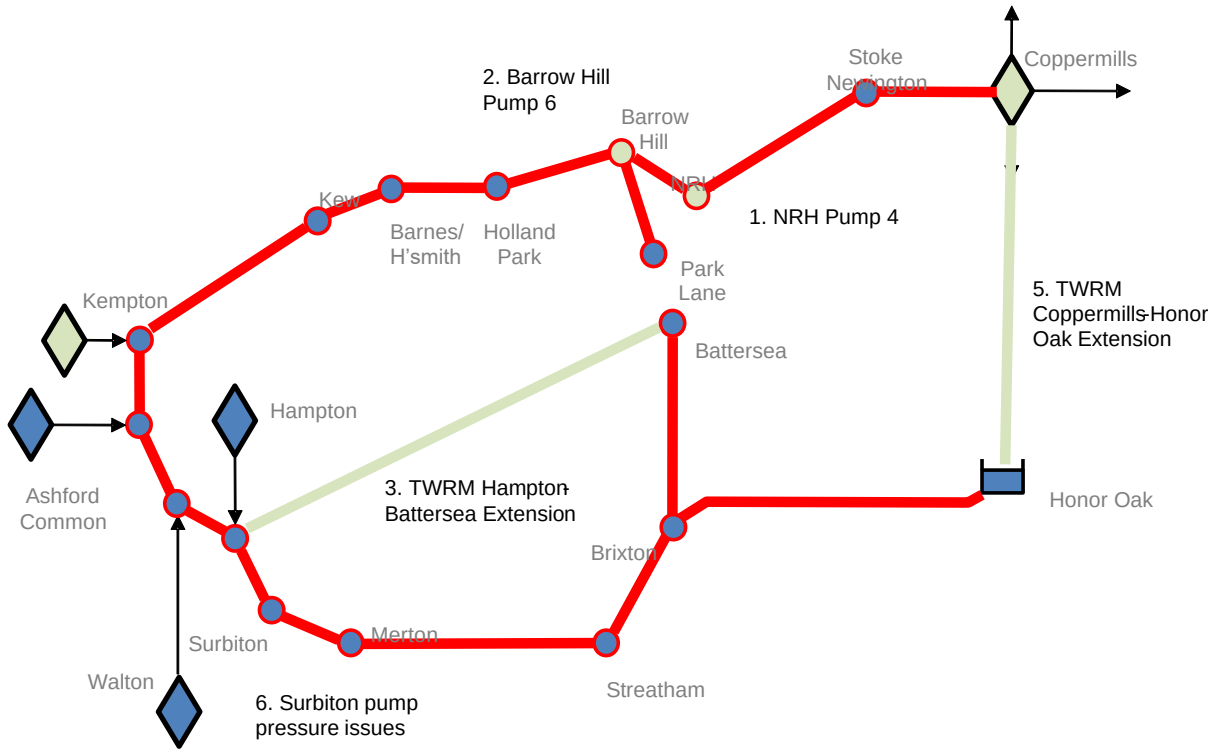
12.11 Network Reinforcement – Kempton WTW New shaft - NET-TWRM-KEM

Name	Network Reinforcement – Kempton WTW New shaft
WRMP19 Reference	NET-TWRM-KEM
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	This element includes a new shaft on the TWRM to accommodate 800 Ml/d of treated water flow from the expanded Kempton WTW. The component will be required when additional resources from the west of London water resource zone (WRZ) are increased.
Engineering Components	▪ New shaft on TWRM shaft 12.5m diameter and 15-20m depth. ▪ Land requirement of 200 m^2.
Benefit	n/a
Lead Time	6 Years
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	This element is interdependent with the new WTW at Kempton to treat new water resources in west London (Abingdon Reservoir, Severn Thames transfer) and will be required at the time that the first additional treatment at Kempton is provided.



12.12 Network Reinforcement – New River Head Pump 4 replacement - NET-TWRM-NRV-PUM

Name	Network Reinforcement - New River Head Pump 4 replacement
WRMP19 Reference	NET-TWRM-NRV-PUM
Element Type	Network Reinforcement
WRZ	LONDON
Engineering Scope	The element will be required when additional resources from the west and/or east of the London water resource zone (WRZ) are increased reach a trigger value. This element consists of replacing a variable speed unit pumping of 45-60Ml/d with a more suitable unit.
Engineering Components	▪ Replacement 700 kW pump with a 900 kW pump
Benefit	n/a
Lead Time	5 Years
Mutual exclusivities	This element is not mutually exclusive with other options/elements
Interdependencies/ Exclusivity	The network reinforcement is required as new water resources are developed and treated for delivery into the London WRZ to meet demand growth. Additional treated water will be supplied from new WTW at Coppermills and/or Kempton, depending on the resource options developed



B. Demand options: Scheme dossiers

R.1 This section provides a high level description of the demand management options that have been included in the Feasible Options List for our revised draft Water Resources Management Plan 2019 and details our assessment of their carbon impact.

R.2 The environmental and social adverse effects of our demand management interventions have been found to be broadly negligible with the exception of carbon. The environmental and social beneficial effects are mainly of a minor to moderate magnitude with the exception of some major beneficial effects in the London WRZ associated with water efficiency for encouraging customers and the public to contribute to more sustainable management of water resources. The environmental and social effects of demand management interventions are detailed in Section 9: Environmental appraisal. The calculation of carbon impact is outlined in this appendix.

R.3 For a detailed description of all demand management interventions and their optimisation within the Integrated Demand Management (IDM) model refer to Section 8: Demand management options appraisal. For further detail of the Integrated Demand Model, refer to Appendix N: Metering.

Metering

Table R-1: Engineering scope - Metering

Name	Metering
WRMP19 Reference	IDM-DM-M
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Metering would be achieved through the installation of advanced metering infrastructure (AMI) meters or automatic meter reading (AMR) meters. This includes the commissioning of fixed network masts for the AMI meter rollout.
Benefit	Metering contributes to the volume of water saved in the IDM programme for both a demand usage reduction and demand leakage reduction.
Lead Time	n/a (currently implemented in AMP6)
Interdependencies/ Exclusivity	Considered with each IDM option.

Mains replacement

Table R-2: Engineering scope - Mains replacement

Name	Mains replacement
WRMP19 Reference	IDM-DM-MR
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Mains replacement achieved by a variety of construction techniques including: open cut, insertion, directional drilling.
Benefit	Mains Replacement contributes to the volume of water saved in the IDM programme for a leakage reduction.
Lead Time	n/a (currently implemented in AMP6)
Interdependencies/ Exclusivity	Considered with each IDM option.

Pressure management

Table R-3: Engineering scope - Pressure management

Name	Pressure management
WRMP19 Reference	IDM-DM-PM
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	London WRZ
Scope	Pressure Management achieved through the installation of pressure reducing valves and tall building booster pumps.
Benefit	Pressure Management contributes to the volume of water saved in the IDM programme for a leakage reduction.
Lead Time	n/a (currently implemented in AMP6)
Interdependencies/ Exclusivity	Considered with each IDM option.

DMA enhancement

Table R-4: Engineering scope - DMA enhancement

Name	DMA enhancement
WRMP19 Reference	IDM-DM-DE
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	DMA Enhancement achieved through the installation of District Meters, valves and washouts and the provision of enabling activities including traffic management and network investigations to enable more accurate targeting and repair of leaks within a DMA.
Benefit	DMA Enhancment contributes to the volume of water saved in the IDM programme for a leakage reduction.
Lead Time	n/a (currently trialled in AMP6)
Interdependencies/ Exclusivity	Considered with each IDM option.

AMP6 leakage reduction carry over

Table R-5: Engineering scope – AMP6 Leakage Reduction Carry Over

Name	AMP6 Leakage Reduction Carry Over
WRMP19 Reference	IDM-DM-CO
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	London, SWOX and Guildford
Scope	The annual average leakage position in 2020/21 (year 1 of AMP7) is lower as a result of the lower starting position in April 2020 due to the high level of leakage reduction activity planned for 2019/20. This means leakage in April 2020 is expected to be 21 Ml/d lower than the leakage in April 2019.
Benefit	AMP6 Leakage Reduction carry over contributes to the volume of water saved for a leakage reduction.
Lead Time	n/a
Interdependencies/ Exclusivity	Applicable to Year 1 of AMP7 only (2020/21)

Innovation (Leakage reduction)

Table R-6: Engineering scope – Innovation (Leakage reduction)

Name	Innovation (Leakage reduction)
WRMP19 Reference	IDM-DM-IL
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Innovation (Leakage reduction) is a future demand management option that refers to enhanced leakage reduction activity achieved using innovative methods. Innovation in leakage reduction will be developed based on the lessons from implementing Mains Replacement, DMA Enhancement, CSL Repair and Pressure Management in AMP7 and early in AMP8.
Benefit	Innovation contributes to the volume of water saved in the IDM programme for a leakage reduction.
Lead Time	10 years
Interdependencies/ Exclusivity	Considered with each IDM option.

Water efficiency

Table R-7: Engineering scope - Water efficiency

Name	Water efficiency
WRMP19 Reference	IDM-DM-WE
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Water efficiency is achieved by a variety of techniques including smarter home visits, smarter business visits, wastage fixes, water efficiency retrofitting schemes on housing association properties and innovative new solutions to further reduce household usage.
Benefit	Water Efficiency contributes to the volume of water saved in the IDM programme for a demand usage reduction.
Lead Time	n/a (currently trialled in AMP6)
Interdependencies/ Exclusivity	Smarter Home Visits to newly metered properties is dependent on the metering programme. All other options are considered with each IDM option.

Incentives programme

Table R-8: Engineering scope - Incentives programme

Name	Incentives Programme
WRMP19 Reference	IDM-DM-IN
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Incentives Programme is achieved by offering customers an incentive to be more efficient with their water consumption through non-financial offers (vouchers, prize draws, community rewards).
Benefit	Incentives Programme contributes to the volume of water saved in the IDM programme for a demand usage reduction.
Lead Time	n/a (currently trialled in AMP6)
Interdependencies/ Exclusivity	Considered with each IDM option.

Non-potable water – combined options

Table R-9: Engineering scope - Non-potable water – combined options

Name	Non-potable water – combined options
WRMP19 Reference	IDM-DM-NPC
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Non-potable water includes water that is not of drinking water quality but that can be used for other purposes such as toilet flushing and garden watering. Non-potable water sources include stormwater, rainwater, greywater and a combination of these sources.
Benefit	Non-potable water contributes to the volume of water saved in the IDM programme for a demand usage reduction.
Lead Time	1 year
Interdependencies/ Exclusivity	Considered with each IDM option.

Innovative Tariffs

Table R-10: Engineering scope – Innovative Tariffs

Name	Innovative Tariffs
WRMP19 Reference	IDM-DM-TA
Element Type	Element within Integrated Demand Management (IDM) options
WRZ	All WRZ's
Scope	Imposition of tariff or pricing controls to incentivise water conservation.
Benefit	Innovative tariffs contributes to the volume of water saved in the IDM programme for a demand usage reduction.
Lead Time	1 year (to set up pricing controls)
Interdependencies/ Exclusivity	Requires a minimum meter penetration of 65% to ensure fairness in billing to customers

Carbon cost assessment

R.4 We engaged Mott MacDonald to assess the carbon impact of our demand management activities for Metering, Mains Replacement, Pressure Management and DMA Enhancement. The Water Efficiency assessment is included in Section 9: Environmental Appraisal and the Non-potable water assessment is included in Appendix L: Water Reuse.

Methodology

R.5 Carbon was assessed on a demand management activity basis. The number and cost of activities undertaken within each optimised demand management programme was summarised and included:

- Domestic meter installation
- Bulk meters (small and large blocks of flats) installations
- Household and bulk meter replacements (this includes only the replacement of a meter and not the meter chamber which is assumed to have a longer asset life, see Table R-11)
- Pressure management activities
- Mains replacement

R.6 Each of these demand management interventions were linked to an asset category, specified asset life and carbon impact, which in turn was linked to £'s spent on that demand management intervention (Table R-11). The asset category was based on Driven Rates from April 2015[4] and the Asset Class Structure[5].

[4] Mott MacDonald, 2015, 'Driven Rates (2015-04-28)' excel spreadsheet.
[5] Mott MacDonald, 'Asset Class Structure for Portal', excel spreadsheet

Table R-11: Carbon cost assessment

Demand management activity	Asset category	Unit	Value	Asset Life
Mains Replacement	2210 (Local treated: Distribution main, 80yrs) -> 2210_Carbon (Carbon from Local treated: Distribution..., 80yrs)	£1 Capex > tCO2e	0.00025	80 years
Pressure Management	2270 (Local treated: Mechanical & Electrical, 20yrs) -> 2270_Carbon (Carbon from Local treated: Mechanical &..., 20yrs)	£1 Capex > tCO2e	0.00018	20 years
Meter Chambers	2280 (Local treated: Meter chambers, 40yrs) -> 2280_Carbon (Carbon from Local treated: Meter chambe..., 40yrs)	£1 Capex > tCO2e	0.00025	40 years
Bulk Meters	2281 (Local treated: Meters - District, 20yrs) -> 2281_Carbon (Carbon from Local treated: Meters - Dis..., 20yrs)	£1 Capex > tCO2e	0.00018	20 years
Domestic Meters	2282 (Local treated: Meters - Domestic, 15yrs) -> 2282_Carbon (Carbon from Local treated: Meters - Dom..., 15yrs)	£1 Capex > tCO2e	0.00018	15 years
DMA Enhancement	2210 (Local treated: Distribution main, 80yrs) -> 2210_Carbon (Carbon from Local treated: Distribution..., 80yrs)	£1 Capex > tCO2e	0.00025	80 years

R.7 The profile spent across each activity was linked to its associated asset life and an 80 year spend profile was calculated. This spend profile for each activity was then multiplied by the associated tonnes per £ spent emissions factor and an equivalent carbon impact tCO2e was estimated. These were then combined to estimate the overall carbon impact of each integrated demand management programme.