PR24

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RESERVOIR SAFETY SUPPLEMENTARY INFORMATION

NES22A

1. INTRODUCTION

1. In the draft determination, Ofwat makes a 50% reduction to our costs for **reservoir safety** through a deep dive in the PR24-DD-W-Reservoir-Safety model[1].

2. We knew that there was significant uncertainty in this area, and said in our enhancement case NES22 that:

> "we are conducting ongoing and detailed drawdown site investigations for our eight sites, including outline design and feasibility assessment to further validate our cost data by May 2024, and inform Ofwat's Final Determination".[2]

3. We described this in more detail later in the same enhancement case:

> "Identifying viable options to address shortfalls in drawdown capacity requires detailed feasibility and design, including hydraulic modelling to test options against the compliance criteria. Given the early stage of investigation and solution development, and the fact that for some sites we are anticipating work to be required following future S10 reservoir inspections, the optioneering process for all sites is not yet complete (and cannot yet be completed). A number of sites are currently under investigation and the initial options screening and development phase. Other sites are awaiting S10 inspection at the end of 2023. Ongoing work to conduct site investigations and carry out design and feasibility as part of our reservoir programme will make sure more detailed costing data is available in 2024, before Ofwat's Final Determination.
>
> "Therefore, for our business plan submission we have used expert judgement to define the most likely solutions for each of the nine reservoirs to build a sound basis for cost estimation. This is based on the preferred options being taken forward for those sites currently in initial optioneering and options screening, and expert knowledge of the site context and operating constraints for the remaining sites."[3]

4. Ofwat raises some concerns about why part of the risk associated with reservoir safety investments could not have been proactively managed through previous base allowances; about the high level of solution and cost uncertainty and the uncertainty of scope; and the scale and scope of benchmarking and cost assurance.

5. We said at the time that not all of these inspections had taken place yet[4]:

> "The S10 inspection report for Hallington East is due to be issued in Q3 2023. Work is currently ongoing at Derwent and Waskerley to undertake on-site validation of the initial shortfall assessment. A

[1] PR24-DD-W-Reservoir-Safety, sheet NES
[2] NES22, October 2023, p4
[3] NES22, October 2023, p14
[4] NES22, p12

compliance date will be assigned following the outcome of the validation exercise. Both Cow Green and Whittle Great Southern are scheduled for S10 inspection in Q4 2023, after which we expect an action to investigate and conduct on-site validation of the calculated shortfall will be assigned. A compliance date for completion of a solution to address the shortfall will then be set based on the outcome of the validation exercise. Given that compliance dates are usually assigned with a three-year window to allow investigation, design, and completion of the work, we anticipate a date for these sites of 2026/27."

6. This meant that in October, the scope of work for these reservoirs was not clear (we were waiting for S10 reports for five out of the nine reservoirs). We had also not carried out this work fully before, with our first reservoir (West Hallington) only just underway.

7. We have now also completed the work at West Hallington, and a **description and review from our contractors** can be found online. This explains how we developed a new design which uses two siphons to meet the required drawdown capacity, and how we encountered challenges and learned lessons on the way. This project was successful and delivered on time (with a revised date agreed with the Panel Engineer) and on budget.

8. We also noted in NES22 that most of the costs needed for reservoir safety schemes were not included in our standard iMOD cost models, as we had not carried out similar schemes before. We explained how we had carried out an options development workshop, which identified the most likely technically feasible option for each reservoir and the high-level scope requirements[5]. Since then, we have further reviewed costs with our consultants and stakeholders to review what would be needed and how much this would cost.

9. This has allowed us to revise our cost estimates and timescales for reservoir drawdown projects – as we now also have a clearer scope of work and a standard solution that can be applied (from West Hallington). As a result, we have reduced our enhancement case from £80.578m to **£71.164m**.

10. This is because:

- We have now developed a scope and costed the likely solution to install a siphon at each reservoir, calculating pipe/siphon sizes based on the size of the drawdown deficit (that is, the flow rate required). We created a standard siphon design so that we now have more certainty about the scope.
- We reviewed our costs at four sites where we now have final estimates of scope (that is, Scaling Dam, Waskerley, Fontburn, and Lockwood Beck). We have costed our primary recognised engineering solution.
- We will use these standard costs for Scaling Dam, Waskerley, Fontburn, and Lockwood Beck reservoirs – reducing costs in AMP8 by £6.237m.

[5] NES22, p15 and Table 8

- We had previously used piling costs of £3.5m, based on a quotation we had for Lockwood Beck[6]. Our costing panel considered that this was not comparable to construction costs for reservoirs, and reduced this to £1.3m based on piling costs at Fontburn Reservoir.
- After the inspection at Cow Green, the statutory compliance date now means that the majority of construction costs for this reservoir (this was £17m) fall after 2030 – leaving £1.5m in 2025-30. We now estimate that this site may require £25m to £30m of funding at PR29.
- After the inspection at Hanningfield, we have added £12.6m of costs to the 2025-30 plan to bring forward work on this reservoir (which we had previously expected to fall into AMP9).

11. Since publishing our business plan in October 2023, we have continued to work on this (as we said we would in NES22. We provide further detailed evidence about our options selection and benchmarking process in the sections below.

TABLE 1 - SUMMARY OF RESERVOIR SAFETY COSTS

Reservoir	% of costs in AMP8	October Business Plan Capex (£m)	August 2024 representations Capex (£m)
Scaling Dam	55%	5.215	4.172
Waskerley	100%	10.701	7.489
Fontburn	55%	5.336	4.994
Lockwood Beck	55%	5.279	3.639
Derwent	100%	12.608	12.608
Hallington East	100%	12.077	12.077
Whittle Dene	100%	12.077	12.077
Cow Green	100%[7]	17.286	1.500
Hanningfield	100%	0.000	12.608
TOTAL	**-**	**80.578**	**71.164**

12. Not including changes in timing for Cow Green and Hanningfield reservoirs, this means we can deliver the reservoir safety schemes for about 10% less than our original estimates (£6.237m saving).

[6] NES22, p15
[7] No costs fall into AMP7. The expected AMP9 costs are not included here.

2. NEED FOR ENHANCEMENT INVESTMENT

13. Ofwat raised some concerns that part of this could overlap with base expenditure. They said:

> "The remaining investment is related to more certain drivers and result in significant infrastructure interventions (e.g. spillway upgrades). This includes updated guidelines on drawdown capacity for reservoir safety and emergency planning (2017). However, for the residual £80.578 million we make a further 10% cost challenge as the company has not provided sufficient and convincing evidence that all the investment is enhancement rather than base maintenance. This includes why part of the risk associated with these investments could not have been proactively managed via previous base allowances, noting that base water resources spend over 2020-25 on reservoirs (infrastructure costs used as proxy) appears low compared to the water supply (distribution input) delivered by these types of assets."[8]

14. We included an enhancement case to meet these new requirements in our business plan in October 2023[9].

15. We explained that our reservoir safety programme is currently funded by overspending base allowances, and this has been delivering our statutory requirements under the Reservoirs Act – with capital maintenance interventions prioritised on the basis of expert engineering judgment provided via our cyclical inspection programme. This programme will continue in 2025-30 with an estimated capital maintenance budget of approximately £55m, compared to our forecast outturn of £42m in 2020-25. This spend is targeted to address actions identified by our inspecting engineers, either in the interests of safety (IoS) or in the interests of maintenance (IoM), and does not include meeting new drawdown capacity requirements.

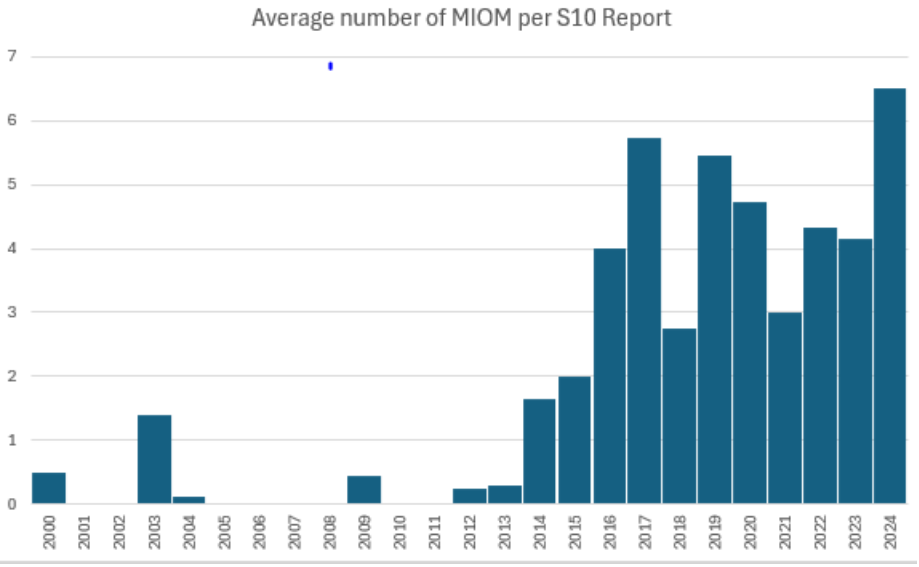
16. Investment to address the shortfall in drawdown capacity is driven specifically by a change in Defra guidance, and inspecting engineers are now required to enact the guidance via the inspection programme (and issue us with a statutory date for compliance). Our enhancement case NES22 described two reservoirs (West Hallington and Hury), where we are already investing to meet our statutory compliance dates (April 2024 and May 2025). We explained that, as a new statutory requirement that means significantly higher costs, meeting drawdown requirements meets the requirements for enhancement expenditure in AMP8. In our enhancement case NES22 we explained the schemes we expected to require and the costs of these.

17. We note that Ofwat's assessment says that this "includes updated guidelines on drawdown capacity for reservoir safety and emergency planning (2017)" – but in fact, **all** of this investment relates to drawdown capacity, and **none** of this relates to base maintenance (or even spillway upgrades). There are no risks being addressed that could (or should) have already been addressed by base maintenance, because we are already addressing any

[8] PR24-DD-W-Reservoir-Safety, NES worksheet
[9] NES22

other maintenance issues from base expenditure. There has been an increase level of measures for both IoS and IoM since 2014 (but this is particularly pronounced for IoM, as shown in Figure 1). Figures 2 and 3 show that siphons are separate assets, and do not involve upgrading or maintaining existing assets.

FIGURE 1 - MEASURES IN THE INTERESTS OF MAINTENANCE



18. Ofwat notes that base water resources spend over 2020-25 on reservoirs appears low compared to the water supply (distribution input) delivered by these types of assets. However, this is not relevant to the question of whether or not this could (or should) have been funded by base expenditure. None of the base models for water resources or wholesale water use the types of water resources as a driver. None of the expenditure proposed in this enhancement case relates to any risks that could have been previously tackled through better maintenance or by managing risks differently - they are all additional and separate siphons relating specifically to the 2017 regulations, where inspections have led to compliance dates in AMP8. In most cases, inspections were not complete even for the business plan in October 2023.

19. We note that base expenditure allowances at PR24 are based on cost models that use outturn data up to 2022-23, which will not include our own expenditure on reservoir safety – and we do not expect that these costs are included in costs up to 2022-23 for other companies either, who have similar timescales for this.

3. BEST OPTION FOR CUSTOMERS

20. Ofwat raised some significant concerns about whether the investment is the best option for customers. They said:

> "The company states that despite the work to quantify the costs of delivering the programme, there remains a high level of solution and cost uncertainty that will only be resolved by further detailed feasibility, investigation and design work. We would have expected to see alternative options such as increasing capacity of existing drawdown pipework, etc.
>
> Uncertainty of scope, due to inspections yet to have taken place, is flagged within the options development discussion. The company only presents a single most-likely option per site. There is no clear description of alternative solutions presented to manage the risks nor quantified cost-benefit analysis of alternatives."[10]

21. We accept that there was a high level of solution and cost uncertainty at the time of the business plan – as inspections had not yet taken place. However, since then, we have developed these solutions in more detail.

22. We identified some possible options for each site as part of our business planning process, and we described some of these in our enhancement case NES22 – for those reservoirs with a 2025 compliance date. These options were for a new siphon, valve operated pipework discharging to existing overflow shafts, or modifications to existing overflow arrangements (see Table 7 of NES22). However, we acknowledged that without inspections it was not clear how these options could be compared – and so we used a combination of expert judgement and risk assessment. We also acknowledged that building robust cost estimates for interventions of this type would be very challenging, as there had been a limited number of schemes implemented across the sector and the material factors driving the costs would be difficult to predict without detailed investigations. We observed very limited correlation between the size of the drawdown and the cost of the solution.

23. Since then, we have been able to develop three standard options that could be used for this need. We assessed these options against qualitative criteria (as items like health and safety and access are difficult to quantify). In each case, the standard siphon option was the lowest cost and had the most benefits.

24. In the tables in section 3.1, we present the three alternative options and the cost-benefit analysis of these alternatives. It is not necessary to quantify the benefits in this case, as these are often intangible and the ranking of the options is clear without the need for quantification.

[10] PR24-DD-W-Reservoir-Safety, NES worksheet

3.1. ASSESSMENT OF OPTIONS AT EACH SITE

3.1.1. Scaling Dam

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	Low risk as no need to excavate through the central core.	Increased risk as will be low level and through the lowest part of the core.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	May require full drawdown and hence disruption to supply. Impact low.	Likely to require full drawdown and hence disruption to supply. Impact low.
Health & Safety	No need for diving work.	Work needed within a deep coffer dam or use of divers.	Work needed within a deep coffer dam. New tunnelling.
Environment	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat.	Works may require substantial drawdown of reservoir with impact on fish and habitat.	Works may require full drawdown of reservoir with impact on fish and habitat.
Access	Access for construction plant good.	Access for construction plant good.	Access for construction plant good.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	Requires confined space access for inspection. Reduced room in tunnel. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.2. Waskerley

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	Low risk as no need to excavate through the central core. Limited room in existing culvert.	Increased risk as will be low level and through the lowest part of the core.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	May require full drawdown and hence disruption to supply.	Likely to require full drawdown and hence disruption to supply.
Health & Safety	No need for diving work. Short length of tunnel may be required.	Work needed within a deep coffer dam or use of divers.	Work needed within a deep coffer dam. New tunnelling.
Environment (note: reservoir is stocked for fishing)	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat including protected species.	Works may require substantial drawdown of reservoir with impact on fish and habitat including protected species.	Works may require full drawdown of reservoir with impact on fish and habitat including protected species.
Access	Third party land may be needed for construction plant access.	Third party land may be needed for construction plant access.	Third party land may be needed for construction plant access.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	Requires confined space access for inspection. Reduced room in tunnel. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.3. Fontburn

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	Low risk as no need to excavate through the central core.	Increased risk as will be low level and through the lowest part of the core.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	May require full drawdown and hence disruption to supply.	Likely to require full drawdown and hence disruption to supply.
Health & Safety	No need for diving work. Short length of tunnel may be required.	Work needed within a deep coffer dam or use of divers.	Work needed within a deep coffer dam. New tunnelling.
Environment (note: reservoir is stocked for fishing)	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat including protected species.	Works may require substantial drawdown of reservoir with impact on fish and habitat including protected species.	Works may require full drawdown of reservoir with impact on fish and habitat including protected species.
Access	Third party land needed for construction plant access.	Third party land needed for construction plant access.	Third party land needed for construction plant access.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	Requires confined space access for inspection. Reduced room in tunnel. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.4. Lockwood Beck

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	No existing tunnel. Would require pipe jacking. Increased risk as will be low level and through the lowest part of the core.	Increased risk as will be low level and through the lowest part of the core. Dam has history of instability. Previous dam built on a fault line.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	Will require full drawdown and hence disruption to supply. Impact low.	Likely to require full drawdown and hence disruption to supply. Impact low.
Health & Safety	No need for diving work.	Work needed within a deep coffer dam.	Work needed within a deep coffer dam. New tunnelling.
Environment	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat including protected species.	Works will require substantial drawdown of reservoir with impact on fish and habitat including protected species.	Works may require full drawdown of reservoir with impact on fish and habitat including protected species.
Access	Access for construction plant good.	Access for construction plant good.	Access for construction plant good.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.5. Derwent

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	Low risk as no need to excavate through the central core.	Increased risk as will be low level and through the lowest part of the core.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	May require full drawdown and hence disruption to supply.	Likely to require full drawdown and hence disruption to supply.
Health & Safety	No need for diving work.	Work needed within a deep coffer dam or use of divers.	Work needed within a deep coffer dam. New tunnelling.
Environment	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat.	Works may require substantial drawdown of reservoir with impact on fish and habitat.	Works may require full drawdown of reservoir with impact on fish and habitat.
Access	Access for construction plant good.	Access for construction plant good.	Access for construction plant good.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	Requires confined space access for inspection. Reduced room in tunnel. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.6. Hallington

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	No existing tunnel. Would require pipe jacking. Increased risk as will be low level and through the lowest part of the core.	Increased risk as will be low level and through the lowest part of the core.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	Will require full drawdown and hence disruption to supply.	Likely to require full drawdown and hence disruption to supply.
Health & Safety	No need for diving work. Short length of tunnel may be required.	Work needed within a deep coffer dam.	Work needed within a deep coffer dam. New tunnelling.
Environment (note: reservoir is stocked for fishing)	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat including protected species.	Works will require substantial drawdown of reservoir with impact on fish and habitat including protected species.	Works will require full drawdown of reservoir with impact on fish and habitat including protected species.
Access	Construction plant access may need to avoid the narrow causeway between West and East Hallington.	Construction plant access may need to avoid the narrow causeway between West and East Hallington.	Construction plant access may need to avoid the narrow causeway between West and East Hallington.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.7. Whittle Dene

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	No existing tunnel. Would require pipe jacking. Increased risk as will be low level and through the lowest part of the core.	Increased risk as will be low level and through the lowest part of the core. Dam has history of instability.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	Will require full drawdown and hence disruption to supply.	Will require full drawdown and hence disruption to supply.
Health & Safety	No need for diving work.	Work needed within a deep coffer dam.	Work needed within a deep coffer dam. New tunnelling.
Environment	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat including protected species.	Works will require substantial drawdown of reservoir with impact on fish and habitat including protected species.	Works may require full drawdown of reservoir with impact on fish and habitat including protected species.
Access	Access for construction plant good.	Access for construction plant good.	Access for construction plant good.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Highest cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Highest cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.1.8. Hanningfield

Consideration	Option		
	Siphon(s)	Increasing capacity of existing pipework and valves (using existing tunnel)	Increasing capacity of existing pipework and valves (new tunnel)
Risk to safety of the dam (from internal erosion / leakage / differential settlement)	Low risk as no need to excavate through the central core (siphons will go through the top of the core where recompaction will be easier).	Little space in existing tunnel. Increased risk as will be low level and through the lowest part of the core.	Increased risk as will be low level and through the lowest part of the core.
Disruption to supply	Does not require full drawdown and hence some supply can be maintained.	Will require full drawdown and hence disruption to supply.	Likely to require full drawdown and hence disruption to supply.
Health & Safety	No need for diving work. Short length of tunnel may be required.	Work needed within a deep coffer dam.	Work needed within a deep coffer dam. New tunnelling.
Environment (note: reservoir is stocked for fishing)	Works can be constructed with partial drawdown of reservoir and hence reduced impact on fish and habitat including protected species.	Works will require substantial drawdown of reservoir with impact on fish and habitat including protected species.	Works will require full drawdown of reservoir with impact on fish and habitat including protected species.
Access	Construction plant access available on NWL land.	Construction plant access available on NWL land.	Construction plant access available on NWL land.
Buildability	NWG have a standard proven design.	Deep coffer dam required. May need divers.	Deep coffer dam required. May need divers.
O&M	NWG have standard Ops manual.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.	New valve tower may be required. Requires confined space access for inspection. Bespoke operations and maintenance.
Capital Cost	Lowest cost.	Medium cost.	Highest cost.
Maintenance Cost	Lowest cost.	Highest cost.	Medium cost.
Preference	Preferred option.		

Key: Green = low risk / likely to be acceptable to a QCE. Amber = some risks which can be managed / likely to be acceptable to a QCE. Red = high risk / not likely to be acceptable to a QCE.

3.2. WHY CAN SIPHONS PRESENT THE BEST SOLUTION?

25. Since new advice on emergency drawdown capacity for reservoirs was published in 2017, QCEs have required reassessment of the drawdown capacity as part of their periodic inspections. Where a deficiency is identified, they required that works are undertaken to rectify it. These are invariably measures that are legally enforceable requirements on the reservoir undertaker (owner).

26. There are at least 54 major reservoirs in the UK and many other smaller reservoirs which are fitted with siphons for drawdown/supplementary discharge. Most have been constructed in the last 10-20 years.

27. Existing installed drawdown capacity usually consists of pipework through the dam with associated control valves. Unless the pipework is an existing tunnel, a QCE is highly unlikely to sanction placing new pipework through the dam because of the risk this can pose to dam core integrity, especially for an old dam.

28. New pipework within an existing tunnel may not be possible due to lack of space. In most cases of new non-siphon pipework full drawdown of the reservoir and its removal from supply is likely to be required or at least partial drawdown and extensive sheet pile coffer dam works.

29. Because they require significant advance planning, take longer to activate and generally provide a much smaller drawdown capacity than permanent facilities, temporary and emergency options are generally best used as a supplement to fixed drawdown facilities. The use of temporary pumping or siphons are not acceptable according to EA Report SC130001 unless the deficiency in drawdown capacity is small (that is, less than 50% of total requirement). We did not consider temporary or emergency options for this reason.

30. From an engineering and supply viewpoint, siphons are much lower risk compared to other methods because they do not require pipework through the dam. The pipework can be installed on/above the dam with only minor excavation needed for pipe supports. In particular, the impermeable core is not disturbed. Construction is also generally possible year-round.

31. The superior benefits of siphons were identified by others soon after the 2017 drawdown guidance was published. Additional research was undertaken by Defra/EA and new guidance was published (CIRIA Report C813) in February 2024 to recommend this approach.[11]

32. We have now developed a standard siphon design and operation procedures. In future, this will deliver both capital and operational efficiencies. We provide a detailed engineering briefing note about how these siphons are designed and the standards used as a separate annex.

[11] *Siphons in dams – design, installation, operation, management and testing*. CIRIA Report C813, February 2024.

FIGURE 2 - EXAMPLE OF A SIPHON

Figure 2.1 Typical siphon arrangement as adopted at Queen Mary and King George V reservoirs (courtesy of Thames Water)

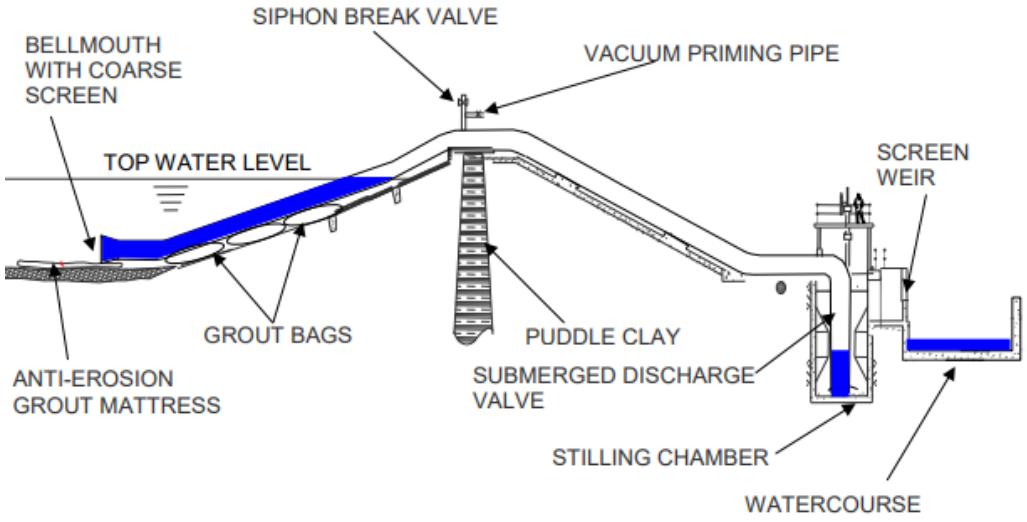
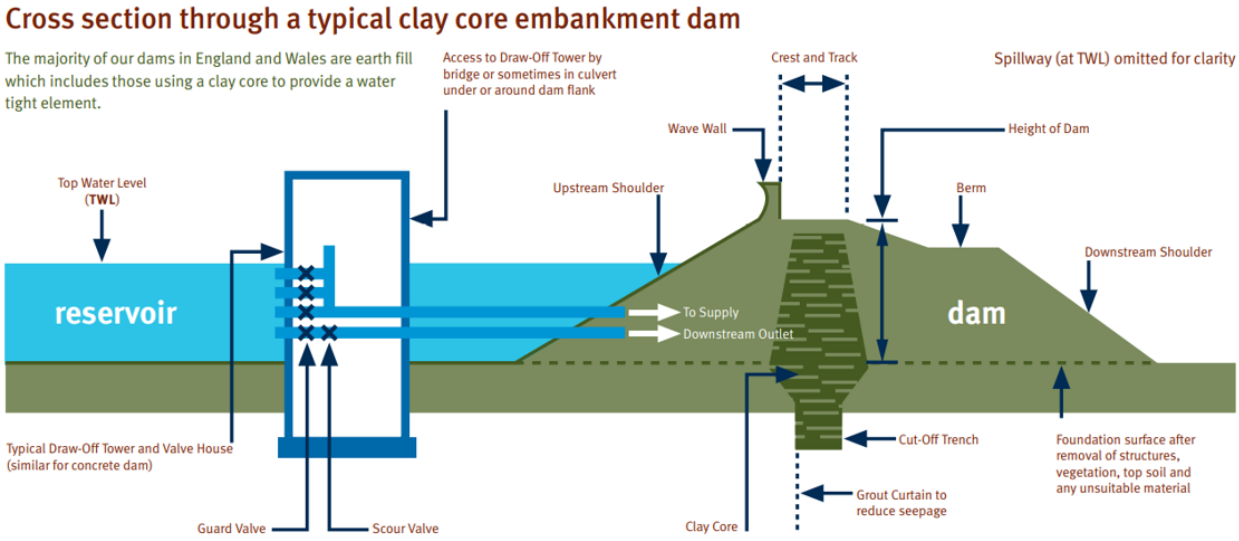


FIGURE 3 - TYPICAL DRAWDOWN ARRANGEMENT



4. COST EFFICIENCY

33. Ofwat raised some minor concerns about whether the investment is efficient. They said:

> "The company provides detailed breakdown of the costs for each site. However, there is significant uncertainty in scope of works at this stage in development and it is unclear how relevant any assumptions are to the work being proposed or that ultimately gets delivered. Although evidence of benchmarking is provided and the company appears efficient against this, it is limited in terms of scale and scope. There is limited evidence of third-party cost assurance."[12]

34. We have now developed a clear scope, and we attach our engineering note on the principles of siphon design as an appendix. This helps to explain the work at each site.

35. In our enhancement case NES22, we noted that as a limited number of drawdown schemes have been implemented across the industry to date, sufficient data was not available to allow external benchmarking of complete schemes. However, we had benchmarked three of the main cost components from our estimates against comparable water and wastewater companies. These are siphon pipework (water mains), concrete chambers, and water pumping.

36. Since then, we have been able to confirm that these items are relevant to the work that will be delivered, and we have revised costs for piling based on observed costs at other projects – this is a large part of the remaining costs that we could not benchmark in NES22. This has contributed to reducing costs by £6.237m.

37. We also reduced our costs following improved scopes and costing information. Our completed scheme at Hallington (see paragraph 7 above) also came in close to our cost estimate, giving us more confidence in these costs.

38. We note that this reduction in our costs from benchmarking means that we have closed around 77% of Ofwat's efficiency challenge in this area, and ask Ofwat to reflect this cost reduction in their FD in response to this challenge.

39. Having developed our scope and costs in more detail, we also commissioned third-party cost assurance from Aqua consultants – as this was not possible to obtain for October 2023, when we had more uncertainty. This report provides cost benchmarking and cost assurance. The report finds that our costs are around the mean benchmark, and provide a satisfactory level of cost assurance (with reasonable cost certainty at this stage). The report finds that it is unlikely that there are further efficiencies available for these schemes. We attach this report as **NES22A2**.

[12] PR24-DD-W-Reservoir-Safety, NES worksheet