Jersey Water

Water Resources and Drought Management Plan

Appendix J. Programme Appraisal and Decision-Making

CONTENTS

JERSEY WATER

WATER RESOURCES AND DROUGHT MANAGEMENT PLAN

APPENDIX J. PROGRAMME APPRAISAL AND DECISION-MAKING

1. PURPOSE

This appendix describes and explains:

a) the programme appraisal process that has been followed to consider alternative programmes of measures to address the forecast supply-demand deficit
b) the decision-making criteria used to evaluate these alternative programmes
c) how the findings of the programme evaluation process were taken into consideration to determine the optimal recommended plan for Jersey Water to secure water supply reliability for customers into the future.

2. PROGRAMME APPRAISAL

2.1. OVERVIEW OF APPROACH

Taking account of the findings of the appraisal of the feasible options (see **Appendix I**), the final stage of the planning process was to consider a range of alternative programmes (comprising of different combinations of feasible options) that would be able to address the forecast supply deficit. A shortlist of alternative programmes was then subject to more detailed multi-criteria appraisal and financial appraisal to evaluate their strengths and weaknesses to help inform decision-making on the optimal recommended plan to address the forecast supply deficit over the 25-year planning period to 2045.

The decision-making process involved active engagement with Jersey Water staff and the Jersey Water Board in determining the relative importance of the different appraisal criteria and consideration of the different risks associated with each of the alternative programmes. This active dialogue informed decision-making about the optimal mix of solutions to form the recommended plan and informed consultation with stakeholders, including the government, during summer 2021.

2.2. DEVELOPMENT OF ALTERNATIVE STRATEGIC PROGRAMMES

Following consideration of a range of possible alternative strategic programmes to address the forecast supply deficit, we short-listed four distinctly different strategic alternative programmes for detailed appraisal. These programmes were considered to represent the key different types of feasible strategic water source solutions (additional storage, additional desalination, indirect water re-use). Each alternative programme was evaluated in terms of the relative risks, benefits, financial and affordability implications.

Tables J.1 to J.4 illustrate these four different alternative strategic programmes:

A. La Rosière desalination plant extension strategy
B. Bellozanne indirect effluent reuse strategy
C. East coast new desalination plant strategy
D. Enhanced raw water storage strategy

Each table summarises the timing of option implementation within each programme and shows the benefit to the supply-demand (S-D) balance, together with the expenditure profile (both capital and operational costs) over the 25-year planning period. Further details about each of these programmes are provided below.

Table J.1. La Rosière Desalination Plant Extension Strategy

Programme A: La Rosière Desalination Strategy					
	2020	2025	2030	2035	2045
Initial S-D Balance Ml/d	-2.3	-3.9	-5.0	-6.1	-8.2
Water Efficiency Measures 0.4 Ml/d					
Leakage Reduction Measures 0.5 Ml/d					
Drought Management Restrictions 1.0 Ml/d					
La Rosière Desalination Extension 5.0 Ml/d					
Enhanced extraction from St Ouen's Boreholes (PFAS permitting) 1.0 Ml/d					
West to East Links Enhancement 0.8 Ml/d					
Revised S-D Balance Ml/d	-1.3	3.0	1.9	0.8	0.5
Capex (£m)	0.0	12.6	0.0	0.0	23.2
Opex (£m/yr)	0.0	0.2	0.2	0.2	0.2

Table J.2. Bellozanne Indirect Treated Effluent Reuse Strategy

Programme B: Bellozanne Indirect Effluent Reuse Strategy					
	2020	2025	2030	2035	2045
Initial S-D Balance Ml/d	-2.3	-3.9	-5.0	-6.1	-8.2
Water Efficiency Measures 0.4 Ml/d					
Leakage Reduction Measures 0.5 Ml/d					
Drought Management Restrictions 1.0 Ml/d					
Bellozanne Indirect Effluent Reuse 6.0 Ml/d					
Enhanced extraction from St Ouen's Boreholes (PFAS permitting) 1.0 Ml/d					
Revised S-D Balance Ml/d	-1.3	4.0	2.9	1.8	0.7
Capex (£m)	0.0	39.4	0.0	0.0	2.0
Opex (£m/yr)	0.0	0.1	0.0	0.0	0.0

Table J.3. East Coast New Desalination Plant Strategy

Programme C: East Coast New Desalination Plant Strategy					
	2020	2025	2030	2035	2045
Initial S-D Balance Ml/d	-2.3	-3.9	-5.0	-6.1	-8.2
Water Efficiency Measures 0.4 Ml/d					
Leakage Reduction Measures 0.5 Ml/d					
Drought Management Restrictions 1.0 Ml/d					
East Coast Desalination 10.0 Ml/d					
Revised S-D Balance Ml/d	-1.3	8.0	6.9	5.8	3.8
Capex (£m)	0.0	58.1	0.0	0.0	0.0
Opex (£m/yr)	0.0	0.2	0.1	0.1	0.1

Table J.4. Enhanced Raw Water Storage Strategy

Programme D: Enhanced Raw Water Storage Strategy					
	2020	2025	2030	2035	2045
Initial S-D Balance Ml/d	-2.3	-3.9	-5.0	-6.1	-8.2
Water Efficiency Measures 0.4 Ml/d					
Leakage Reduction Measures 0.5 Ml/d					
West to East Links Enhancement 0.8 Ml/d					
Drought Management Restrictions 1.0 Ml/d					
Enhanced extraction at St Ouen's Boreholes (PFAS permitting) 1.0 Ml/d					
Rozel New Stream Intake 0.3 Ml/d					
New Groundwater Source 0.5 Ml/d					
Gigoulande Quarry Partial Conversion 1.1 Ml/d					
Val de la Mare Raising 1.9 Ml/d					
Revised S-D Balance Ml/d	-1.3	0.6	0.6	1.4	-0.7
Capex (£m)	0.0	34.5	17.7	29.6	0.0
Opex (£m/yr)	0.0	0.2	0.2	0.2	0.2

Alternative Strategies: Demand Management Components

As shown in **Tables J.1 to J.4**, each of these alternative programmes adopt a "twin-track" approach: taking early action to reduce customer demand initially while enhancements to reliable water supplies are developed and implemented. This approach builds on Jersey Water's leadership in reducing water leakage and the success of its universal metering programme to help customers reduce their water consumption. It also recognises the importance of demonstrating to customers that Jersey Water is playing its part in managing water consumption before expanding existing water sources and/or developing new water sources.

However, the benefits of water efficiency and leakage reduction activities are limited, reflecting the significant work already carried out in Jersey. Both per person consumption[1] and leakage levels[2] are at a frontier position when compared to the other water companies in the British Isles and therefore the scope for further cost-effective demand management measures is limited. For each of the four alternative programmes, we have selected the most cost-effective demand management measures that have the greatest chance of delivering material demand savings, taking account of the uncertainties about the precise benefits that these options can deliver in practice.

The selected **water efficiency** options provide demand savings of approximately 0.4 Ml/d but lead to a reduction in revenue to Jersey Water of around **£0.65m** over the first five years due to reduced customer demand.

Implementation of the leakage reduction options provide demand savings of approximately 0.5 Ml/d and would continue to position Jersey Water at the frontier of leakage performance in the British Isles[2].

Further details about the feasible water efficiency and leakage options selected (and excluded) are provided at **Annex A** to this appendix.

Alternative Strategies: Drought Management Component

For each alternative programme, we have reviewed a range of drought management measures (as set out in more detail in **Appendix H**). We decided to include the implementation of enhanced customer communications to encourage customers to voluntarily restrict non-essential water uses, plus temporary mandatory customer water use restrictions in severe drought which would provide a combined (and conservative) estimated benefit of 1.0 Ml/d to the supply deficit (see **Appendix H** for further details. We have not included any of the temporary drought management supply options in any of the alternative programmes (see **Appendix H**), primarily due to the logistical and engineering challenges in delivering these options in a relatively short timeframe in drought conditions.

Alternative Strategies: Water Source Enhancement Components

Demand management and temporary water use restrictions alone will not resolve the forecast supply deficit. We have therefore considered different mixes of strategic supply enhancement options in the alternative programmes as shown in **Tables J.1 to J.4.** (more details about each option are provided in **Appendix I**):

- **Strategy A**: This strategy would be focused on early implementation (by 2025) of La Rosière desalination plant extension which will provide an additional 5 Ml/d of reliable supply. To address the supply deficit beyond 2035, it would also be necessary to implement the 1 Ml/d enhancement of the St Ouen's boreholes (subject to addressing the PFAS pollution issues with government). The West to East links enhancement option (0.8 Ml/d) would also be necessary before 2045 to address the remaining small residual supply deficit – this option would also provide improved resilience of the raw water supply system for the longer term.

[1] 2018-19 data: per person consumption for Jersey Water was 124 l/person/day compared to England & Wales average of 143 l/person/day and lower than the two best performing English companies (Southern Water: 130 l person/day; Anglian Water: 135 l/person/day)

[2] RPS (2020). Jersey Water: Leakage Options Technical Report

- **Strategy B**: This strategy would be focused on early implementation (by 2025) of the Bellozanne indirect effluent reuse scheme which will provide an additional 6 Ml/d of reliable supply. To address the supply deficit beyond 2035, it would also be necessary to implement the 1 Ml/d enhancement of the St Ouen's boreholes (subject to addressing the PFAS pollution issues with government).

- **Strategy C**: This strategy would be focused on early implementation (by 2025) of a new 10 Ml/d desalination plant and sea water abstraction intake on the east coast of Jersey, with the treated water blended in Queen's Valley Reservoir directly and/or blended with raw water taken from Queen's Valley reservoir prior to potable treatment at the existing water treatment works. Given the reliable yield benefit of this new option, no other water source enhancements would be required over the planning period. This strategy would deliver a supply surplus to meet longer term reliable water supply challenges beyond 2045, but conversely would require substantial early investment to provide the new desalination scheme.

- **Strategy D**: This strategy would be focused on enhancing raw water storage capacity in Jersey to increase reliable water supplies whilst also increasing the resilience of the raw water system to climate change risks and outage risks. The strategy would involve maximising use of existing facilities on the island through the partial conversion of La Gigoulande quarry into a raw water storage facility (1.1 Ml/d benefit) and raising the level of the dam at Val de la Mare reservoir (1.9 Ml/d benefit). These two options would not however be sufficient to resolve the forecast supply deficit. Additionally, the quarry option could not be delivered until around 2030 and the technical challenges of the Val de la Mare reservoir option is dependent on the prior implementation of all the other supply enhancement schemes in order that water supplies can be maintained while the dam raising works take place.

  In view of these issues, Strategy D would also require early implementation of the 1 Ml/d enhancement of the St Ouen's boreholes by 2025 (subject to addressing the PFAS pollution issues with government). Additionally, the West to East links enhancement option (0.8 Ml/d) would be necessary before 2025 (and would increase supply resilience prior to the Val de la Mare dam raising works). Early delivery of a new stream intake at Rozel (0.3 Ml/d) and a new groundwater source (0.5 Ml/d) would also be required by 2025. These are challenging timescales for concurrent delivery of four new water source schemes within less than five years. Even with these additional supply enhancement schemes, this raw water storage strategy would result in a small (0.7 Ml/d) supply deficit remaining by the end of the planning period in 2045.

2.3. PROGRAMME APPRAISAL – INITIAL PHASE

We compared the cost, benefits, risks and customer affordability implications of the above four alternative strategic programmes as part of an initial phase of programme appraisal to help inform decision-making on the development of an optimal recommended plan. This involved financial appraisal to assess the net present value (NPV) of each programme as well as evaluation of each programme using multi-criteria appraisal (**Figure J.1**).

A summary of the key findings of the multi-criteria appraisal is provided in **Table J.5** (with more detail provided in **Table J.6**), comparing the four alternative strategic programmes in respect of the trade-offs between the different criteria, including cost (as NPV), acceptable levels of service for water supply reliability, customer affordability, revenue implications, financing, environmental and social impacts, customer and political acceptability, delivery and operational risks.

Figure J.1. Criteria considered in programme appraisal process

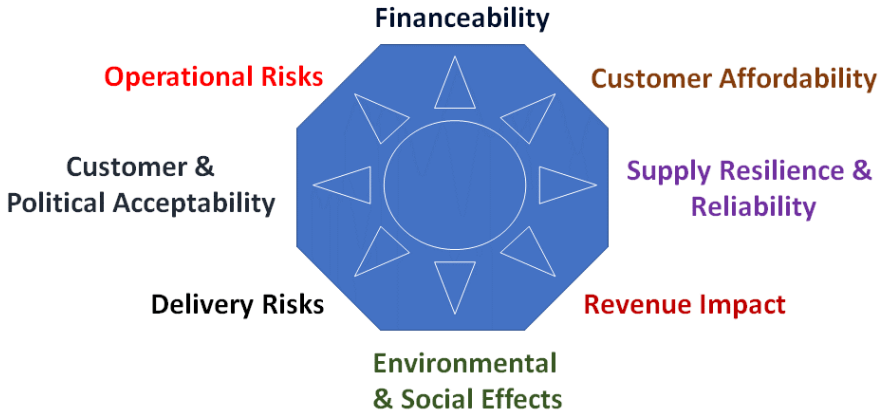

Table J.5. Multi-criteria appraisal summary of alternative programmes (note: revenue impacts of demand management measures are identical for each programme)

Strategic Programme	Total Cost NPV (£M)	Total Supply Benefit Ml/d	Customer affordability & financeability	Supply Resilience & Reliability	Delivery Complexity Risks	Environmental & Social Effects	Customer & Political Acceptability	Operational Risks
(A) La Rosière Desalination Plant Extension	28.9	8.7						
(B) Bellozanne Indirect Treated Effluent Reuse	41.4	8.9						
(C) East Coast Desalination	54.2	11.9						
(D) Raw Water Storage Enhancement	81.6	7.5						

Key:

Positive Impact/ Low Risk	Minor impact/ risk	Moderate impact/ risk	High, Impact/ Risk

Table J.6. Comparison of the strategic alternative programmes against key decision-making criteria

Programme	NPV (£m)	Reliable Supply Benefit (Ml/d)	Cost, financing and affordability	Supply Reliability	Key risks	Environmental Effects
(A) La Rosière Desalination Plant Extension Programme	28.9	8.7	Lowest whole life cost programme and within likely financing limits, although high opex when the desalination plant is fully utilised in a drought. Likely to be affordable for customers. Feasible to operate with current workforce skills/knowledge.	High reliability and West to East link enhancement to Queen's Valley reservoir increases supply system resilience. Lead time for delivery of the desalination plant extension extends period of current supply deficit to 2025. Level of service standards for water use restrictions secured over planning period from 2025.	High reliance on desalination in drought with raw water blending ratio with freshwater sources at the upper limit, presenting some drinking water quality risks and some operational water treatment challenges.	Energy intensive process but Jersey Electricity is certified as carbon neutral therefore no adverse carbon impact. Possible deterioration of groundwater quality and local water levels due to increased use of St Ouen's boreholes. Low level environmental effects.
(B) Bellozanne Indirect Treated Effluent Reuse Programme	41.4	8.9	2nd lowest whole life cost but outside of likely acceptable financing limits, so may not be affordable for customers. High opex when the reuse plant is fully utilised in a drought. Significant operational challenges for the current workforce due to lack of skills and	High level of reliability with secure source of water in central location and able to support Queen's Valley reservoir. Delivery of the new reuse scheme by 2025 is very challenging and may take until 2028 to deliver, thereby extending the period of supply deficit in drought conditions. Level of service standards for water use restrictions secured over planning period from 2028.	New complex treatment process, requiring additional skills, training and/or resources. Higher risk of outage due to pollution events in sewer network and/or process failures at Bellozanne wastewater treatment works. Drinking water quality risks due to variable effluent quality presents significant operational challenges,	Energy intensive process but Jersey Electricity is certified carbon neutral therefore no adverse carbon impact. Low level of other environmental effects. May help reduce nitrate loading to St Aubin's Bay when operated by reducing the volume of treated effluent being discharged

			knowledge of running an effluent reuse treatment process.		particularly for water treatment. Gaining public acceptability of indirect effluent reuse could be a challenge.	from Bellozanne wastewater treatment works.
(C) East Coast Desalination Programme	54.2	11.9	High capital cost due to the significant new infrastructure required. High opex when the desalination plant is fully utilised in a drought. Costs exceed likely financing limits, even with phased delivery approach. Unlikely to be affordable for customers. Financing may be inefficient as the programme provides a healthy supply surplus over planning period. Feasible to operate with current workforce skills/knowledge.	High reliability with a healthy supply surplus provided at 2045 to meet potential future effects of climate change and further population growth beyond 2045. Lead time for delivery of the new desalination scheme extends period of current supply deficit to 2028. Level of service standards for water use restrictions secured over planning period from 2028.	Development of new sea water intake in a challenging coastal environment will present engineering risks. High reliance on desalination in drought presenting some drinking water quality risks due to reduced surface water supplies available for blending with the desalinated supply prior to full potable water treatment.	Energy intensive process but Jersey Electricity is certified carbon neutral therefore no adverse carbon impact. Risk of adverse effects to internationally designated coastal conservation site (Ramsar Convention site) and Coastal National Park and Green Zone. Public acceptability of site at St Catherine's and planning considerations (Coastal National Park and Green Zone) may be challenging.
(D) Raw Water	81.6	7.5	Highest cost programme due to significant new	Increases diversity of water sources, increasing supply resilience in normal weather	Raising of Val de la Mare reservoir is technically challenging and requires the	Less energy intensive programme but as Jersey Electricity is certified carbon

Storage Programme			infrastructure required with multiple water source enhancement options. Significantly exceeds likely financing limits. Not affordable for customers. Feasible to operate with current workforce skills/knowledge.	conditions. Lead time for delivery of the new Gigoulande Quarry scheme extends period of current supply deficit to 2028. Without a desalination scheme or the indirect effluent reuse scheme, there are insufficient new water source options to fully address the supply deficit at 2045. Level of service standards for water use restrictions secured over most of the planning period after 2028, but additional measures would be needed in drought conditions by 2045 due to a residual supply deficit of 0.7 Ml/d.	reservoir to be taken out of use during construction, placing water supply reliability at high risk during the construction period. Reliable supply benefits of the new groundwater and stream intake are currently uncertain without detailed site investigations.	neutral there is no carbon benefit of this programme. New water storage facility at Gigoulande Quarry may provide some benefit for biodiversity enhancement and may help to deliver decommissioning requirements of the quarry. Possible deterioration of groundwater quality and local water levels due to increased use of St Ouen's boreholes.

3. PROGRAMME APPRAISAL: FURTHER DEVELOPMENT OF OPTIMAL RECOMMENDED PLAN

It was concluded from the multi-criteria appraisal process (as summarised in Section 2 above) that none of the four alternative programmes initially considered fully met the Water Resources and Drought Management Plan objectives. Consequently, further iterations of the programme appraisal were carried out to develop a plan that achieved an optimal balance of trade-offs between the different objectives. Additionally, following the initial programme appraisal phase, it became clear that the Gigoulande quarry storage option had to be excluded from further consideration. This decision followed dialogue with the Government of Jersey about the Island Bridging Plan and infrastructure review. This decision removed the most cost-effective feasible water storage option from consideration for inclusion in the final recommended plan.

Building on the objective information gained from the initial programme appraisal, the next phase of the appraisal process involved a detailed decision-making planning workshop, Board dialogue and further discussions with stakeholders. The further appraisal included detailed consideration of the need for additional raw water storage in light of the removal of the Gigoulande quarry option, as well as greater evaluation of the financing and customer affordability implications of different alternative programme options. Decision-making and development of the recommended plan also took account of the uncertainties in the supply-demand forecast, in particular:

- Demand forecast uncertainty, which reflects the uncertainties in the island population growth projections and future immigration and housing policy, particularly after 2030, as well as uncertainties around the economic growth assumptions.
- Climate change uncertainty – impact on deployable output could be higher or lower than the central forecast over the planning period.

To mitigate against these uncertainties, we sought to develop a "no regrets" and adaptive plan that takes account of option lead-times and the timing of the key forecast uncertainties. This approach:

- Identifies key decision-points that allow enough time for solutions to be implemented as needed
- Minimises the risk of investment being redundant or being delivered too far ahead of actual need (i.e. inefficient financing and consequent water bill implications)
- Identifies solutions with multiple benefits and/or which can be more easily adapted if the forecast supply deficit changes over time.

Work was also carried out to examine the sensitivity of alternative programmes to the uncertainties in the demand forecast (see Annex C for more details).

4. DECISION-MAKING: FINAL OPTIMAL RECOMMENDED PLAN

Our final optimal recommended plan resulting from the further programme appraisal and decision-making process is shown in **Table J.7**. The recommended plan meets the water supply reliability standards throughout the planning period with a balanced portfolio of demand management and temporary water use restrictions together with investment in enhancing existing water sources or

development of additional reservoir storage. The recommended plan compares favourably to the four strategic alternative programmes considered in the initial appraisal process (see Section 2) against the key decision-making criteria (**Table J.8**). The plan NPV of £36.3m is within likely financing limits and is therefore likely to be affordable to customers. The plan secures water supply reliability from 2025 with a small supply-demand (S-D) balance maintained across subsequent years of the planning period (1.6 Ml/d supply surplus at 2045), as illustrated in **Table J.7**.

Table J.7. Recommended Plan to 2045

Recommended Plan: La Rosière Desalination and Additional Reservoir Storage					
	2020	2025	2030	2035	2045
Initial S-D Balance Ml/d	-2.3	-3.9	-5.0	-6.1	-8.2
Water Efficiency Measures 0.4 Ml/d					
Leakage Reduction Measures 0.5 Ml/d					
Drought Management Restrictions 1.0 Ml/d					
Targeted Catchment Protection Initiatives 0.0 Ml/d					
La Rosière Desalination Extension 5.0 Ml/d					
Increased abstraction from St Ouen's Boreholes (PFAS permitting) 1.0 Ml/d					
Additional reservoir storage solution 1.9 Ml/d					
Revised S-D Balance Ml/d	-1.3	3.0	2.9	1.8	1.6
Capex (£m)	0.0	12.6	2.8	0.3	29.6
Opex (£m/yr)	0.0	0.4	0.3	0.3	0.3

Table J.8. Comparison of the performance of the recommended plan with the strategic alternative programmes

Strategic Programme	Total Cost NPV (£M)	Total Supply Benefit Ml/d	Customer affordability & financeability	Supply Resilience & Reliability	Delivery Complexity Risks	Environmental & Social Effects	Customer & Political Acceptability	Operational Risks
(A) La Rosière Desalination Plant Extension	28.9	8.7						
(B) Bellozanne Indirect Treated Effluent Reuse	41.4	8.9						
(C) East Coast Desalination	54.2	11.9						
(D) Raw Water Storage Enhancement	81.6	7.5						
Recommended Plan	**36.3**	**9.8**						

Annual average operational costs would increase by around **£0.4m** by 2030 (but falling to around £0.3m/year by 2045 following early delivery of operational demand management activities). As set

out earlier, implementation of the water efficiency measures in the recommended plan would lead to a revenue impact to Jersey Water of around **£0.65m** (cumulative total) over the first five years and increasing over time thereafter over the full planning period. Despite this revenue impact, promotion of water efficiency to customers is vitally important before promoting the investment in water source enhancement.

The investment required to deliver the recommended plan over the 25-year planning period has been assessed as being within financing limits and would keep customer water bill impacts to an acceptable level.

Demand Management

The recommended plan retains the same twin-track approach included in the strategic alternative programmes for the reasons previously set out in **Section 2.2**. The plan includes the same water efficiency options (providing 0.4 Ml/d demand savings) and leakage reduction options (providing 0.5 Ml/d demand savings) as those included in the four strategic alternative programmes presented in **Section 2.2.**

These demand management measures will be implemented over the first five years of the plan to provide early benefits to the supply-demand balance and in advance of the delivery of any water source enhancements. **Annex A** provides further details about the water efficiency and leakage reduction options included in the recommended plan and those feasible options that have been excluded.

Drought Management Measures

Our recommended plan includes the implementation of enhanced customer communications to encourage customers to voluntarily restrict non-essential water uses, plus temporary mandatory customer water use restrictions in severe drought which would provide a combined (and conservative) estimated benefit of 1.0 Ml/d to the supply deficit (see **Appendix H** for further details). We consider that customers will accept temporary restrictions on non-essential water use in severe drought conditions with an implementation frequency of no greater than once in every 20 years on average for a mandatory temporary use ban and no greater than once in every 50 years on average for a mandatory non-essential use ban covering a wider range of uses, including by commercial customers.

We have not included any of the temporary drought management supply options in any of the alternative programmes (see **Appendix H**), primarily due to the logistical and engineering challenges in delivering these options in a relatively short timeframe in drought conditions.

Water Source Enhancement

The recommended plan includes a combination of additional desalination (extension of La Rosière desalination plant) and enhanced raw water storage. This brings together the benefits of a very reliable seawater source with the resilience benefits afforded by enhanced raw water storage on the island.

The **La Rosière desalination plant extension** has the lowest unit cost of the supply augmentation options available and will be implemented by 2025 to provide 5.0 Ml/d of additional reliable supply.

The fundamental need to provide **additional reservoir storage** remains central to the future resilience of Jersey's long-term water supply needs. The preferred solution for providing adequate reservoir storage on the island would have been the partial conversion of La Gigoulande quarry into a new raw water storage facility. However, as explained above, in dialogue with Government about the Island Bridging Plan and infrastructure review, we excluded this option from our recommended plan. We will therefore carry out further work over the next few years on the remaining feasible options for increasing reservoir storage and confirm the best solution for securing the required long-term supply resilience by 2045. We have included a benefit of 1.9 Ml/d in the recommended plan for a storage solution based on the assessed deployable output for the raising Val de la Mare reservoir option or a new reservoir option (Les Mouriers) that could be developed within the existing Le Mourier stream intake catchment.

To address the supply deficit beyond 2025, work will also be required to **address the historic PFAS pollution in the St Ouen's boreholes** to provide 1.0 Ml/d of additional reliable groundwater supplies by 2030. This provides time for the government to further investigate the options for addressing the PFAS groundwater pollution such that more water can be abstracted and drinking water quality standards relating to PFAS can be achieved. Early investigation action is important: should the investigations conclude this option is not feasible, or would not provide the full additional 1 Ml/d, there would still be sufficient time for an alternative water source option to be developed instead to maintain a supply-demand balance (see also Annex C).

We decided to include **targeted catchment protection initiatives** in the optimal recommended plan. As indicated in **Table J.7**, whilst these initiatives do not create additional water supplies, they provide water supply resilience benefits by improving land use management to reduce pollution risks to our water sources (and therefore reduce the risk of asset outages that impact on reliable water supply availability). It should be acknowledged that catchment management interventions are usually outside of the direct control of Jersey Water and will require close collaboration, partnership and co-ordination between all stakeholders to ensure that the resilience benefits are delivered.

Minimising the risks

The current lack of adequate reservoir storage on the island presents a considerable risk to long-term supply resilience. We need to address this risk by developing an additional reservoir storage solution by 2045. The provision of increased reservoir storage will offer a higher level of supply resilience for the long term, future proofing the island against further pressures on our water supplies beyond 2045. It will also reduce our reliance on expensive desalination.

Financing and Affordability

The anticipated cost of delivering the first phase of our plan over the 5 years to 2025 is estimated at around £12.5 million capital investment, with operational costs increasing by around £0.4 million per year. Further work is underway to secure capital funding and build an affordable payment plan for all customers that minimises customer tariffs going forward. For the first 5 years of the plan the investment in our water resources is calculated to increase the average customer bill by £22 including inflation.

We will further review the delivery costs and assess the tariff impacts of subsequent phases of the

plan over the next few years, in particular to take account of our further planning work for the PFAS management options and additional reservoir storage solution. By including a new storage option in our plan, it will reduce the need to increase water bills in the long term due to less reliance on expensive desalination.

An adaptive plan to address uncertainties

Our plan needs to be adaptive and flexible due to the range of uncertainties in the supply-demand forecast over 25-year planning period, including population growth, economic growth and the potential effects of climate change on water supply reliability. We have adopted a scenario testing approach to assess how the plan can adapt to changing circumstances and ensure a 'no regrets' approach to investment (see Annex C).

We considered the supply-demand forecast scenario 'envelope' of the plausible upper and lower variation from the 'central' estimate of the future supply deficit. Using these scenarios, we have considered an adaptive approach to delivery of our Plan that allows key decisions to be taken in a timely manner about investment in new water sources, taking account of the planning and construction lead times associated with each new source. This analysis has indicated that our recommended Plan is robust to uncertainties in the supply deficit forecast with sufficient new water source options available to enable an adaptive approach to respond to uncertainties in the forecast supply deficit.

West to East Transfer Option
In view of the currently very high capital costs of enhancing west to east transfer links, this option is currently excluded from our recommended plan. However, enhancing the transfer flexibility of our raw water supply system from the west of the island to the east would be very beneficial, particularly with the further planned expansion of La Rosière desalination plant and the future provision of additional reservoir storage. It would also help move water from the west of the island over to Queen's Valley reservoir in the east to aid the refill of this reservoir in a severe 2-year drought with a dry winter.

The cost-benefit of this option is currently not considered acceptable and would stretch financing limits and adversely affect customer bills. However, the value of the resilience benefits of the west-east transfer do need to be considered further and additional work is planned to:

- examine the value of the wider resilience that this option would deliver
- consider opportunities to reduce the capital cost (possibly by removing some elements of the option)
- consider alternative operational solutions for some elements of the scheme which would be of a lower cost but which may involve some temporary works in a severe drought.

Annex B sets out the other feasible supply enhancement options excluded from the optimal

recommended plan. In particular, while the option of a new desalination plant on the east coast seems attractive as it could supply an additional 10 Ml/d, resolving the forecast supply deficit in full, it has been discounted because of high construction costs, engineering complexity, environmental impact and the high impact on customer bills.

5. RECOMMENDED PLAN: CONCLUSIONS

Our recommended plan meets the forecasted water needs of the island community, our on-going commitment to customer service and protection of the environment. It is consistent with planning objectives, is adaptive and provides a "no regrets" approach to investment in new infrastructure:

- **Resilient and future-proof:** the plan addresses the lack of adequate water storage for the island to deliver enhanced supply resilience. The mix of different supply options will also help to improve overall supply resilience in 'normal' years as well as in drought conditions. Future work on a west to east transfer option will also help re-balance supply reliability between the west and the east of the island.

- **Twin-track approach**: we are prioritising demand management in the short term to help address the existing supply deficit before increasing the capacity of water sources. We will continue to remain at the frontier of leakage control in the British Isles while further strengthening water efficiency performance wherever possible.

- **Reliable**: our plan increases supply reliability and delivers a level of service for water use restrictions comparable with water companies in southern England which act as an appropriate benchmark for Jersey.

- **Adaptable**: our plan can be adapted to respond to the key uncertainties surrounding the demand forecast (population growth and economic growth assumptions) and climate change effects on water sources.

- **Environmental:** our plan maximises use of the existing infrastructure at La Rosière and St Ouen's boreholes, and the catchment management and water storage solutions can be delivered with net environmental benefit.

- **Acceptability**: we plan to balance additional freshwater supplies with additional desalination, as well as delivering demand savings at the earliest opportunity. By maximising the use of existing facilities on the island, and ensuring net environmental benefit from the delivery of the supply-demand solutions, our plan should command broad acceptability. The new storage option will reduce the need to increase water bills in the long term due to less reliance on more expensive desalination.

- **Financing and affordability**: our plan will be affordable for our customers, subject to securing efficient financing. We will continue to develop the longer-term investment needs as part of

our Resilience Framework and Capital Programme planning dependent on the further development of solutions identified in later phases of the plan.

- **Risk management**: in addition to an adaptive plan with a "no regrets" approach to infrastructure investment, the construction and operational risks are currently within acceptable limits and will be regularly reassessed on any significant changes to the Water Resources and Drought Management Plan.

- **Future proofing**: our plan helps future-proof water supply resilience beyond the 2045 planning horizon, notably with the development of additional water storage. This will help address the likelihood that the supply deficit will worsen beyond 2045 due to increasing effects of climate change and potential further growth in the Jersey population.

ANNEX A. FEASIBLE DEMAND MANAGEMENT OPTIONS SELECTION

Water Efficiency Options

Table J.A1 Feasible water efficiency options excluded from the recommended plan, but which will be reviewed over the next few years

Option Ref.	Option	Reason(s) for discarding
D2 / D9 / D20 / D14	Grouped options because of synergies and overlaps: D2. Smart meter installation (and rapid response to leaks) at domestic and commercial properties D9/D20. "Smart" water use audits at domestic and/or commercial properties D14. Night-flow / high use detection using smart meters	Not cost effective at present, particularly as Jersey Water is already pro-active in identifying cases of high customer demand likely due to supply pipe leakage and requesting the customer to fix their customer supply pipe. To be reviewed further over the coming few years as to the incremental costs of smart meter installation on a cyclical basis as existing customer meters are replaced at the end of their relatively short asset life, taking account of probable further innovation in smart meters and unit costs over the next few years. The position will then be reviewed at the next update to the WRDM Plan.
D8 / D19	"Traditional" water use audits at domestic properties or commercial properties (for schools see below)	As above
D10 / D21	"Smart customer engagement" at domestic and/or commercial properties	Novel approaches being tested in UK and so effectiveness is currently unproven. Very small water saving benefit volumes from current UK trials. Jersey Water is already pro-active in identifying cases of high customer flows and requesting mending of leaks.

The remaining feasible water efficiency options considered during the programme appraisal process and incorporated into the recommended plan are shown below (**Table J.A2**).

Table J.A2. Feasible water efficiency options included in the recommended plan

Option Ref.	Option	Inclusion in Recommended Plan
D5 / D16	Targeted water conservation information at domestic and/or commercial properties	D6. Base Demand Management (incorporating elements of D5, D16, D17, D7 and D18)
D6 / D17	Education and publicity programmes at domestic and/or commercial properties	

D7 / D18	Promotion of water base devices at domestic and/or commercial properties	
D13 / D24	Planning regulations for new homes and new commercial properties	D13. Planning Regulations at New Properties
D19 schools	"Traditional" water use audits and education programme at schools	D19. Visit-and-Fit Water Audits (schools)

These options will provide **cumulative demand savings of 0.4 Ml/d** at an operational cost of £0.31m over the period to 2025 (5-year total). However, whilst there is a demand saving which defers the need for investment in new water sources for a short period, there would be an estimated impact on Jersey Water's revenue of around £0.65m (**Table J.A3**) due to reduced metered customer water use (with commensurate reduced bills for those customers making the savings).

Beyond 2025, some operational expenditure will continue to be required to continue some programmes. To address the risk of decay in water efficiency savings beyond 2025 due to customer behaviour, the water efficiency programme will need to be reviewed by 2025 and extra new measures may need to be chosen for implementation to sustain the savings into the longer term.

Table J.A3 Costs and revenue impact at 2025 of the water efficiency options included in the recommended plan

Option	Operational Cost over first 5 years (excludes revenue impact)	Revenue impact over first 5 years
D6 (A). Base demand management: Sustained publicity	£0.12m	£0.25m
D6 (B). Base demand management: Schools engagement	£0.06m	£0.12m
D19. Visit-and-fit audits: Schools	£0.05m	£0.08m
D13. Planning regulations at new properties	£0.08m	£0.20m
TOTAL	**£0.31m**	**£0.65m**

Leakage Reduction Options

Table J.A4 Feasible leakage reduction options excluded from the recommended plan

Option Ref	Option	Reason(s) for discarding
D36	Poor condition mains replacement	High costs and small water savings as Jersey Water already pro-actively maintains its water mains system.

D37	Raw water losses reduction	Low cost effectiveness as raw water losses are difficult to find and are estimated to amount to a very low volume.

The following three feasible leakage reduction options were retained for consideration during the option appraisal and programme development process. Jersey Water commissioned UK leakage expert consultants (RPS) to further develop, model and cost these options, working in partnership with Jersey Water staff and the water resource planning consultants (Ricardo and Sweco).

- **Option D29** (incorporating option D28 for service reservoir and trunk main leak detection, and Option D31 for District Meter Area (DMA) monitoring improvements). This option involves implementation of intensive leakage data reviews, including reviewing the allowances made for legitimate night use of water by customers to deduct from the night-time DMA flow monitoring which is otherwise assumed to be actual water leakage. This will improve the quality of the data used by Jersey Water to target leak detection activities and thereby improve the timeliness of leak detection and repair activities, which in turn helps reduce leakage levels.
- **Option D32**. This option involves improved monitoring of leakage in target areas of the water network using permanently installed noise loggers as well as further division of flow measurement where monitoring currently covers a relatively large area. This will help improve the timeliness of leak detection and help to better pinpoint leak locations.
- **Option D35.** This option involves enhanced water pressure management by further controlling the water pressure at certain points around the island's treated water distribution system where the pressure remains relatively high (whilst maintaining water pressure at an acceptable level for customers). Lower pressure reduces the volume of water lost from a leaking pipe.

Following consideration of these three leakage reduction options during the programme appraisal process, the recommended plan incorporates a combination of all three options (**Table J.A5**), which produces a robust and achievable level of leakage reduction over the period to 2025.

Table J.A5 Leakage reduction options included in the recommended plan

Option Ref	Option	Inclusion in recommended plan
D28	Service Reservoir and Trunk Main Leakage Reduction	D29. Enhanced Leak Detection and Repair (composite option including elements of D28 and D31)
D29	Enhanced Leak Detection and Repair	
D31	Improved District Meter Area Monitoring	
D32	Improved Distribution Monitoring and Modelling	D32. Improved Distribution Monitoring and Modelling
D35	Pressure Reduction Programme	D35. Pressure Reduction Programme

These three options cumulatively will maintain Jersey Water's position at the frontier of leakage performance in the British Isles, **cumulatively reducing leakage by 0.5 Ml/d** (from 2.5 Ml/d at 2020 to 2.0 Ml/d at 2025) at a capital cost of £0.495m and operating cost of £0.200m (5-year totals) as set out

in **Table J.A6.** Beyond 2025, capital expenditure for replacement of relatively short asset life monitoring equipment and additional annual operational expenditure will continue to be required to maintain leakage at the lower level. These ongoing costs beyond 2025 have been reflected in the long-term NPV of the optimal recommended plan.

Table J.A6 Cost of leakage options included in Recommended Plan

Option	Capital cost over first 5 years (£m)	Operational cost over first 5 years (£m)
D29. Enhanced Leak Detection and Repair	0.09	0.09
D32. Improved Distribution Monitoring and Modelling	0.37	0.08
D35. Pressure Reduction Programme	0.04	0.03
TOTAL	**0.50**	**0.20**

ANNEX B. FEASIBLE SUPPLY ENHANCEMENT OPTIONS EXCLUDED FROM RECOMMENDED PLAN

This Annex sets out the supply enhancement options **excluded** from the recommended plan**,** as summarised in **Table J.B1.**

Table J.B1 Feasible supply enhancement options excluded from optimal recommended plan

Option Ref.	Option
S12	New desalination plant on the east coast
S25	Gigoulande Quarry partial conversion to raw water storage
S5	New stream abstraction (Rozel)
S15	New groundwater abstraction
S18	Bellozanne indirect treated effluent reuse
S14	Enhance West to East raw water transfer links

The principal reasons for the exclusion of these options from the optimal plan are set out below.

New Desalination Plant on the East Coast

Whilst providing 10 Ml/d of very reliable seawater supply, there are some substantial delivery complexity risks associated with this option (particularly relating to the development of new sea water abstraction facilities). There are significant environmental concerns due to the risk of adverse effects to an internationally designated coastal conservation site (Ramsar Convention site), as well as public acceptability of developing the site at St Catherine's and associated planning considerations (Coastal National Park and Green Zone). The initial capital investment is very high compared to the La Rosière desalination plant extension costs and would be beyond financing and affordability limits.

Gigoulande Quarry partial conversion to raw water storage

This option would have been the preferred option for the recommended plan to provide additional raw water storage but the option was removed from consideration following dialogue with government as to the future use of the quarry as part of the development of the Island Bridging Plan.

New stream abstraction (Rozel)

This option has a lower cost-benefit due to the small (and uncertain) additional reliable supply available in a drought when compared to other options in the recommended plan.

New groundwater abstraction

This option has a lower cost-benefit due to the relatively small additional reliable supply available in a drought when compared to other options in the recommended plan. This option may be required as a more expensive unit cost solution should any of the options in the recommended plan prove to be infeasible to deliver.

Bellozanne indirect treated effluent reuse

The capital cost of this option would likely take the overall programme beyond acceptable financing limits, bringing affordability for customers into question. Compared to the extension of La Rosière desalination plant and additional reservoir storage, this option would present greater operational challenges for the current workforce due to lack of skills and knowledge of running an effluent reuse treatment process. Compared to La Rosière desalination plant, delivery of the new reuse scheme by 2025 to address the existing and forecast supply deficit would be very challenging and could take until 2028 to deliver, thereby extending the period of supply deficit in drought conditions. This option would bring a higher risk of outage compared to the options included in the recommended plan due to the risk pollution events in the sewer network and/or process failures at Bellozanne wastewater treatment works. It would also bring greater drinking water quality risks due to the variable effluent quality, presents significant operational challenges, particularly for the final potable water treatment. Additionally, gaining public acceptability of indirect effluent reuse could be a challenge whereas desalination has long been accepted by customers.

West to East Transfer Option

In view of the currently very high capital costs of enhancing west to east transfer links, this option is currently excluded from our recommended plan. However, enhancing the transfer flexibility of our raw water supply system from the west of the island to the east would be very beneficial, particularly with the further planned expansion of La Rosière desalination plant and the future provision of additional reservoir storage. It would also help move water from the west of the island over to Queen's Valley reservoir in the east to aid the refill of this reservoir in a severe 2-year drought with a dry winter.

The cost-benefit of this option is currently not considered acceptable and would stretch financing limits and adversely affect customer bills. However, the value of the resilience benefits of the west-east transfer do need to be considered further and additional work is planned to:

- examine the value of the wider resilience that this option would deliver
- consider opportunities to reduce the capital cost (possibly by removing some elements of the option)
- consider alternative operational solutions for some elements of the scheme which would be of a lower cost but which may involve some temporary works in a severe drought.

ANNEX C. SENSITIVITY TESTING

Our plan needs to be adaptive and flexible due to the range of uncertainties in the supply-demand forecast over 25-year planning period, including population growth, economic growth and the potential effects of climate change on water supply reliability. We have adopted a scenario testing approach to assess how the plan can adapt to changing circumstances and ensure a 'no regrets' approach to investment.

We considered the supply-demand forecast scenario 'envelope' (**Figure JC. 1**) of the plausible upper and lower variation from the 'central' estimate of the future supply deficit. Using these scenarios, we considered an adaptive pathways approach to delivery of the plan that allows key decisions to be taken in a timely manner about investment in new water sources, taking account of the planning and construction lead times associated with each new source. This analysis has indicated that the plan is robust to uncertainties in the supply deficit forecast with sufficient new water source options available to enable an adaptive approach to respond to uncertainties in the forecast supply deficit.

Figure J.C1 Envelope of Future Supply Deficit Planning Scenarios

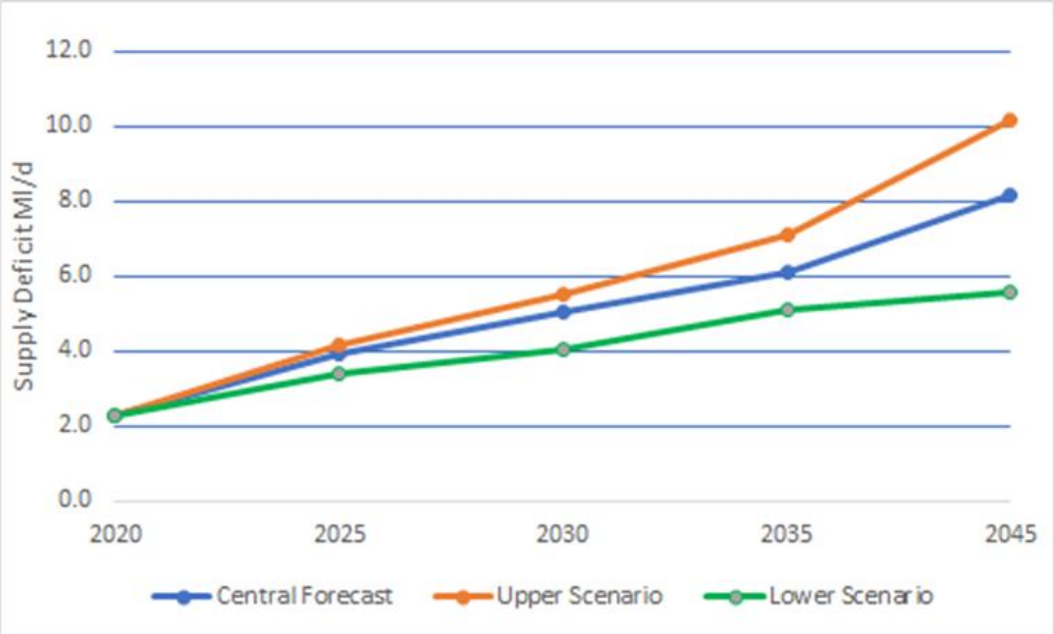

Figure JC.2 illustrates the principles of this adaptive plan taking account of the upper and lower supply deficit scenarios. It shows the key decision points over the planning period when a decision will need to be taken about investment in a new water source after taking account of the latest forecast of demand and assessed supply deficit along with the lead times for different water source options.

Figure J.C2 shows how our recommended plan ("central" plan) would need to be modified to cater for both the upper and lower scenarios but, as the lead times for alternative scheme delivery are relatively short, final decisions (indicated by the vertical red bars in the diagram) on proceeding with investment can be deferred to avoid the risk of abortive investment or inefficient investment.

There is a degree of flexibility for making a final decision on developing additional reservoir storage as the latest date for having this source available for supply is 2045 for both the central and upper

scenarios. For the lower scenario, the La Rosière desalination scheme provides a small surplus from 2030 and no further investment would be required.

For the upper scenario, there is a need for further action beyond the additional reservoir storage to provide an additional 0.4 Ml/d as a minimum after 2040 to address a higher supply deficit, but there is adequate time to decide on the solutions (Figure J.C2 suggests that a new borehole (BH) source would be an appropriate solution, but it may also be feasible to close this gap with some further demand management actions by this date).

Figure J.C2 Adaptive pathways approach for future planning supply deficit scenarios