Jersey Water

Water Resources and Drought Management Plan

CONTENTS

EXECUTIVE SUMMARY

Background

Jersey Water's purpose is to supply the water needed for the island to thrive, today and everyday. Our water supplies are provided by an integrated water resource system comprising of reservoirs and stream abstractions, groundwater boreholes and our La Rosière desalination plant. The water provided from these different water sources is treated at our two water treatment works for supply to our customers through an interlinked network of water distribution pipes. We currently supply an average of around 20 million litres of water per day to some 37,000 homes and 3600 commercial properties across Jersey. More information about Jersey Water is available on our website at www.jerseywater.je

Jersey Water has a responsibility to maintain secure, high quality, reliable and affordable water supplies to its customers over the long-term and which are resilient to potential future events.

We have developed this long-term Water Resources and Drought Management (WRDM) Plan, covering the 25-year period from 2020 to 2045, to understand the likely future changes in demand for water and reliability of water supplies so that we can determine the actions required to maintain high standards of water supply reliability to our customers. Our WRDM Plan therefore identifies:

- How demand for water and supply availability will change over the next 25 years.
- The risks and uncertainties, such as climate change and other events outside of our control, which may affect the future balance between demand for water and water supply availability.
- The range of options we could consider taking over the coming years to ensure there is adequate water availability to meet future demand, particularly in drought conditions.
- Our decisions and actions to secure water supply reliability for customers over the next 25 years and beyond.

In years of average rainfall, the current water supply for Jersey is secured, however in the event of a severe drought the island will face significant water shortages. The current deficit in a severe drought is forecast to grow into the future if action is not taken now. Our recommended WRDM Plan sets out the proposed measures to be implemented over the next 25 years to maintain reliable water supplies to customers across the island.

Water supply-demand forecasts

Estimated water demand under dry weather conditions for Jersey Water is expected to increase by 15% from around 21 million litres per day (Ml/d) in 2019-20 to nearly 24 Ml/d by 2044-45.

This growth in demand is driven primarily by the forecast population growth. From the range of population scenarios set out by the Government of Jersey, a central growth projection scenario has been used for calculations. Other population growth scenarios have also been modelled as any changes to the central projection can have a material impact on the forecast supply-demand balance.

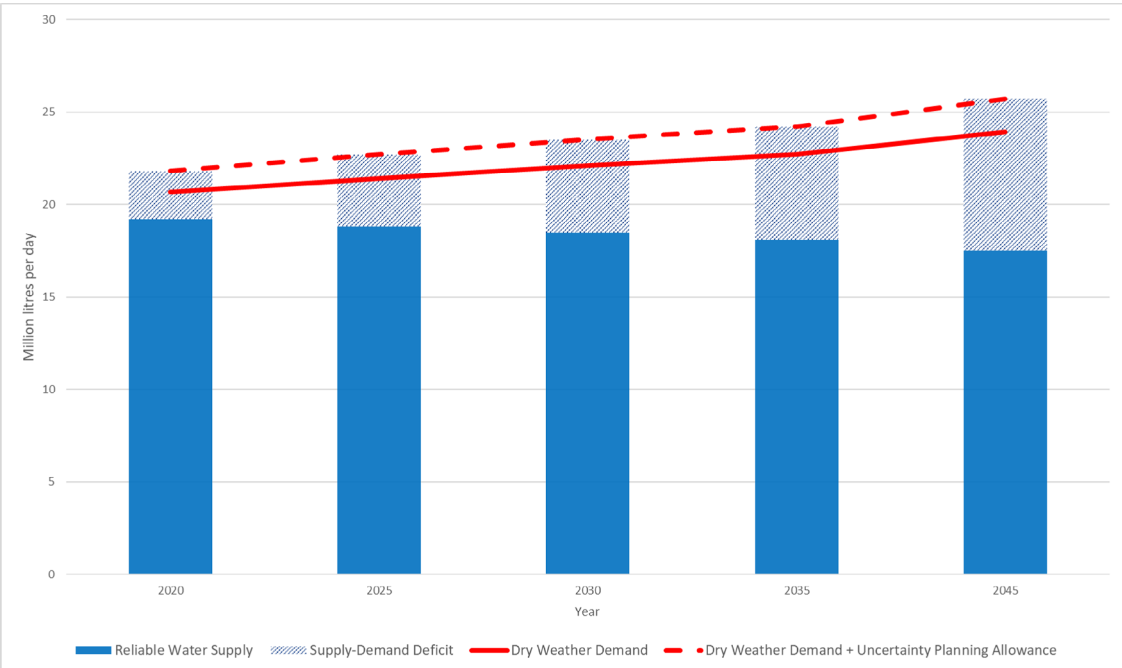
The amount of water that can be reliably supplied from our existing water sources during a severe drought is estimated at just over 19 Ml/d. The reliable supply is forecast to reduce to around 17.5 Ml/d by 2045 due to the potential impact of climate change.

The reliable supply from the St Ouen's boreholes is currently significantly constrained due to the impact of historic PFAS groundwater pollution in the aquifer which reduces the reliable supply from the boreholes by around 1.0 Ml/d to just 0.3 Ml/d. Without intervention this constraint will continue due to potential changes to the guidance values and regulatory limits for the presence of PFAS in drinking water supplies.

The forecast balance between dry weather demand and reliable water supply in drought is summarised in **Figure A**. This includes a planning allowance (or safety margin) to allow for the uncertainties in the demand and supply forecasts which increase over the planning period.

Figure A shows that there is already a supply deficit in 2020 if there was a repeat of the worst historic drought conditions (the 1991-92 drought event). The supply deficit rises throughout the planning period to around 8.2 Ml/d by 2045 as a consequence of the forecast growth in water demand.

Figure A. Supply-Demand Balance Forecast (million litres per day or Ml/d)



The WRDM Plan - Options to address the current and forecast supply deficit

To address the shortfall in the forecasted water supply/demand balance we assessed 72 options to provide acceptable supply reliability standards for Jersey from the present day to 2045 and beyond. These included:

- measures to reduce demand for water (water efficiency and leakage reduction measures)
- measures to increase reliable supply (including additional desalination, indirect effluent reuse, new stream and groundwater sources, expand existing reservoirs or develop new water storage facilities)
- measures to increase supply resilience (including catchment management to control water pollution risks and enhancements to our raw water transfer infrastructure)
- temporary measures to be taken in a drought (water use restrictions, temporary supply enhancements).

To identify the most holistic and optimal solution for the WRDM Plan a structured appraisal process was applied to evaluate each of the options against agreed assessment criteria listed below:

- Acceptability – how acceptable is the option to customer's perception of their water supply?
- Delivery complexity – how complex is the solution to implement in terms of operational risk and engineering?
- Cost per Ml/d of additional supply or demand savings – what is the cost versus benefit of delivering the option?
- Performance and resilience – will the solution perform and meet its objective and how resilient is it in the long term?
- Operational factors – how practically challenging is the solution to run and manage by Jersey Water day to day and in the long term?
- Environmental factors – how detrimental to the environment could the solution be to implement and operate?

The initial option appraisal process led to a short-list of 17 options being identified as being "feasible", taking account of the different appraisal criteria. These 17 options were subsequently investigated in greater detail and the appraisal findings, as summarised in **Table A** below, allowed the WRDM Plan solutions to be identified and refined.

Recommended WRDM Plan

Our recommended WRDM Plan addresses the supply deficit over the 25-year planning period by implementing a balanced portfolio of demand management measures, water source enhancements to increase supply and, if needed in extreme circumstances, temporary water use restrictions. Our Plan:

- takes a "no regrets" and adaptive approach that reflects the lead-times for delivery of different options, key forecast uncertainties, the needs of the island and value for money
- builds on Jersey Water's leadership in reducing water leakage and the success of the universal metering programme that is already in place to help customers reduce their water consumption before developing new and expensive water sources
- avoids options that are high risk or would have a high impact on the island community and environment.

Table A. Options Appraisal Summary (grouped by the selected and excluded options)

	Option	Benefit (Ml/d)	Acceptability	Delivery Complexity	Cost per Ml/d	Performance & Resilience	Operational	Environmental
Recommended Plan	La Rosière Desalination Plant Extension	5.00						
	Increased Reservoir Storage (Existing or New)	1.90						
	Increased Abstraction from St Ouen's Boreholes (PFAS permitting)	1.00						
	Drought Management Restrictions (when required)	1.00						
	Leakage Reduction: Enhanced Distribution Monitoring and Modelling	0.26						
	Water Efficiency Planning Regulations at New Properties	0.2						
	Water Efficiency: Enhanced Base Demand Management	0.19						
	Leakage Reduction: Pressure Reduction Programme	0.15						
	Leakage Reduction: Enhanced Leak Detection and Repair	0.13						
	Water Efficiency Visit-and-Fit Water Audits (Schools)	0.02						
	Targeted Catchment Protection Initiatives	N/A						
Excluded Options	New Desalination Plant on the East Coast	10						
	Bellozanne Indirect Treated Effluent Reuse	6.00						
	Gigoulande Quarry Partial Conversion to Raw Water Storage	1.10						
	Enhance West to East Raw Water Transfer Links	0.80						
	New Groundwater Abstraction	0.50						
	New Stream Abstraction (Rozel)	0.30						

The measures proposed were prioritised to provide a manageable improvement programme against the 2020-2045 timeline. The measures and delivery programme are summarised in **Table B** and include:

- water efficiency measures to provide around 0.4 Ml/d of demand savings by 2025
- measures to reduce leakage by around 0.5 Ml/d by 2025
- temporary customer water use restrictions in times of severe drought to achieve around 1 Ml/d of demand savings. These events are expected to be no greater than once every 20 years for a temporary use ban and once every 50 years for a wider non-essential use ban, which is felt to be within customer levels of acceptance. This level of service for water supply reliability is consistent with many water companies in Southern England
- targeted catchment protection initiatives to be developed over the next few years to protect raw water quality and increase supply resilience to pollution – fully implemented by 2025
- extension of La Rosière desalination plant by a further 5.0 Ml/d by 2025
- working with the Government to agree a solution which addresses the historic PFAS pollution in the St Ouen's boreholes by 2030 so that abstraction can be increased and provide approximately 1 Ml/d of additional reliable groundwater supplies
- delivering additional reservoir storage to provide around 1.9 Ml/d of additional reliable supply by 2045.

Table B. Summary of the Recommended WRDM Plan and benefit to the supply-demand (S-D) balance profile

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

A balanced plan to deliver enhanced water supply resilience

Our WRDM Plan is built on a twin-track approach of taking action to reduce demand alongside enhancing reliable water supplies with a balance of freshwater and desalination options. It seeks to maximise the use of existing facilities and infrastructure on the island.

Jersey Water already leads the UK in reducing water leakage and we will build on this success, alongside increased partnership with customers to increase efficiencies in water use. Together, this has the potential to save approximately 0.9 Ml/d by 2025.

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.

Work is required by Government 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 and help to reduce the reliance on expensive desalination during normal summer weather conditions.

Our preferred solution for addressing the lack of adequate reservoir storage on the island would have been the partial conversion of La Gigoulande quarry into a new raw water storage facility. However, in dialogue with Government about the Island Bridging Plan and infrastructure review, we have excluded this option from our recommended plan. This decision removed the most cost-effective water storage solution but the fundamental need to provide additional reservoir storage remains central to the future resilience of Jersey's long-term water supply needs. 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.

The targeted catchment protection initiatives do not create additional water supplies but provide resilience benefits by improving land use management to reduce pollution risks to our water sources. 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.

The option for enhancement to our west to east raw water transfer link has not been included in the recommended plan due to an unfavourable cost-benefit analysis to secure supplies during severe drought. 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. We therefore will continue to develop this option over the next few years to investigate a more cost-efficient solution for improving raw water transfer capacity from the west to the east of the island as part of our strategy to improve water supply resilience.

Addressing supply reliability risks

The further expansion of the existing La Rosière desalination plant effectively plugs the gap of the immediate supply deficit by providing a climate change resilient source and minimising the risk of water shortages in the short term. 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 the high construction costs, engineering complexity, environmental impact and the high impact on customer bills.

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.

An affordable plan

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.

Conclusions

Jersey Water's recommended WRDM Plan meets the forecasted water needs of the island community, 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. It aims to deliver a holistic solution to the water supply demand deficit by:

- **Applying a twin-track approach**: whilst our long-term Resilience Framework is under development to assess future water infrastructure requirements, our approach to demand management is being prioritised in the short term to help address the existing supply deficit before developing new and expensive water sources. Jersey Water aims to remain at the frontier of leakage control in the British Isles while further strengthening water efficiency performance wherever possible.
- **Reliable:** the 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.
- **Resilient:** 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.
- **Adaptable**: the 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:** the plan maximises the use of existing infrastructure and catchment land wherever possible reducing the need to build new infrastructure.
- **Acceptability:** the plan maximises the use of existing facilities on the island and seeks to balance additional freshwater supplies and desalination, as well as delivering demand savings at the earliest opportunity.
- **Financing and affordability**: the 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 the 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 WRDM Plan.

1. INTRODUCTION

1.1 JERSEY WATER: A BRIEF OVERVIEW

Jersey Water's purpose is to supply the water needed for the island to thrive, today and everyday. Our water supplies are provided by an integrated water resource system comprising of reservoirs and stream abstractions, groundwater boreholes and our La Rosière desalination plant. The water provided from these different water sources is treated at our two water treatment works for supply to our customers through an interlinked network of water distribution pipes. We currently supply an average of around 20 million litres of water per day to some 37,000 homes and 3600 commercial properties across Jersey. More information about Jersey Water is available on our website at www.jerseywater.je

1.2 PURPOSE OF WATER RESOURCES AND DROUGHT MANAGEMENT PLAN

Jersey Water has a responsibility to maintain secure, high quality, reliable and affordable water supplies to its customers over the long-term and which are resilient to potential future events.

We have developed this long-term Water Resources and Drought Management (WRDM) Plan, covering the 25-year period from 2020 to 2045, to understand the likely future changes in demand for water and reliability of water supplies so that we can determine the actions required to maintain high standards of water supply reliability to our customers. Our WRDM Plan therefore identifies:

- How demand for water and supply availability will change over the next 25 years.
- The risks and uncertainties, such as climate change and other events outside of our control, which may affect the future balance between demand for water and water supply availability.
- The range of options we could consider taking over the coming years to ensure there is adequate water availability to meet future demand, particularly in drought conditions.
- Our decisions and actions to secure water supply reliability for customers over the next 25 years and beyond.

1.3 STRUCTURE OF THE PLAN

We have structured our WRDM Plan in accordance with relevant UK guidelines for preparation of water resources management plans and drought management plans. **Figure 1.1** details the various sections contained in the plan and the key information each section provides.

Figure 1-1 Structure of our Water Resources and Drought Management Plan

Introduction Section 1	Jersey Water overview and purpose of this plan
Policy and Strategy Background Section 2	Describes the key policies and strategies that underpin development of our plan
Our Water Supply System Section 3	Describes the key features of our water supply system and the key planning challenges of the future
Water Supply Availability Section 4	Explains how much water is reliably available for supply in drought conditions and how this has been calculated
Demand Forecast Section 5	Sets out the different components of water demand and explains how they will change in the future
Uncertainty, Risk and Resilience Section 6	Describes how forecast uncertainties are addressed in the Plan and the key risks to water supply resilience
Supply-Demand Balance Section 7	Sets out the forecast supply-demand balance over the next 25 years and the key planning implications
Option Appraisal Section 8	Describes the appraisal of alternative options for securing future water supply reliability and resilience
Programme Appraisal, Decision-Making and Recommended Plan	Considers alternative programmes of measures to secure future water supply reliability and resilience and how we determined our recommended plan
Conclusions Section 10	Sets out key conclusions about our recommended plan

The detailed assessments that underpin our plan are set out in a series of accompanying Technical appendices as shown overleaf:

Figure 1-2 Technical Appendices to the Water Resources and Drought Management Plan

Appendix A	Water Resource Zone Integrity
Appendix B	Water Resource Zone Problem Characterisation
Appendix C	Water Source Yield Assessment
Appendix D	Climate Change Assessment
Appendix E	Demand Forecast
Appendix F	Uncertainty, Risk & Resilience Assessment
Appendix G	Target Headroom
Appendix H	Drought Management
Appendix I	Option Appraisal
Appendix J	Programme Appraisal, Decision-making and Recommended Plan

2. POLICY AND STRATEGY BACKGROUND

2.1 WATER RESOURCES AND DROUGHT MANAGEMENT PLANNING

Water companies in England and Wales have a statutory duty to prepare a Water Resource Management Plan and a Drought Plan every 5 years. Although Jersey Water is not regulated in the same way and has no statutory requirement to publish such plans, Jersey Water recognises the benefits of taking a long-term view of water supply provision and managing supplies during drought conditions. We have therefore developed this integrated Water Resources and Drought Management Plan ('WRDM Plan' or 'the Plan') to update and refresh the Water Resource Management Plan (WRMP) that we prepared in 2010.

The WRDM Plan considers long-term planning for water resources and how essential water supplies can be maintained during future drought events. This is important to account for long term pressures such as demographic changes and climate change. Long term planning allows for the appropriate timescales required to develop any measures necessary to maintain reliable water supplies when demand for water in Jersey is growing. A 25-year planning period has been adopted for the plan to 2045, but we have also considered the longer-term view beyond 2045.

The key objectives of the WRDM Plan are to:

- Develop a robust evidence base to characterise the scale and complexity of the water resource and drought management challenges facing Jersey's water supplies over the next 25 years, including consideration of risks and uncertainties.
- Review the current components and trends in demand for water and to forecast the future water demand over the next 25 years, taking account of population and housing growth projections for the island.
- Assess the reliable supply of water available in drought conditions of different severities, taking account of the risks to future water supply availability over the next 25 years such as climate change.
- Assess the key water supply resilience risks and uncertainties over the next 25 years.
- Quantify the water supply-demand balance over the next 25 years to assess the future vulnerability to drought and other pressures affecting the reliability of water supply provision.
- Consider a range of alternative options to maintain water supply reliability, including temporary drought management measures alongside permanent measures to manage demand or augment supply reliability.
- Carry out multi-criteria appraisal of alternative programmes of measures to balance supply and demand to inform decision-making on the preferred plan to secure future supply reliability for our customers.

In preparing our Plan, we have considered relevant technical guidance for water resources management planning and drought management planning principles that have been developed in the UK, including:

- Guiding principles for water resources planning, prepared by the Department for Environment, Food and Rural Affairs (Defra) (2016)
- Water resources planning guideline, prepared by Defra, Welsh Government, Environment Agency, Natural Resource Wales, Ofwat and Defra (2016 and 2020)
- Water Company Drought Planning Guideline prepared by the Environment Agency (2016 and 2020)
- Water resources planning and drought management guidance for Northern Ireland (2015)
- UK Water Industry Research (UKWIR) (2016), Water Resources Planning Methodologies
- UKWIR (2020), Developing a Best Value Water Resources Management Plan.

We have also benchmarked our existing and proposed standards of service for water supply reliability against those offered to water company customers in other parts of the British Isles.

2.2 POLICY CONTEXT

Our Plan has been developed in the context of the relevant Jersey statutory provisions relating to water catchments, water abstraction, water supply provision, drinking water quality and water charging as covered by the follow legislation:

- The Water (Jersey) Law 1972
- The Water Pollution (Jersey) Law 2000
- The Water Resources (Jersey) Law 2007

We have also considered relevant aspects of Government of Jersey planning activities, including:

- Challenges for the Water Environment of Jersey (2014)
- Water Management Plan 2017-2021
- Common Strategic Policy 2018-2022
- Island Plan (revised 2011) and the Island Plan Review (ongoing)

In developing our WRDM Plan, we have published a submission to the Island Plan Review, recommending that a water strategy be developed and for water to be included as a key consideration for island planning alongside minerals, energy, waste and transportation strategies.

Our WRDM Plan focuses on how we are going to ensure the reliable supply of water that meets drinking water quality standards to our customers whilst safeguarding public health. We also recognise the importance of secure water supplies for our commercial customers in both the public and private sector to help support the future economic growth of Jersey.

2.3 JERSEY WATER STRATEGY

There are five key pillars to our business strategy and all our work at Jersey Water. The five key pillars are underpinned by ten strategic objectives:

- *High Standard of Service*:
  - Charges that are fair, affordable and value for money
  - High customer satisfaction
- *A Great Place to Work*
  - Safety and wellbeing come before everything else
  - Engaged, empowered and effective people
- *Community Conscious*
  - A positive impact on Island life and our local community
  - Environmentally responsible and sustainable business
- *Long-Term Stability*
  - Efficient, financially secure and generates a fair profit
  - Good governance with a focus on long term resilience and stability
- High Quality Water
  - Safe, high quality drinking water
  - Sufficient water resources to meet demand

These strategic objectives support and underpin the development of our WRDM Plan.

2.4 CONSULTATION ON THE PLAN

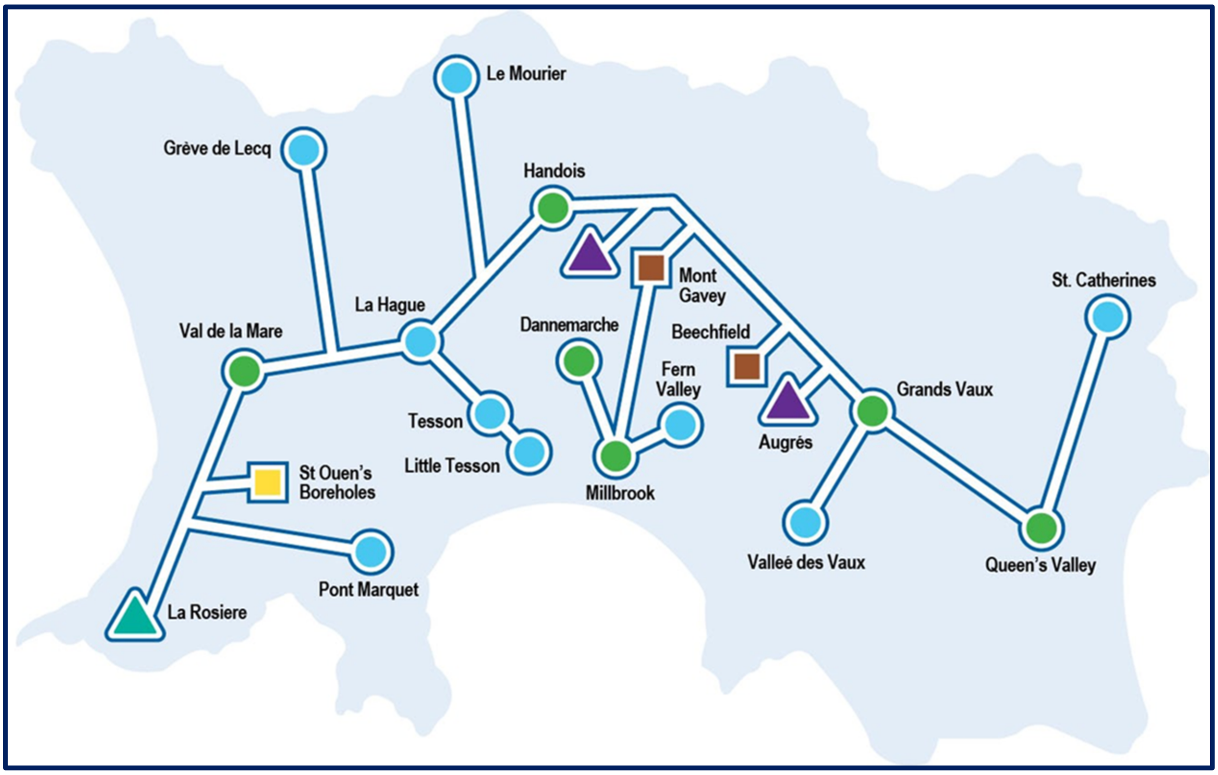
Although there is no statutory requirement to consult on our Plan, we are keen to engage and consult with our customers and stakeholders on the measures set out in this Plan. We intend to publish this Plan on our website during summer 2021 to provide the opportunity for customer and stakeholder comment.

3. OUR WATER SUPPLY SYSTEM

3.1 WATER RESOURCES OPERATION AND MANAGEMENT

Figure 3-1 shows our integrated water resource system comprising of reservoirs (green circles), stream abstractions (blue circles), groundwater boreholes (yellow square) and La Rosière desalination plant (blue triangle). Our largest (and newest) reservoir is Queen's Valley reservoir in the south-east of the island followed by Val de la Mare reservoir in the west. The "Waterworks Valley" cascade of reservoirs (Handois, Dannemarche and Millbrook) and Grands Vaux reservoir are strategically located but smaller capacity reservoirs. Mont Gavey and Beechfield (brown squares) are important balancing tanks to help control the conveyance of water around the raw water supply system. The water provided from these different water sources is treated at our Handois and Augrès water treatment works (purple triangles) for supply to our customers through an interlinked network of water distribution pipes.

Figure 3-1 Jersey Water Resource System: Key Raw Water Assets

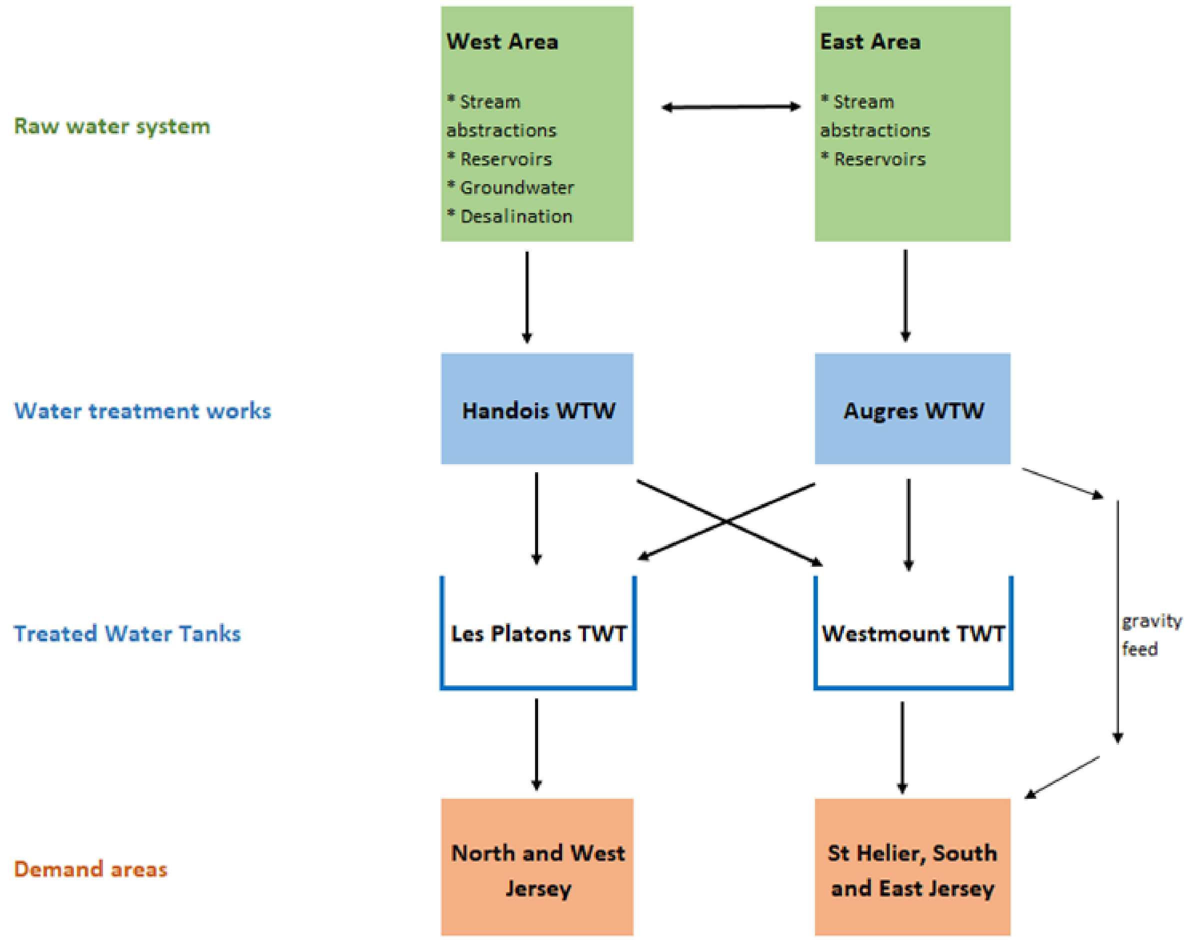


Our raw water supply system has been developed and enhanced over many decades creating an integrated system that enables raw water resources (including water from the desalination plant) to be moved between our sources and storage reservoirs through inter-linked pipelines and pumping stations. This system provides flexibility and allows for greater catchment utilisation as water can be moved from more productive catchments with little storage, to storage facilities with less productive catchments. In total, our current raw water storage facilities can hold up to 2678 million litres (megalitres, or Ml) of water, enough storage to meet our customers' average water demand for around 130 days and therefore provide a degree of resilience to prolonged dry weather events.

La Rosière desalination plant has recently (2018-19) been doubled in capacity and can produce up to 10.8 million litres per day (Ml/d), approximately equivalent to just over half of the average daily water demand in Jersey. The desalination plant is used when there is reduced availability of freshwater from our surface water and groundwater sources and taking account of the risk of drought as indicated by water storage levels in our reservoirs, stream flows and groundwater levels.

As illustrated in **Figure 3-2**, water from our raw water storage facilities is treated at our Handois and Augrès water treatment works (WTWs) before being supplied to customers via the treated water distribution system. Both WTWs are situated at a similar elevation thereby enabling flexibility between the two WTWs in supplying treated water into the distribution system, affording resilience to planned and unplanned maintenance activities.

Figure 3-2 Schematic of Jersey Water Resource Zone



Given the integrated nature of the water supply system, the whole of Jersey can be considered as a single water resource zone for the purposes of supply-demand balance assessments and planning, in line with UK water industry water resource planning guidance. Further details are provided in **Appendix A**.

3.2 WATER SUPPLY SYSTEM RESILIENCE IMPROVEMENTS

The resilience of our water supply system to drought is constantly being improved and has benefitted from many improvements made over the last 20 years or so, including the recent doubling of the capacity of La Rosière desalination plant after the need was identified in our 2010 Water Resource Management Plan. Universal metering was also introduced and well received and is crucial in helping to plan and manage water resources. Recently, we have been working closely with the Action for Cleaner Water Group in order to support catchment management activities to avoid the pollution of raw water supplies which can reduce the amount of raw water available for treatment.

3.3 OPERATIONAL WATER RESOURCES AND DROUGHT MANAGEMENT

We operate our integrated raw water supply system to maximise raw water storage so we can maintain a high standard of water supply reliability to our customers. In the event of a prolonged period of dry weather, we proactively move water around the raw water storage system to balance storage levels across the island as far as possible and maximise the abstraction from our water sources. If storage in our reservoirs falls, we commence operation of La Rosière desalination plant to supplement freshwater resources.

During periods of high demand for water, we have sufficient water treatment capacity available to be able to increase the output from our two WTWs to meet any peaks in demand. At other times when demand is lower, we aim to optimise the operation of our raw water system, water treatment works and treated water networks to ensure efficient delivery of water supplies to our customers at lowest possible cost.

In periods of prolonged dry weather, we carefully monitor the rate of decline of raw water storage and assess the risks to water supplies on a weekly basis, taking account of the time of year, flow conditions at abstraction intakes and prevailing water demand. Based on these supply reliability assessments, we undertake appropriate management actions that reflect the level of risk, including:

- Actions to control demand, including more intensive leak detection activity and publicity to ask customers to use reduce non-essential uses of water
- Maximising abstraction from all water freshwater sources
- Commencing La Rosière desalination plant at 50% or 100% of capacity, depending on how much additional raw water supply is required to safeguard water supplies
- Moving raw water supplies around our supply system to balance storage levels across our storage facilities.

If the dry weather persists into drought conditions and raw water storage reduces further, we might need to introduce temporary water use restrictions (for example, temporarily banning household customers from using sprinklers and hosepipes for external water uses). In developing this Plan, we have reviewed our operational management practices and drought management measures as part of the consideration of options to safeguard future water supply reliability in drought conditions.

3.4 FUTURE CHALLENGES AND PLANNING APPROACH

Future Challenges

We face a range of future challenges in respect of water resources reliability and resilience, in particular:

- Increased demand for water over the next 25 years, primarily driven by forecast population and housing growth. Different demand scenarios have a large impact on the forecast supply-demand balance, so our Plan needs to be sufficiently flexible to be able to respond to changing pressures on demand when they arise.

- Supply forecast uncertainties due to climate change and extreme weather. Climate change is expected to result in more frequent and/or intense periods of drought which could mean less reliable water availability from our water sources over the next 25 years and beyond. Our Plan needs to take account of the potential effects of climate change and extreme weather, particularly prolonged dry weather and drought conditions.

- Physical asset risks (unplanned outage) that impact on maximising surface water storage or which hinder groundwater abstraction or desalination plant output. Our Plan needs to consider whether future demand for water can be met if a key asset, or selection of key assets, are taken offline due to an unplanned outage.

- Supply forecast uncertainties due to pollution. Notably, we need to consider the impact of agricultural activity on levels of nitrate and pesticide pollution and the consequent impact on the raw water quality of our stream, reservoir and groundwater sources. Additionally, our St Ouen's boreholes suffer from historic pollution arising from use of fire-fighting foam at the airport. Our Plan needs to consider how best to address these water pollution risks to supply reliability.

- Isolated supply position – we cannot readily bring in additional resources or replacement parts / assets at short notice to the island from elsewhere if required, so we need a high level of resilience in our supply system.

- There are current limitations to how much water we can convey from raw water sources in the west of the island to those in the east. Our Plan needs to examine if greater flexibility can be provided to the cross-island transfer of water to help further improve drought resilience and explore whether this is cost-effective.

Planning Approach

We have applied the "WRMP 2019 water resources planning decision-making guidance" for

UK Water Companies, published by UKWIR (2016) and adapted it to the Jersey situation (as set out in **Appendix B**) to assess the complexity of the water resource planning issues in Jersey. The "Problem Characterisation" assessment concluded that (in a UK-wide context), the issues and challenges faced by Jersey Water are of a "medium level of concern". This indicates that existing water resources assessment and planning techniques developed by the UK water industry should be adequate for our water resources planning and decision-making processes, and that the development of more complex tools is unlikely to be warranted. This conclusion does not imply that there are no material risks or uncertainties to consider, but that existing and tested methodologies to assess them are available and should be appropriate to the problems we face in Jersey.

The assessment highlighted that:

- The possible effects of climate change, water quality deterioration and population growth are the more uncertain elements of the supply-demand balance projections over the planning horizon.
- There are potentially significant environmental and planning sensitivities around any new water supply schemes so that robust and transparent decision-making approaches are needed.
- Options to address any identified future supply deficit could carry a level of risk and uncertainty (e.g. the potential need to adopt new technologies and possible planning and/or land availability constraints).
- Extended decision-making techniques such as multi-criteria analysis and scenario testing are likely to be needed. These will help us to provide transparency to stakeholders and customers about the reasons for choosing a particular programme of measures to secure future water supply reliability.

4. RELIABLE WATER SUPPLY AVAILABILITY

4.1 RELIABLE WATER SUPPLY AVAILABILITY: DEFINITIONS

There are two important measures of reliable water supply availability in drought conditions used in the UK water industry that we have adopted for this Plan:

- **Deployable output** is defined as the maximum quantity of water output from a water source, or group of sources, that can be sustained during a dry year using all of the available raw water storage in the driest period on the hydrological record. This equates to the reliable water source yield of the raw water supply system. The deployable output can be constrained by the hydrological characteristics, the capacity and/or operation of the abstraction assets, constraints on abstraction volumes, source water quality and/or existing water treatment and supply system capacities.
- **Water Available For Use (WAFU)** is the maximum quantity of water available for supply from a water treatment works, or group of treatment works, that can be sustained during a dry year. It is calculated as follows:

Forecast Water Available For Use (WAFU)

= Forecast deployable output

minus Raw water and water treatment works losses

minus Outage allowance

The assessment of deployable output and WAFU is detailed in **Appendix C** and sets out how much water can be reliably provided in drought conditions, both now and in the future. The results are summarised in the following sub-sections.

4.2 SURFACE WATER RELIABLE SUPPLY ASSESSMENT

Assessment of the reliable water supply in drought conditions (deployable output) for the Jersey Water supply system has followed the best practice guidance issued by UKWIR (2014), adapted where necessary to take account of the availability and/or quality of data. The assessment has been based on hydrological estimates derived from the historic rainfall record for the island (dating back to 1865) and the catchment areas of the various stream intakes, as well as consideration of evaporation losses from the catchment land and the total water raw storage available. Additionally, we have reviewed the reliable supply in drought conditions available from our groundwater sources and La Rosière desalination plant.

The surface water reliable supply assessment focused on identifying historic drought events from the long historic rainfall record. These rainfall records plus estimates of evaporation losses from catchment land and the calculated water catchment areas were included in an industry standard computer model ("rainfall-runoff model") to estimate monthly stream flows and reservoir inflows for each year of the rainfall record, with a particular focus on drought events that occurred over the historic record.

Four water system storage models were developed for each key reservoir storage system (Val de la Mare, Waterworks Valley reservoirs, Grands Vaux and Queen's Valley) to simulate the refill and drawdown of the reservoir systems using the estimated flows from the rainfall-runoff model over the period 1901 to 2007. The reliable supply (deployable output) was determined from these water storage models, taking the worst historic drought flow conditions (the 1991-92 drought) and assessing the maximum demand that can be met without raw water storage volumes falling below a defined minimum acceptable level (see **Appendix C** for full details).

The minimum acceptable storage level (see **Figure 4-1**) is based on two risk allowances:

- **"Dead Water"** – indicated by the red dashed line. 5% of the total storage volume has been classified as unavailable (i.e. "dead water") for planning purposes, based on the risk that the water stored at the very bottom of storage reservoirs in drought conditions may be of poor quality (e.g. high sediment content and therefore not feasible to treat to drinking quality water standards) and/or it may not be possible to physically abstract it from the bottom of the reservoir.

- **"Emergency Storage"** – indicated by the orange line. In line with UK good practice for water resources planning, an Emergency Storage allowance has been included in the assessment to allow some contingency storage to guard against the risk that a future drought may be more intense or prolonged than the worst historic drought. The Emergency Storage allowance amounts to a storage volume equivalent to 30 days' supply at the reliable supply available from the reservoirs.

This assessment indicated that the total reliable supply (deployable output) from the reservoirs and stream intakes in the worst-case drought of 1991-92 is **9.12 Ml/d**.

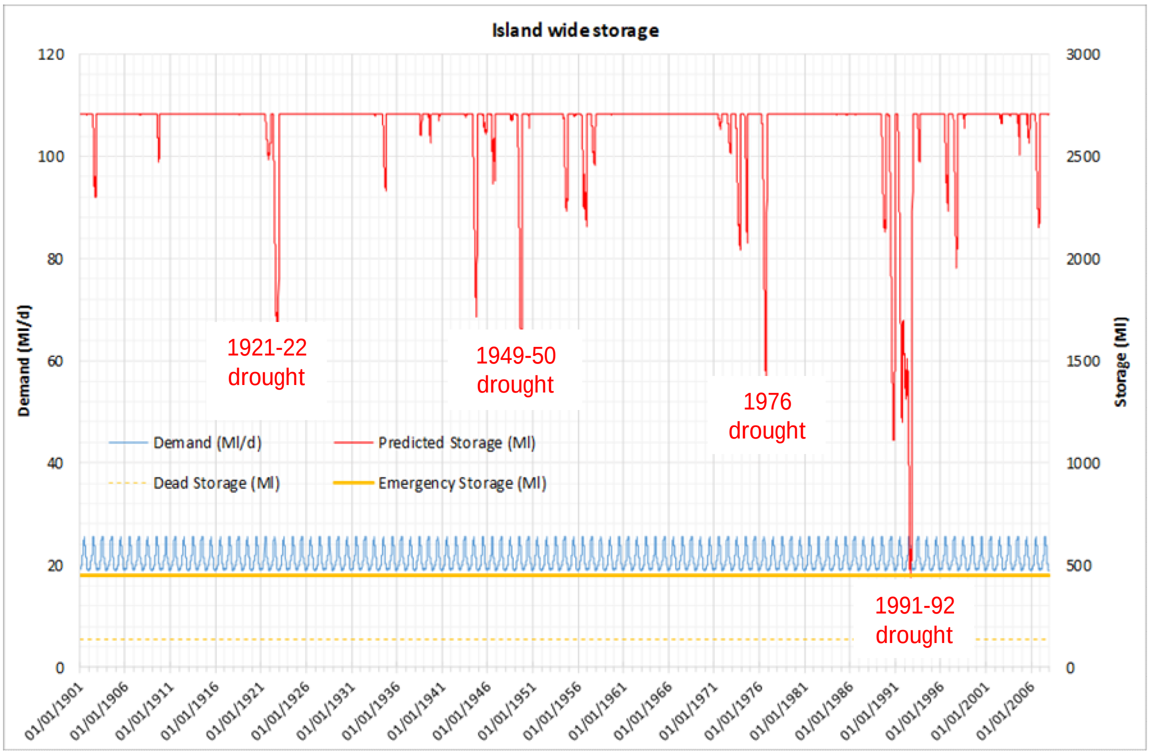
Historic Drought Analysis

The long-term rainfall record was analysed to identify the frequency, duration and magnitude of historic drought conditions in Jersey. This showed that there have been some significant drought events (**Figure 4-1**), some of which have extended over two years (i.e. including a dry winter), notably:

- 1921 - 1922
- 1949 - 1950
- 1991 - 1992

The analysis demonstrated that the reliable supply assessment needed to consider the implications for water storage of at least a 24-month drought event with the modelling showing that the 1991-92 drought event was the critical drought period (**Figure 4-1**). Other severe drought events (e.g. 1921-22) were also shown to lead to low water storage levels but with some surplus storage remaining above the emergency storage level (**Figure 4-1**).

Figure 4-1 Modelled pattern of total raw water storage from 1901 to 2007 at maximum reliable supply



4.3 GROUNDWATER RELIABLE SUPPLY ASSESSMENT

Our assessment of the reliable supply (deployable output) of groundwater from our St Ouen's boreholes and Tesson borehole has taken account of historic abstraction records in drought conditions. This indicated that the reliable supply from Tesson borehole is constrained to 0.24 Ml/d. The situation at St Ouen's boreholes is complicated by constraints on abstraction due to historic chemical pollution of the groundwater due to use of fire-fighting foam at Jersey Airport (see **Appendix C** and **Appendix F** for more details). While the reliable supply from the St Ouen's boreholes in a drought could be between 1.0 Ml/d and 1.3 Ml/d (and potentially higher), the groundwater pollution means that abstraction is currently limited to a safe level of 0.3 Ml/d to avoid polluted groundwater being abstracted which would not meet drinking water quality standards (even after treatment at our WTWs). Total groundwater reliable supply (deployable output) is therefore assessed at **0.54 Ml/d**.

4.4 DESALINATION PLANT RELIABLE SUPPLY ASSESSMENT

The recently expanded La Rosière sea water desalination plant can reliably supply either 5.4 Ml/d (using only one treatment stream) or 10.8 Ml/d (using two treatment streams) during drought conditions. This total reliable supply volume (deployable output) of **10.8 Ml/d** reflects the treatment capacity of the desalination plant as the seawater supply to the plant is not impacted by drought.

4.5 RELIABLE SUPPLY ASSESSMENT: CONCLUSIONS

The reliable supply assessment demonstrates that:

- The total baseline reliable water supply (deployable output) from the existing supply system is estimated at **20.46 Ml/d** based on the worst historic drought of 1991-92.
- The supply system is resilient to single season droughts, such as 1976, which reflects the availability of raw water storage (equivalent to around 120 days of supply).
- There have been several 2-year droughts in Jersey and our Plan needs to consider how essential water supplies can be maintained to customers in these severe drought conditions.

4.6 BASELINE LEVEL OF SERVICE FOR WATER USE RESTRICTIONS

Using the water storage model, we have assessed the baseline level of service for temporary water use restrictions (at 2020), taking account of the frequency and severity of the modelled drought events over the period 1901 to 2007 inclusive.

We operate the water supply system to minimise the risk of asking our customers to reduce non-essential uses of water or introducing formal water use restrictions. However, in severe drought conditions we do need the help of our customers to conserve water. At current (2020) levels of dry weather demand and with our current water resources, our level of service for implementing temporary water use restrictions approximates to once in every 20 years, with restrictions on a wider range of non-essential water use being required no greater than once in every 50 years. This customer level of service for water supply reliability is consistent with many water companies in Southern England. Further details are provided in **Appendix H**.

4.7 POTENTIAL EFFECTS OF FUTURE CLIMATE CHANGE ON RELIABLE SUPPLY

We have carried out an assessment of the potential effects of future climate change on supply reliability (deployable output) using the UK water industry methodology and the UK Climate Projections 2009 (UKCP09) for the Channel Islands. Full details are provided in **Appendix D**.

The UKCP09 climate change emissions scenario projections show that summer (June to August) rainfall might potentially decrease by between 12% and 16% by 2040 depending on the greenhouse gas emissions scenario selected from the UKCP09 projections, whereas winter rainfall (December to February) might potentially increase by between 10% and 14%. Increases in mean temperature might potentially range from +2.1 to +2.2 °C in summer and autumn for the low and high emission scenarios, which will increase the evapotranspiration rate from the Jersey stream catchments.

Table 4-1 shows that modelling the effects of these climate change scenarios on Jersey's stream flows and reservoir inflows would have a negative impact on future reliable water supply by the 2040s, with a reduction of between 1.45 Ml/d (high emissions) and 1.67 Ml/d (medium emissions). The high emissions scenario results in a slightly lower impact as higher winter rainfall under this scenario offsets the drier summer conditions to a greater extent than for the low or medium scenarios. Given this relatively small range of impacts across these different climate change scenarios, we have applied the medium emissions scenario impact of approximately **1.7 Ml/d** to our forecast of reliable water supply at 2045 and applied a linear glide path of the reduction to reliable supply for the intervening years from 2021 onwards.

Table 4-1 Potential climate change impact on reliable water supply in Jersey by 2040 for the low, medium and high emissions scenarios for the Channel Islands

Emissions Scenario	Reliable Supply (Ml/d)	Potential Impact (Ml/d)
Baseline (2020)	20.46	
Low	18.86	-1.60
Medium	18.79	-1.67
High	19.01	-1.45

It should be noted that the potential effects of climate change increase over time, so the changes that might arise over the next 25 years to 2045 are relatively modest compared to the effects that might occur in 80 years' time (i.e. by 2100).

The outcome of this assessment should be viewed with some caution given the uncertainty surrounding the climate change emissions scenario projections, particularly at the small geographical scale of the Channel Islands. These uncertainties are reflected in our target headroom assessment (**Section 7** and **Appendix G**) and are also considered as part of the wider resilience and sensitivity testing of the plan (**Section 9**).

4.8 OTHER POTENTIAL FUTURE CHANGES TO SUPPLY RELIABILITY

We have reviewed the potential risks (aside from climate change) to supply reliability that might materialise over the 25-year planning horizon, such as the loss of a water source or a storage facility due to a long-term pollution impact or a permanent reduction in reservoir storage volume due to safety considerations. These risks have been assessed as having a low probability of occurrence and so they have been incorporated as a risk within the target headroom allowance (**Section 7** and **Appendix G**) and no reductions have been made to our water supply reliability forecast.

4.9 WATER AVAILABLE FOR USE: RAW WATER CONVEYANCE SYSTEM AND WTW LOSSES

Our raw water conveyance system is regularly monitored for leaks and the volumes lost within the conveyance system are assessed as very low to negligible as a proportion of the reliable water supply. We have invested in comprehensive treatment and recycling facilities for the washwater from our WTW processes so that we do not lose any raw water resource.

Consequently, we have not included any allowance for raw water conveyance system losses or WTW losses in our calculation of Water Available For Use (WAFU).

4.10 OUTAGE ALLOWANCE

In accordance with the UK water resources planning guidance, an outage allowance has been included in our assessment of WAFU which reflects potential losses to reliable water supplies in a drought associated with temporary unplanned outages at raw water abstraction sources or storage facilities, on raw water conveyance systems or at water treatment works. Our outage risks are assessed as at the lower end of the scale of UK water companies: this reflects our very high maintenance standards and rapid response times to asset failures for our raw water supply and WTW assets, reflecting their critical importance to water supply security. In view of Jersey's isolated position, we operate a critical spares retention policy to avoid potential delivery delays (particularly in bad weather) and we have also invested in standby arrangements for key assets so that any outages that may arise can be quickly addressed to avoid impacts to our customers.

The key residual risk relates to water pollution events in water source catchments which can result in some raw water supplies being temporarily diverted away from our storage reservoirs to safeguard drinking water quality, and therefore leading to a loss of water resource. If this occurs during a drought event (or prevents reservoirs refilling completely before the start of a drought event), there will be some impact on WAFU. This risk is being proactively managed through our collaborative work with the Action for Cleaner Water Group to support catchment management activities to reduce the risk of pollution of raw water supplies. Our Plan considers what further measures could be taken to reduce this risk (see **Sections 8 and 9**).

Given these outage risks, we have made a relatively small outage allowance of **1.3 Ml/d** in our reliable supply forecast, equivalent to around 6% of deployable output.

4.11 WATER AVAILABLE FOR USE (WAFU) FORECAST

Based on the above assessments, the WAFU forecast to 2045 is set out in **Table 4.2** taking account of the impact on the baseline reliable water supply forecast (deployable output) of climate change risks and the outage allowance. The Water Available For Use forecast can then be compared to the dry year demand forecast (Section 5) to assess the future supply-demand balance (see Section 7).

Table 4-2. Reliable Water Available For Use Forecast

Reliable Water Available For Use Component (Ml/d)	2020	2025	2030	2035	2045
Baseline Deployable Output	20.46	20.46	20.46	20.46	20.46
Climate Change Impact	0	0.4	0.7	1.1	1.7
Raw Water and Water Treatment Works Losses	0	0	0	0	0
Outage Allowance	1.3	1.3	1.3	1.3	1.3
Water Available For Use	**19.2**	**18.8**	**18.5**	**18.1**	**17.5**

5. DEMAND FORECAST

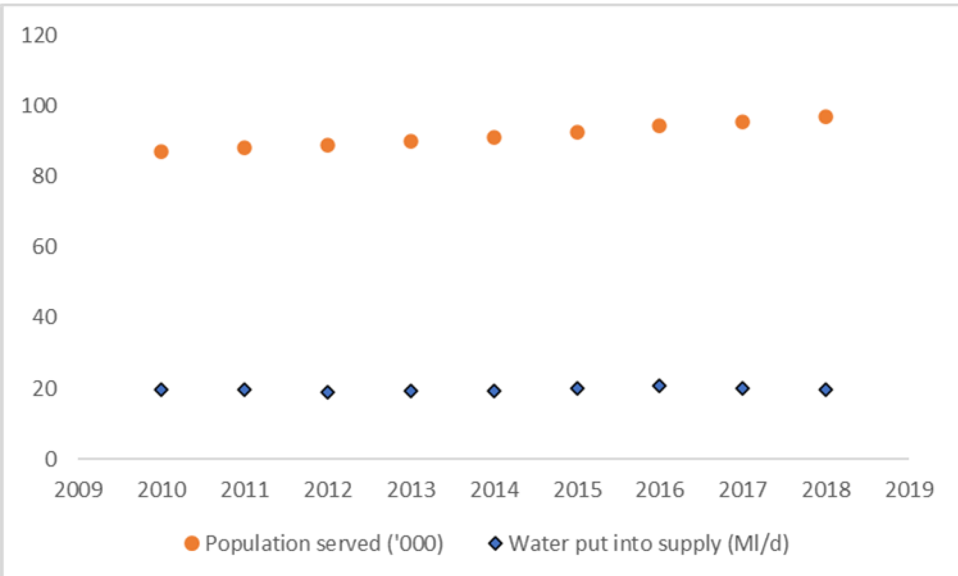
5.1 OVERVIEW OF WATER DEMAND IN JERSEY

In 2018, we supplied an average of 19.7 Ml/d to 37,000 homes and 3600 commercial properties across the island. Approximately 98% of properties are metered and so our customers have a direct incentive to conserve non-essential water use to save on their water bills. Customers can benefit from various water saving advice and devices that we make readily available to them.

Demand for water is significantly higher in the summer months than the rest of the year, due in particular to increased water use by domestic households and agriculture/horticulture in hotter, drier weather and more visitors to the island during the summer.

Overall, the average amount of water we put into supply each year has remained steady at about 20 Ml/d over the past decade (19.8 Ml/d in 2010; 19.7 Ml/d in 2018). Over this time, the population we have supplied with water has increased by 11% from 87,100 in 2010 to 96,800 in 2018. However, the potential associated increase in water demand has been cancelled out by our demand management actions to reduce leakage and our comprehensive customer metering programme. The volume of water lost due to leakage has also reduced from 3.5 Ml/d in 2010 to less than 2.6 Ml/d in 2018, whilst our customer metering programme has resulted in 98% of customers being metered compared with only 43% in 2010.

Figure 5-1 Population served and water put into supply since 2010



5.2 DEMAND MANAGEMENT

Our actions to manage water demand, and hence minimise the quantity of water needing to be put into supply, play an important part in maintaining reliable water supplies. Demand management measures can be categorised as:

- Customer metering activities
- Promotion of water efficiency actions
- Leakage control measures

5.2.1 Customer Metering

Customer water meters are acknowledged as an effective way of reducing water use and wastage. Customers on a meter pay according to the amount of water they use and so have a direct financial incentive to minimise their non-essential use of water.

All new properties in Jersey have been metered since the early 1990s, and since 2000 domestic customers have been able to voluntarily opt to be metered through our free meter option scheme. In 2010, a universal metering programme commenced as an important water conservation measure to help ensure adequate reliable water supply availability for Jersey. In consequence, about 98% of customers now have water meters installed, of which about 95% are charged on an individually metered consumption basis, and the remaining 3% are "bulk" metered (e.g. groups of flats with only one meter). The other 2% of properties remain unmeasured as it was found to be impractical to install a meter because of common supply pipes or other complex pipework arrangements.

Many of the customer meters record the water flow on a frequent basis, and so leakage from customer pipework can be readily detected when the meter readings are next downloaded using "drive-by" technology. We routinely use these meter readings to identify cases of high customer water consumption that may indicate underground customer supply pipe leakage or customer property plumbing losses such as leaking or over-flowing toilet cisterns or dripping taps. Where appropriate, we visit the customer and/or contact the customer to inform them of potential leakage or losses, with the aim of achieving prompt resolution of the leaks or water wastage.

Metered properties are charged a standing charge (i.e. fixed charge irrespective of the volume used) and a volumetric charge in accordance with the quantity of water used. Other types of tariff for metered customers (e.g. seasonal or rising block) are not in use. The remaining unmeasured customers are charged on an assessed charge or rateable value basis.

5.2.2. Promotion of Water Efficiency

We recognise the importance of taking action to help our customers manage their water use, and so we carry out a wide range of activities to promote water efficiency by customers to help them save water. These include the provision of:

- Benchmark information presented on billing leaflets to help customers compare their consumption with that of a typical home
- Water saving tips published on our website
- Free water saving devices available for example via our website

- Free water audits and advice to domestic customers found to have high consumption
- Free school visits and water saving advice
- Water audits and advice to commercial customers (on a chargeable basis)
- Media campaigns by radio, social media and TV to promote water savings tips during the summer and advise on cold weather pipe protection measures during the winter
- Meetings with our key customers including farmers and housing associations, to discuss opportunities for water saving
- Water fittings visits to commercial sites to check compliance with regulations and provide advice on efficient water appliances
- Attendance by Jersey Water at major farming and trade shows on the island to offer advice

5.2.3 Leakage Control

Jersey Water is at the frontier of leakage control performance in the British Isles. We are pro-active in controlling leakage and have successfully reduced the volume of leakage by a quarter from about 3.5 Ml/d in 2010 to less than 2.6 Ml/d in 2018. This has been achieved through intensive monitoring of night-time flows in each District Meter Area (DMA, each of which is a small discrete part of the distribution network with a meter to continuously monitor water flows): each day the metered flow information is used to identify any areas with high night-time flows (indicating leakage) and to then direct our leakage detection activity. We have a dedicated leak detection team who will determine the exact location of leaks identified by our flow monitoring or any reports of leaks from our customers. It is important that leaks are repaired as quickly as possible to reduce the amount of water lost from the pipe: leaks are generally repaired within 6 hours of their precise location being determined.

As described above, we have also been pro-active in identifying cases where there is leakage on customer pipework and asking customers to repair the leaks as quickly as possible.

The current estimated volumes of leakage represent about 13% of the water put into the distribution system, which is a low percentage relative to UK and Ireland norms.

5.3 DEMAND FORECASTING APPROACH

5.3.1 Good Practice Methods

The demand forecasting approach we have used is consistent with good practice methods developed by the UK water industry and approaches in general use by UK water companies but adapted where appropriate to circumstances in Jersey.

Water demand forecasting for water resources planning has been undertaken in the UK for many years. As a result, the UK has developed an extensive set of methodologies for carrying out demand forecast calculations: in particular the good practice methods developed by UK Water Industry Research Limited (UKWIR) and the latest national guidance for water resources planning prepared by the Environment Agency in England (2016 and 2020).

5.3.2 Baseline Demand Forecasts

"Baseline" water demand forecasts for Jersey have been calculated throughout the planning period, starting from 2017 (the "base" year for the demand forecast) and out to 2045. The focus of these forecasts is the demand that would occur under **dry weather conditions** as this is when demand is at its highest (and water supply availability at its lowest).

"Baseline" demand forecasts include the effects of our current demand management actions, such as leakage detection and repair activity, household metering and our water efficiency programmes. They exclude the effects of any additional demand management measures that may be identified as part of our plan for resolving any forecast supply-demand deficits. The effects of any such measures included in the WRDM Plan are reflected in the final supply-demand balance forecast (summarised in **Section 9**).

5.3.3 Demand Components

In line with good practice, the starting position for forecasting future demand is to first assess the total water put into supply and each demand component in the base year (2017). Each demand component can then be forecast from that starting point into the future over the planning horizon to 2045. The demand components are then summed to calculate the total demand in each year.

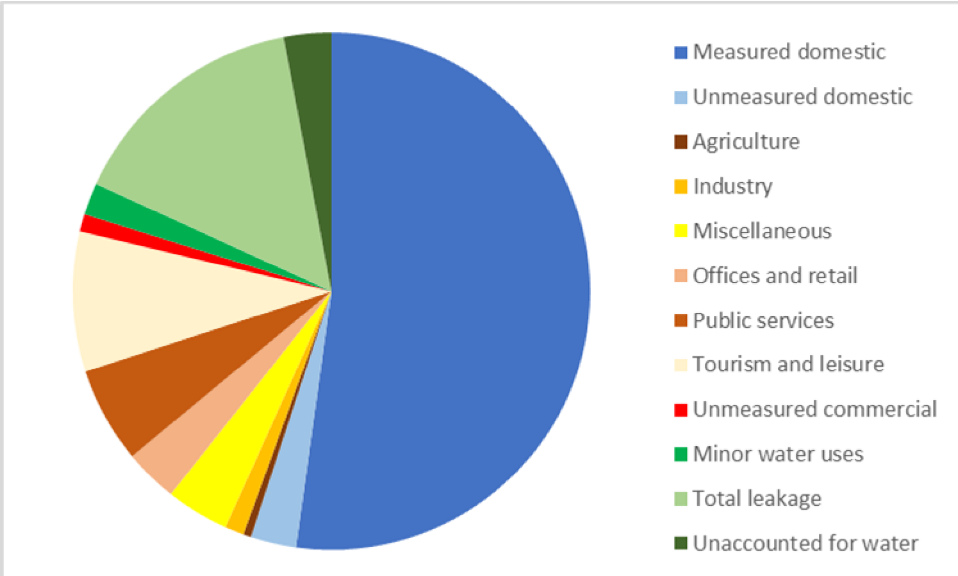
Our demand forecasting has been undertaken for each of the following demand components:

- **Measured domestic consumption** – i.e. water use at homes with a meter that are charged according to their measured consumption
- **Unmeasured domestic consumption** – i.e. water use at homes without a water meter
- **Measured commercial consumption** – i.e. water use at commercial (non-domestic) premises with a meter that are charged according to their measured consumption
- **Unmeasured commercial consumption** – i.e. water use at commercial premises without a water meter
- **Minor water use** – e.g. water used at hydrants by the fire service and local authorities etc., and operational water use by Jersey Water (e.g. to clean water pipes)
- **Total leakage** – including distribution losses from our water distribution system and underground supply pipe leakage from customer pipes
- **Unaccounted for water** – i.e. the small volume of water put into supply in 2017 that cannot be specifically allocated to one of the above components with any certainty.

The values for these components sum to the total water put into supply from our two water treatment works, known as "distribution input".

The contribution of each demand component to distribution input is illustrated in **Figure 5-2**. About 55% of water put into supply from our water treatment works is used in homes whilst some 25% is used at commercial premises (broken-down by the key commercial sectors in **Figure 5-2**). As described earlier, total leakage comprises less than 15% of water into supply.

Figure 5-2 Breakdown of water into supply 2017



5.4 IMPLICATIONS OF CORONAVIRUS PANDEMIC

The world-wide Coronavirus pandemic and the consequential "lockdown" across Jersey resulted in some major changes in water using behaviour during 2020. Many more people worked at home than usual, many people stayed at home because their place of work was closed, visitor numbers to Jersey were greatly reduced, and many businesses including shops, cafes/restaurants, holiday accommodation and hotels were fully closed for some weeks or months. Domestic water consumption was therefore higher than normal, but commercial water demand was significantly lower. Some of these changes in water use could persist for a long time in the future, or to some degree become permanent: home-working may become more prevalent; some people may be less willing to travel or go restaurants or hotels to avoid risk of illness; and more people may be out-of-work due to the effects of economic recession in the UK and elsewhere.

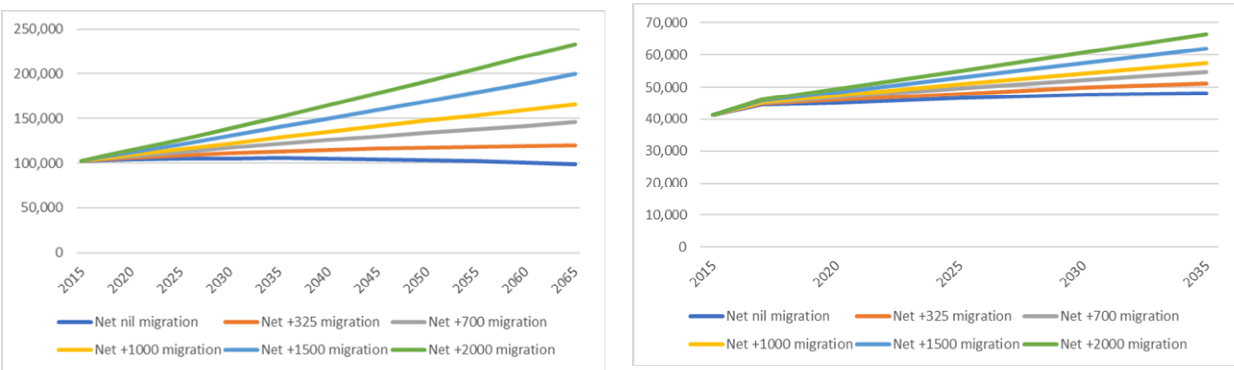
For these reasons, the pattern of water demand in 2020 was different to normal, but it is not yet possible to reliably quantify the effects on water demand in Jersey or how long impacts will last. It is considered likely that, in the long-term, demand patterns will return close to "normal". Therefore, the demand forecast to 2045 and the uncertainty ranges, calculated before the pandemic, are considered to remain as valid long-term projections for the purposes of developing our 25-year WRDM Plan.

5.5 DEMAND FORECAST

5.5.1 Population and Household Forecasts

The population and number of homes that we supply water to are increasing steadily year on year as more people live on the island and more houses are built. Our forecast future growth in domestic customers has been based primarily on the latest available projections produced by the States of Jersey Statistics Unit (2016) for a range of demographic scenarios, which are illustrated in **Figure 5-3**.

Figure 5-3 States of Jersey Statistics Unit: projections of resident population and households



With the Island Plan Review not completed in time for inclusion in our demand forecast, there are no recent current, official planned growth rates for development. Therefore, the 2016 household projection scenarios derived by the Statistics Unit have been used as the basis for estimated future growth in domestic properties to be served. The principal demand forecast has been based on the 700 per year net migration scenario[1] as this is consistent with recent population growth rates. Alternative migration scenarios have been used for uncertainty analyses.

Table 5-1 summarises the key demand forecast values. It shows that the total number of domestic properties receiving water supplies from Jersey Water is expected to increase by 39% between 2017 and 2045. This excludes the small number of properties that have their own private water supplies. Over the same period, the total population receiving water supplies from Jersey Water, living in domestic or commercial properties, is forecast to increase by 30%.

[1] In this case, the change in resident population each year is estimated as:
Population in previous year + Estimated births – Estimated deaths + 700 net migration
Note: Resident population comprises people who normally live in Jersey and so excludes short-term working visitors and tourist visitors.

Table 5-1 Forecast domestic properties and population served by Jersey Water

	2017	2025	2045
Estimated number of domestic customers served:			
Measured	35,053	40,324	50,755
Unmeasured	1727	1461	1295
Total domestic customers served	36,780	41,785	52,050
Estimated resident population served:			
Population in domestic properties	93,516	102,718	121,247
Population in commercial properties (e.g. communal establishments)	2094	2250	2606
Total population supplied by Jersey Water	95,610	104,968	123,853
Average occupancy for domestic customers served	2.54	2.46	2.33

5.5.2 Demand forecasts

Figure 5-4 and **Table 5.2** summarise the dry year annual average (DYAA) demand forecast for Jersey. The following assessments have been used in the calculations:

- The average water use by metered domestic households, under normal weather conditions, is forecast to reduce from 296 l/property/day in 2018 to 268 l/property/day by 2045. This trend is based on studies in the UK of how domestic household water using behaviour could change in the future. The expected changes include, for example, wider installation of modern water-efficient appliances and more people washing by showering instead of bathing.

- The average water consumption by unmeasured domestic households in a dry weather year is estimated to reduce from 331 l/property/day in 2018 to 298 l/property/day by 2045.

- Total commercial water use is forecast to increase by a further 6% by 2045. Water consumption by some commercial sectors (Miscellaneous, Offices and Retail, and Public Services) has been forecast to continue to grow. Decline in water use has occurred in the Agriculture/Horticulture and Tourism/Leisure sectors, but this may not continue and so the volumes of water use have been conservatively assumed to remain at current levels. A downward trend in water use by Industry has been assumed to continue.

- For the purpose of the baseline demand forecast, the volumes of total leakage and not-accounted-for water have been held at the current low levels. The potential for further reduction in total leakage has been considered as part of the option appraisal process (**Section 8**) and selected leakage control measures are incorporated in the final supply-demand forecast (**Section 9**).

- Data analysis of historic demand data over a range of weather conditions was used to estimate that water consumption by domestic customers, and the agriculture and tourism/leisure sectors, is about 5.5% higher in a dry weather year than in a normal weather year. This is comparable with the dry weather uplift factors used by water companies in southern England.

- The potential effects of climate change on demand over the period to 2045 have been taken into account in line with UK water industry guidance.

The forecast shows that metered domestic demand will continue to be the largest component of total demand and is forecast to increase as the number of metered homes increases due the building of new homes and increasing population. This is the main reason why total demand is forecast to grow: the dry weather annual average demand is estimated to be 23.9 Ml/d in 2045, compared with the current 20.5 Ml/d in 2018.

Further details about the demand forecast are provided in **Appendix E**.

5.5.3 Uncertainty

There is significant uncertainty in long-term demand forecasts as it is difficult to accurately predict future trends. For example, growth in the number of homes, population growth, water use patterns by customers and climate change impacts may be different to the current best assessments. Also, the pattern of water demand in 2020 has been very different to normal due to Coronavirus, but it is too early to quantify any long-term effects on water demand.

The range of DYAA forecasts is shown in **Figure 5-5**. The forecast total DYAA demand at 2045 varies between 17.0 Ml/d (very low scenario), 20.8 Ml/d (low scenario), 23.9 Ml/d (main/base scenario) 26.8 Ml/d (high scenario) and 32.0 Ml/d (very high scenario).

We have adopted an adaptive planning approach in developing and testing our Plan to ensure that it is a flexible and robust. As a result, the potential implications of future water demand being significantly higher or lower than anticipated by our main demand forecast have been examined to check the robustness of the proposed plan to such uncertainties (see **Section 9** and **Appendix J**).

Figure 5-4 Summary of DYAA demand forecast by component (Ml/d)

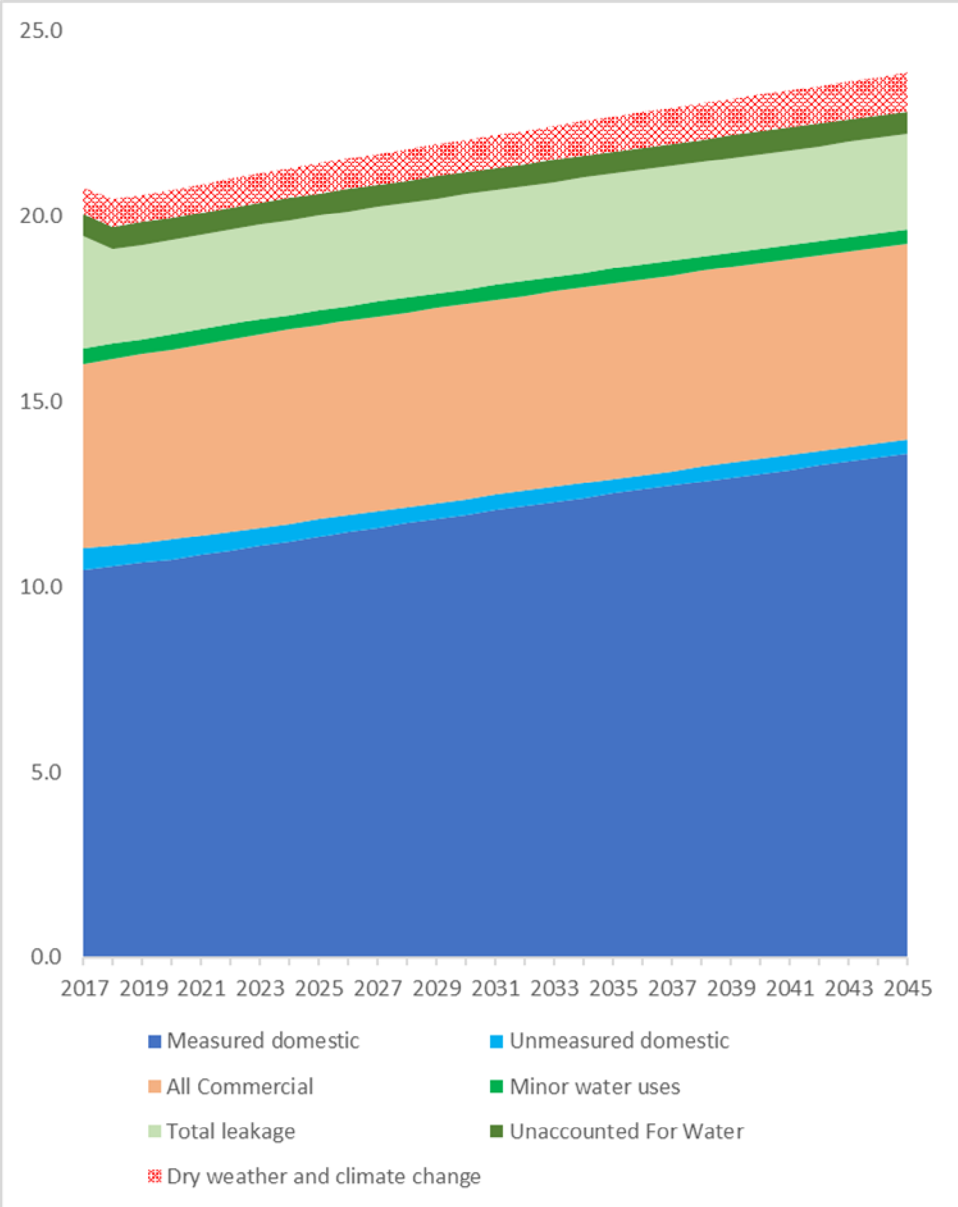
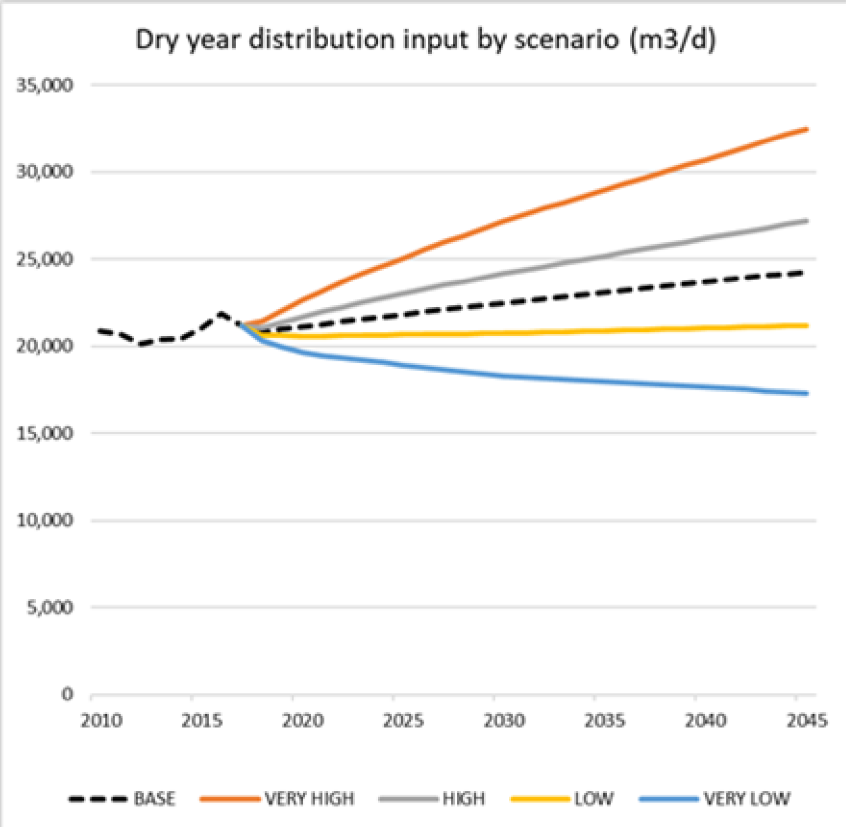


Table 5-2 Baseline Dry Year Annual Average (DYAA) Demand Forecast to 2045 (Ml/d)

	2017	2018	2025	2035	2045
Measured domestic water use	10.5	10.6	11.4	12.5	13.6
Unmeasured domestic water use	0.6	0.6	0.5	0.4	0.4
Total domestic water use	11.0	11.1	11.8	12.9	14.0
Agriculture water use	0.1	0.1	0.1	0.1	0.1
Industry water use	0.2	0.2	0.2	0.2	0.2
Miscellaneous commercial water use	0.8	0.8	0.9	0.9	0.9
Offices and retail commercial use	0.7	0.7	0.8	0.8	0.8
Public services water use	1.2	1.2	1.3	1.3	1.3
Tourism and leisure water use	1.8	1.8	1.8	1.8	1.8
Unmeasured commercial water use	0.2	0.2	0.2	0.2	0.2
Total commercial water use	5.0	5.0	5.2	5.3	5.3
Minor water uses	0.4	0.4	0.4	0.4	0.4
Total leakage	3.1	2.6	2.6	2.6	2.6
Unaccounted For Water	0.6	0.6	0.6	0.6	0.6
Normal Year Annual Average Demand (Ml/d)	20.1	19.7	20.6	21.8	22.8
Estimated extra demand due to dry year and climate change	0.7	0.7	0.8	0.9	1.1
Dry Year Annual Average Demand (Ml/d) (including climate change)	20.8	20.5	21.4	22.7	23.9

Note: values may not sum exactly due to rounding

Figure 5-5 DYAA baseline demand forecasts by uncertainty scenario



5.6 DEMAND FORECAST CONCLUSIONS

In 2018, Jersey Water supplied 19.7 Ml/d to 37,000 homes and 3600 commercial properties across the island. Approximately 98% of properties are individually metered and so have a direct financial incentive to conserve non-essential water use to save on their water bills.

It is expected that the average consumption per domestic customer will reduce by about 10% as a result of future installations of more efficient water appliances and expected changes in water appliance use. However, strong growth in Jersey's population and the number of new homes is expected: it is anticipated that the number of domestic properties served will increase by 42% to 52,000 by 2045. The overall effect is that domestic water consumption is expected to increase by 26% by 2045.

Commercial water consumption, in particular by the office/retail and public service sectors, has increased in recent years. Total commercial water use is forecast to increase by a further 6% by 2045.

The estimated volume of leakage from Jersey Water's distribution system and customer underground supply pipes was about 3.0 Ml/d in 2010 but has reduced to less than 2.6 Ml/d in 2018. Jersey Water is at the frontier of leakage control performance, with our leakage levels lower than most other parts of the UK and Ireland. For the initial, baseline demand forecast future leakage levels are estimated as remaining at the 2018 level (before consideration of any further measures to reduce leakage to lower levels as part of our Plan – see **Sections 8 and 9**).

As a result, the total quantity of water we will put into supply is projected to increase by 16% from 19.7 Ml/d in 2017 to 22.8 Ml/d in 2045 under **normal weather conditions**, and to about 23.9 Ml/d by 2045 under **dry weather conditions**.

There is uncertainty in the demand estimates and so a range of demand forecasts have been derived which apply alternative assumptions. We have examined the potential implications of future water demand being significantly higher or lower than the main demand forecast in our adaptive planning approach to check the robustness of our Plan to such uncertainties (see **Section 9** and **Appendix J**).

The baseline demand forecasts presented in this Section exclude the effects of any additional demand management measures considered in our Plan for resolving any forecast supply-demand deficits and/or water supply resilience requirements (see **Sections 8 and 9**). The effects of such measures are included in the final planning supply-demand balance forecasts (summarised in **Section 9**).

6. UNCERTAINTY, RISK AND RESILIENCE

6.1 ADDRESSING UNCERTAINTY, RISK AND RESILIENCE

It is important that we ensure our water supply service is resilient to the inherent uncertainties and risks associated with operating our assets and factors outside our control. In preparing our Plan, we have taken account of:

- **Uncertainties** – in the data and assumptions that we have used to estimate current and future water supply availability and water demand. We have calculated a planning allowance, known as "target headroom" (see **Section 6.2** and **Appendix G**) which is included in our water supply-demand balance forecast to provide a planning "safety margin" for the uncertainty surrounding the supply and demand forecast components. We have also carried out sensitivity analysis to understand how sensitive our Plan is to forecast uncertainties (see **Section 9** and **Appendix J**).

- **Unplanned outage events** – temporary events that involve the unplanned outage of one or more assets that may impact on water supply availability. The effect of unplanned outage events on reliable water supplies has been considered in calculating an outage allowance as part of the Water Available For Use assessment (see **Section 4**).

- **Risks –** refers to any other factors outside of our control that are not covered within the outage allowance or target headroom allowance and which could have a significant adverse impact on our ability to maintain water supply reliability to our customers. Details of the risk assessment are provided in **Appendix F** and summarised below.

- **Resilience** – refers to the ability of Jersey Water to respond to risks to maintain reliable water supplies to our customers. Further details are provided in **Appendix F** and summarised below.

6.2 UNCERTAINTY: TARGET HEADROOM ALLOWANCE

Target headroom allowance is a planning safety margin developed over the last two decades in UK water resources planning guidance to address demand and reliable supply forecast uncertainties that are outside the control of the water company. A range of uncertainties have been considered in relation to both the demand forecast (for example, the population growth projection uncertainties) and the reliable supply forecast (for example, the potential effects of climate change).

We have calculated target headroom values across the 25-year planning period based on the UK water industry methodology, appropriately adapted for the Jersey situation and using our analysis of the specific uncertainties pertaining to our supply and demand forecasts. **Table 6-1** shows the calculated target headroom values (in Ml/d) that we will apply to the supply-demand balance forecast (**Section 7**) which increase over the planning period to reflect increasing uncertainty with time. The allowance represents 10% of WAFU at the end of planning period in 2045, consistent with the target headroom allowances for most small water companies in England. Full details on the target headroom calculation are provided in **Appendix G**.

Table 6-1 Target headroom for the planning period 2020 to 2045

	2020	2025	2030	2035	2045
Target headroom (Ml/d)	1.1	1.3	1.4	1.5	1.8

6.3 SUMMARY OF KEY RISKS

A number of key risks to our water supply system that may affect future water supply reliability over the planning period have been identified:

- **Water quality risks –** including agricultural pollution risks (nitrates, pesticides, herbicides and fungicides) and PFAS pollution of the St Ouen's boreholes from leakage of historic firefighting foam from the Jersey Airport fire training ground to groundwater. These risks could result in reduced abstraction of water from some of our water sources to ensure we continue to supply water to our customers that meets stringent drinking water quality standards.

- **Jersey's isolated position -** meaning that there is a longer lead time to bring in imported materials such as water treatment chemicals and replacement parts for water supply infrastructure. Additionally, Jersey is not readily able to tanker water into the island during a drought by ship. As a result, we operate a high standard of asset maintenance to reduce the risks associated with these longer supply chain delivery timescales. This provides a high degree of resilience for our raw water supply system and consequently a low outage risk, as explained in **Section 4**.

- **Power supply outage -** between 90% and 95% of Jersey's power is imported from France, with the remainder of the power provide by the electricity generation plant at La Collette. While this provides a high degree of power supply reliability, we have installed back-up emergency electricity generators at both of our water treatment works and at three key raw water pumping stations in case of an outage on the France to Jersey power supply or within the Jersey electricity grid. Power supplies to key water supply assets are therefore robust and reliable with a low risk of outage leading to impacts on our customers.

- **West to East raw water conveyance -** there is a raw water supply and storage disparity between the west and the east of Jersey, with a much greater proportion of our reliable water supplies (principally derived from La Rosière desalination plant) in the west of the island but with our largest raw water storage reservoir located in the east (at Queen's Valley Reservoir). There is currently a limit to the amount of water that can be transferred from west to east, which decreases the overall resilience of our water resource system to drought or unplanned outage risks.

- **Blending requirements for desalination -** whilst La Rosière desalination plant provides a high degree of water resource resilience, there is a requirement for the desalination water supply to be blended with freshwater supplies from Val de la Mare reservoir prior to full treatment at our water treatment works. This means that maintaining sufficient supply availability from the Val de la Mare reservoir system is critical to ensuring that the resilience benefits of La Rosière desalination plant are available in the event of drought or a supply outage elsewhere in the raw water supply system**.**

6.4 ADDRESSING KEY RISKS AND RESILIENCE REQUIREMENTS

We have assessed the potential impacts on water supply reliability and resilience requirements under different demand and supply conditions against a range of impact scenarios (see **Appendix F** for more details).

Our assessment indicated that at the current (2020) demand levels, our water resource system is resilient to most of the risks considered. However, as demand increases into the future and reliable water supply availability falls, the level of resilience decreases. We have therefore considered in our Plan a number of options to improve supply resilience alongside addressing any deficit between reliable water supply availability and dry weather demand. Further details are provided in **Sections 8 and Section 9**, plus **Appendices I and J**.

7. SUPPLY-DEMAND BALANCE FORECAST

7.1 OVERVIEW OF SUPPLY-DEMAND BALANCE ASSESSMENT

Adopting UK water resource planning guidelines, the forecast water supply-demand balance for Jersey can be calculated as follows:

Forecast supply-demand balance

= Forecast Water Available For Use

minus Forecast Dry Weather Annual Average Demand

minus Target Headroom Allowance

Where:

- Water Available For Use (WAFU) is the amount of water that can be reliably supplied from the raw water supply system during a prolonged drought (see **Section 4**).

- Dry weather annual average demand is the total customer demand for water plus total leakage during a prolonged drought (see **Section 5**)

- Target headroom is the calculated allowance for planning uncertainties and risks that are outside the control of the water company (see **Section 6**)

If the supply-demand balance is positive, there is adequate water supply availability in a drought to meet the forecast dry weather water demand and leave a surplus of supply to cater for the forecast uncertainties represented by the target headroom allowance.

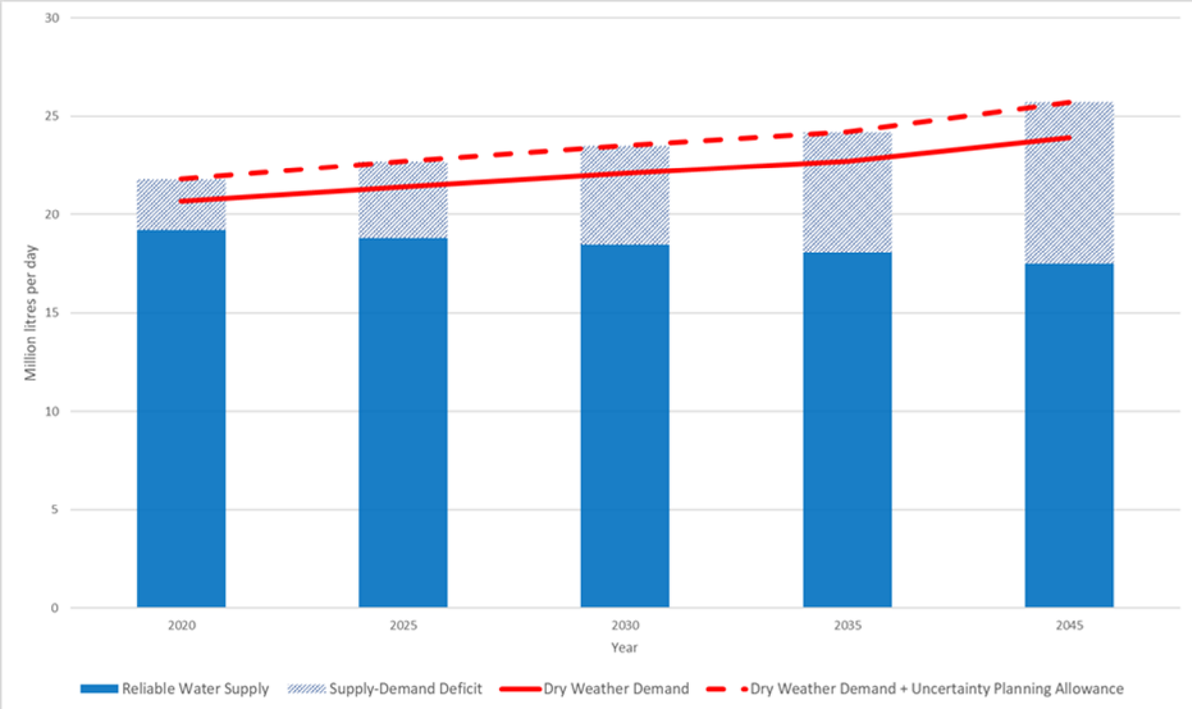
If the supply-demand balance is negative, this indicates a potential risk to maintaining reliable water supplies in a drought. In these circumstances, decisions need to be taken as to how to address the risk: options range from a policy of "do nothing and accept the risk" through to carrying out measures to reduce dry weather demand (permanently or temporarily), increase water supply reliability (temporarily or permanently) and/or address the uncertainties that drive the target headroom allowance.

It is important to note that a supply-demand deficit refers to the situation in drought conditions and that in most years there is an adequate balance between water supply availability and demand.

7.2 BASELINE SUPPLY-DEMAND BALANCE

The baseline supply-demand balance is provided in **Figure 7-1.** The chart shows that there is already a supply deficit in 2020 if there was a repeat of the worst historic drought conditions (the 1991-92 drought). The supply deficit rises throughout the planning period to **8.2 Ml/d by 2045** due primarily to the forecast growth in water demand and the projected decrease in water supply availability due to climate change.

Figure 7-1 Baseline Supply-Demand Balance Forecast (Ml/d)



The assessment shows an increasing forecast supply deficit between reliable water supply availability and dry year demand for water plus the target headroom allowance for all years as WAFU decreases and dry weather demand increases. The deficit more than doubles from 2020 to 2035.

The scale of the forecast supply deficit is influenced by:

- the growth in dry year demand, particularly domestic consumption
- the climate change allowance applied to the reliable supply forecast
- the increasing target headroom (uncertainty) planning allowance over time.

It should be noted that the dry year demand forecast makes <u>no allowance</u> for any benefits to the water supply situation from any water use restrictions and/or any appeals for customers to minimise non-essential water use during a severe drought. These measures could reduce demand by approximately 5% during a drought (see **Appendix H** for more details) and their benefit to partially addressing the forecast supply deficit is considered further in **Sections 8 and 9**.

7.3 PLANNING IMPLICATIONS OF THE SUPPLY-DEMAND BALANCE FORECAST

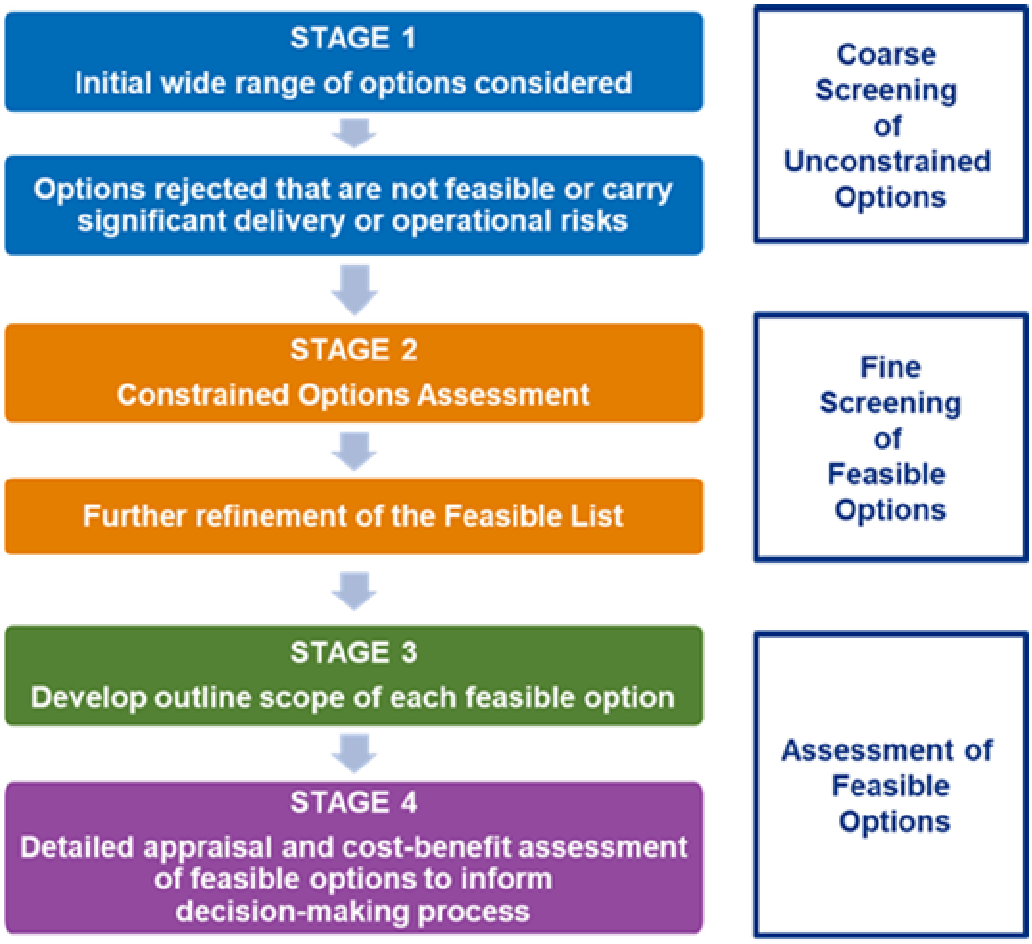
The scale of the forecast supply deficit is significant and we need to determine the best set of measures to address the deficit so that we can meet our customers' expectations for a safe, secure and reliable water supply service. We have developed a range of different options to address the current and future supply deficit, as discussed in **Section 8**. Decisions on the most appropriate mix of measures to secure water supply reliability for our customers and the development of the recommended plan to address the supply deficit are set out in **Section 9** and **Appendix J.**

8. OPTION APPRAISAL

8.1 OVERVIEW OF OPTION APPRAISAL PROCESS

We have developed and applied a multi-criteria appraisal process to evaluate a wide range of alternative options to address the forecast supply deficit. **Figure 8.1** summarises our overall appraisal process.

Figure 8-1 Overview of Option Appraisal Process



8.2 STAGE 1: DEVELOPING THE CONSTRAINED OPTIONS LIST

Stage 1 of the option appraisal process comprised the following key steps:

1. Developing an "unconstrained" option list that considered a wide range of options that may be feasible but without consideration of the potential cost, customer and political acceptability or environmental and social effects.

2. Developing the "coarse screening" evaluation criteria to objectively evaluate each option on a consistent basis.

3. Appraisal of the unconstrained option list against the evaluation criteria to determine a "constrained" options list.

8.2.1 Developing the Unconstrained List of Options

We developed the unconstrained options list through various activities, including a review of options identified in our 2010 Water Resources Management Plan, review of historic options considered over previous decades by Jersey Water, the generation of new option ideas from discussions with our operational and strategic planning staff, options suggested by Jersey Water Board members and other stakeholders, and consideration of options included in UK best practice guidance for water resources planning. These activities led to the production of an initial unconstrained options list which we then reviewed in a structured workshop with our operational and strategic planning staff to ensure that all potential options had been identified.

In total, 72 separate options were included in the unconstrained option list, comprising 37 demand management options and 35 supply augmentation options (see **Appendix I** for more details).

8.2.2 Evaluation Criteria for Coarse Screening of the Unconstrained List of Options

The coarse screening process involved evaluation of each option on the unconstrained option list against the criteria set out in **Table 8-1**. The purpose of coarse screening was to discard options that are infeasible or impractical to deliver in Jersey.

Table 8-1 Coarse screening evaluation criteria

Evaluation Category	Coarse Screening Evaluation Criteria
Feasibility and Risk	• Political acceptability and customer acceptability
Engineering and Cost	• Engineering complexity • Likely capital and operational cost requirements
Performance and Resilience	• Likely scale of reliable supply benefit or demand savings relative to the supply deficiency • Supply resilience benefits • Vulnerability or resilience of the option to climate change risks
Operational	• Compliance risks • Operational complexity • Resource and skills requirements

Evaluation Category	Coarse Screening Evaluation Criteria
Environmental	• Risks to the aquatic and terrestrial environment • Planning risks, including landscape, recreation and heritage • Flood risk impacts • Carbon footprint

We evaluated each of the 72 unconstrained options against these strategic criteria for the coarse screening process. Where options were assessed as having an over-riding constraint or performed very poorly against most criteria, they were rejected and were not taken forward into the constrained options list. Further details are provided in **Appendix I**.

8.3 STAGE 2: CONSTRAINED OPTIONS ASSESSMENT

Options passing through the coarse screening evaluation stage formed our "constrained options" list. These options were then subject to a greater level of evaluation against a more detailed set of "fine screening" evaluation criteria that built on the strategic criteria used at the coarse screening stage. The purpose of the fine screening was to discard options that did not have a realistic chance of being selected in our Plan and thereby filter the option list down to a more manageable number of options for more detailed investigation.

Table 8-2 sets out our evaluation criteria for the fine screening of the constrained options list. For each criterion, we evaluated the options against a five-point grading scale: from positive/beneficial effect through to major adverse/ high risk. In deciding which options should be to be taken through to the "feasible options" list, we considered the following factors:

- The scale of the supply deficit to be addressed over the planning period
- The level of uncertainty and risk associated with each option
- Ensuring a range of different option types were included in the feasible list
- Any option identified as mutually exclusive or having a dependency on other options.

Table 8-2. Feasible options fine screening evaluation criteria and evaluation grading scale

Screening Criteria	
Scheme dependencies	Operational resilience
Timeframe to implement	Climate resilience
Political acceptability	Compliance risk
Customer acceptability	People: resources & skills requirements
Delivery or engineering complexity	Aquatic environment impacts
Indicative capital costs	Terrestrial environment impacts
Indicative operational costs	Planning considerations
Flexibility to adapt to uncertainties	Flood risk
Reliable supply or demand savings benefit	Carbon footprint

Evaluation Grading Scale
Positive/Beneficial
Neutral/Negligible
Minor Adverse/Low Risk
Moderate Adverse/Medium Risk
Major Adverse/High Risk

8.4 OPTION APPRAISAL FINDINGS

72 separate options were included in the unconstrained option list. This was reduced to 61 options following the initial coarse screening and then reduced further to 48 options in the draft feasible options list following the fine screening evaluation. **Appendix I** includes the options we assessed as part of the fine screening evaluation but which we did not take forward to the draft feasible options list.

The draft feasible options list covered a broad mix of both supply augmentation and demand management options: from catchment management measures to enhanced leakage detection and repair; from "smart" water use audits to the extension of La Rosière desalination plant; and from water efficiency promotion activities to developing new raw water storage facilities.

8.4.1 Further Refinement of the Feasible List

In order to focus on a smaller number of options at a much greater level of detail, we carried out a further review of the feasible list options against the evaluation criteria to decide upon a final feasible list of options. We adopted a prioritised approach, taking those options with the best performance against the evaluation criteria through to the final feasible list (**Table 8-3**) whilst ensuring we retained a balanced list between demand management options and supply augmentation options (see **Appendix I** for details). As indicated in **Table 8-3**, the savings from demand management measures will not be sufficient on their own to address the forecast supply deficit and measures to augment supply will also be required.

We investigated the options in the final feasible options shortlist in detail and further developed these options in terms of their design/implementation considerations, costs and benefits to inform the cost-benefit assessment and programme appraisal.

Table 8-3 Final feasible options shortlist

Option ID.	Option	Supply benefit or demand saving	Option Type
DEMAND MANAGEMENT OPTIONS			
D6	Water Efficiency: Base Demand Management	0.19 Ml/d	Water efficiency (3 options)
D19	Water Efficiency Visit-and-Fit Water Audits (Schools)	0.02 Ml/d	
D13	Water Efficiency Planning Regulations at New Properties	0.2 Ml/d	
D29	Leakage Reduction: Enhanced Leak Detection and Repair	0.13 Ml/d	Leakage reduction (3 options)
D32	Leakage Reduction: Distribution Monitoring and Modelling	0.26 Ml/d	
D35	Leakage Reduction: Pressure Reduction Programme	0.15 Ml/d	
SUPPLY AUGMENTATION / RESILIENCE OPTIONS			
S9	La Rosière desalination plant extension	5.0 Ml/d	Desalination (2 options)
S12	New desalination plant on the east coast	10.0 Ml/d	

Option ID.	Option	Supply benefit or demand saving	Option Type
S24	Raising of Val de la Mare reservoir	1.9 Ml/d	Increase storage (3 options)
S25	Gigoulande Quarry partial conversion to raw water storage	1.1 Ml/d	
S35	New storage reservoir option	1 – 2 Ml/d	
S5	New stream abstraction (Rozel)	0.3 Ml/d	New source (4 options)
S15	New groundwater abstraction	0.5 Ml/d	
S18	Bellozanne indirect treated effluent reuse	6.0 Ml/d	
S6	Increased abstraction from St. Ouen's boreholes (PFAS permitting)	0.7 – 1.0 Ml/d	Removal of water quality constraints (1 option)
S1	Targeted catchment protection initiatives (little additional supply benefit but enhanced resilience)	0 Ml/d	Supply resilience (2 options)
S14	Enhance West to East raw water transfer links	0.8 Ml/d	

8.5 STAGE 3: DEVELOP OUTLINE SCOPE FOR EACH FEASIBLE OPTION

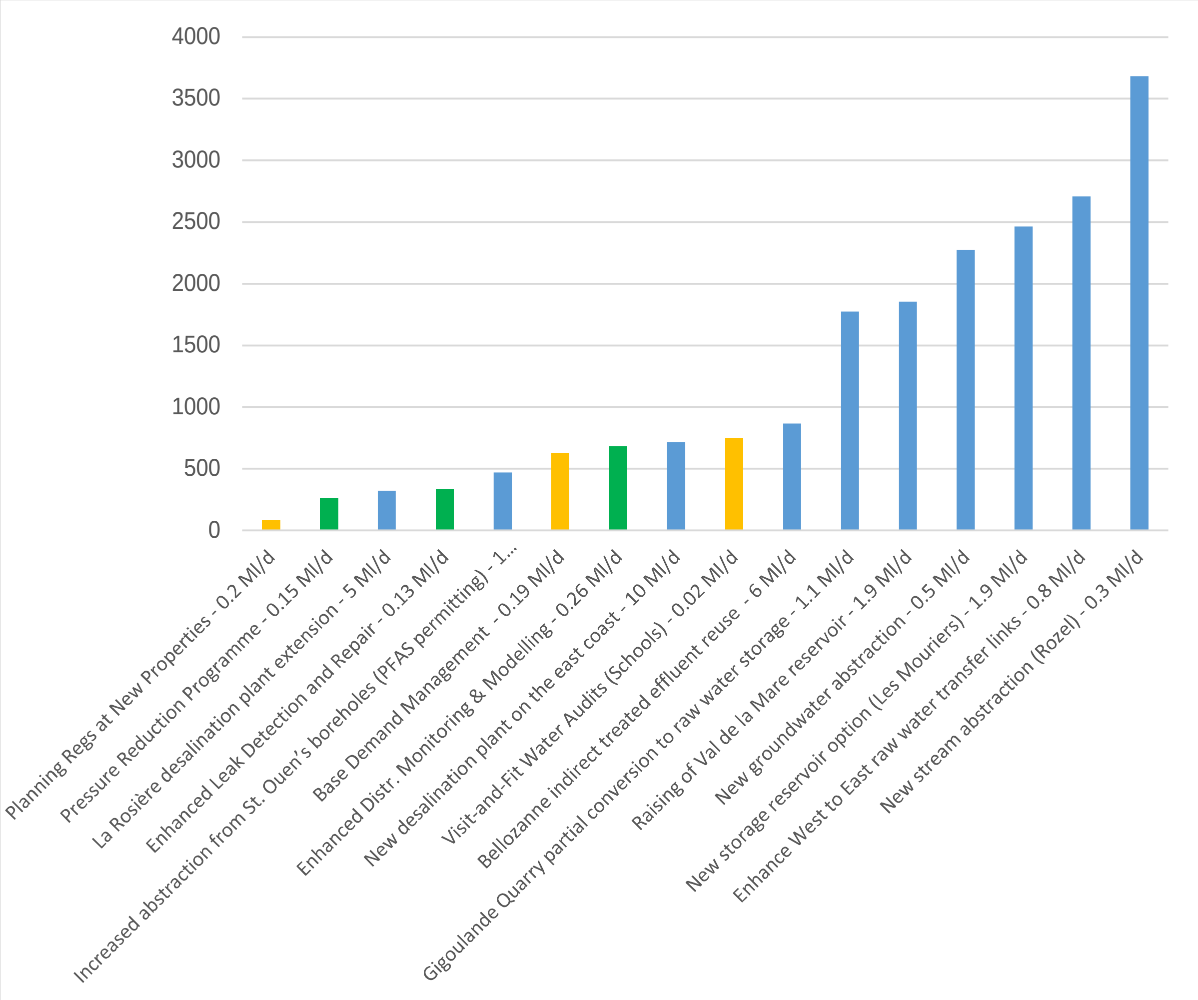
Following the development of the final Feasible Options shortlist, we prepared an outline scope for each option to inform the detailed option appraisal. This included high level engineering design for the supply options, as well as development of capital and operational cost profiles for each option over an 80-year horizon. Additionally, for water efficiency options we calculated the profile of revenue reduction over the planning period due to reduced demand from customers arising from option implementation.

8.6 STAGE 4: DETAILED APPRAISAL AND COST-BENEFIT ASSESSMENT

We used the outline design and cost information for each of the supply and demand options to determine the reliable supply or demand saving benefits, supply resilience benefits, capital and operating costs, impacts on revenue (for water efficiency measures only), delivery risks and any uncertainties, customer and political acceptability, plus any potential environmental and social effects.

We used the costs and supply or demand saving benefits for each option to calculate the discounted Average Incremental Costs (AIC) over the long-term (80-year discount period) using a consistent discount rate (3.5% for the first 30 years, 3.0% until year 75, and 2.5% until year 80). This AIC approach has been adopted for many years in the UK for water resources planning to compare options on a 'like for like' basis (i.e. cost per Ml/d of water provided). An AIC ranking of the options is provided in **Figure 8-1**. The costs and AIC values currently exclude any potential land purchase costs necessary for some new water supply scheme options (due to current high uncertainty about these values). Further work will need to be carried out to provide land purchase cost estimates, where applicable.

Figure 8-1 AIC Ranking of Options



8.7 TEMPORARY DROUGHT MANAGEMENT OPTIONS

In addition to permanent supply and demand options, we assessed a range of feasible temporary drought management measures as summarised in **Table 8-4**. Further details about the development of these drought management options are provided in **Appendix H**.

8.8 OPTIONS APPRAISAL: CONCLUSIONS

We evaluated a wide range of potential options to address the forecast supply deficit and through an objective, multi-criteria appraisal process we developed a final feasible list of options for detailed consideration. These options included demand management (water efficiency and leakage) measures as well as measures to augment reliable water supplies and/or enhance the resilience of our water resource system. We also considered temporary measures to reduce demand or augment supply that could potentially be implemented during a severe drought, and which might be lower cost solutions than permanent measures. Full details are provided in **Appendix I**.

Section 9 discusses how the assessment of these options informed development of a range of alternative programmes of measures to address the forecast supply deficit.

Table 8-4 Temporary Drought Management Options

Option ID	Option Description	Maximum Benefit (Ml/d)
DM3	Install additional temporary desalination treatment process at La Rosière	2.0
DM4	Bring abandoned boreholes back into supply	0.3
DM5	Install temporary treatment process to address PFAS at St Ouen's boreholes to increase borehole output.	0.5
DM6	Enhanced customer water efficiency and "use water wisely" education and awareness campaign	0.3
DM7	Temporary Water Use Ban – covering various non-essential water uses with minimal social or economic impact.	0.4
DM8	Temporary Non-Essential Water Use Ban – covering a wider range of non-essential water uses with some social or economic impact.	0.3

9. PROGRAMME APPRAISAL, DECISION MAKING AND RECOMMENDED PLAN

9.1 PROGRAMME APPRAISAL APPROACH

Taking account of the findings of the appraisal of the feasible options (**Section 8**), 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 options to form the preferred plan and which will be subject to consultation with stakeholders and customers.

9.2 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 distinct alternative strategic programmes for detailed appraisal. These were considered to represent the key different types of feasible water source solutions so as to enable evaluation of their relative risks, benefits, financial and affordability implications.

Table 9-1Table 9-4 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

Each table summarises the broad 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 in **Appendix J**.

Table 9-1 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 9-2 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 9-3 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 9-4 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

Each of these alternative programmes adopt a "twin-track" approach: taking early action to reduce customer demand 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 that is already in place 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 developing new and expensive water sources.

However, the benefits of water efficiency and leakage reduction activities are limited, reflecting the significant work already carried out in Jersey and therefore the scope for further cost-effective demand management measures is limited. The selected water efficiency options provide demand savings of approximately 0.4 Ml/d whilst the leakage reduction options provide demand savings of approximately 0.5 Ml/d. Further details are provided in **Appendix J.**

For each alternative programme, we have included the implementation of temporary customer water use restrictions in a severe drought which provide an estimated benefit of 1.0 Ml/d to the supply deficit (see **Appendices H and I** for further details).

Demand management and temporary water use restrictions alone will not resolve the forecast supply deficit. We have therefore considered different supply enhancement option mixes in the alternative programmes as shown in **Tables 9.1 to 9.4.** More details are provided in **Section 8**, plus **Appendices I and J**).

9.3 PROGRAMME APPRAISAL

We compared the cost, benefits, risks and customer affordability implications of the four alternative strategic programmes using multi-criteria appraisal (**Figure 9-1**) to help inform decision-making on the development of the optimal preferred plan. A summary of the key findings of the multi-criteria appraisal is provided in **Table 9-5** (with more detail provided in **Appendix J**), comparing the four alternative strategic programmes in respect of the trade-offs between the different appraisal criteria.

Figure 9-1 Criteria considered in programme appraisal process

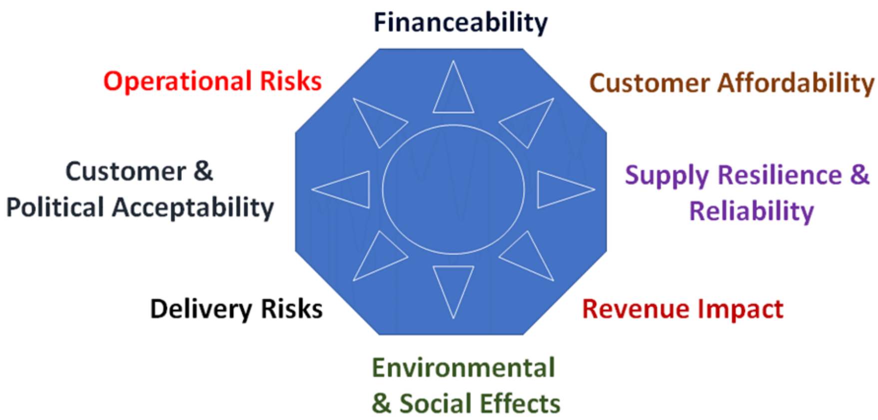


Table 9-5 Multi-criteria appraisal summary of alternative programmes (revenue impacts are identical)

Strategic Programme	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	8.7	[green]	[yellow]	[yellow]	[green]	[green]	[yellow]
(B) Bellozanne Indirect Treated Effluent Reuse	8.9	[orange]	[yellow]	[red]	[yellow]	[red]	[orange]
(C) East Coast Desalination	11.9	[orange]	[green]	[red]	[red]	[orange]	[green]
(D) Raw Water Storage Enhancement	7.5	[red]	[red]	[red]	[green]	[yellow]	[yellow]

Key:

Positive Impact/ Low Risk [green]	Minor impact/ risk [yellow]	Moderate impact/ risk [orange]	High, Impact/ Risk [red]

9.4 DECISION-MAKING AND DEVELOPMENT OF RECOMMENDED WRDM PLAN

It was concluded from the multi-criteria appraisal process that none of the four alternative strategic programmes fully met the WRDM Plan objectives and that a further iteration of the programme appraisal process was needed to develop a plan that achieved an optimal balance of trade-offs between the different objectives. Additionally, the Gigoulande quarry storage option had to be removed from the final feasible options list during the second iteration of the programme appraisal and plan development process. This decision followed dialogue with Government about the Island Bridging Plan and infrastructure review. The decision has removed the most cost-effective feasible water storage option from the recommended plan.

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.

Our decision-making process sought to implement a balanced portfolio of demand management measures, water source enhancement to increase supply and, if needed in extreme circumstances, temporary water use restrictions. Our recommended plan:

- takes a "no regrets" and adaptive approach that reflects the lead-times for delivery of different options, key forecast uncertainties, the needs of the island and value for money

- builds on Jersey Water's leadership in reducing water leakage and the success of the universal metering programme that is already in place to help customers reduce their water consumption before developing new and expensive water sources

- addresses the fundamental need to provide additional reservoir storage to deliver future resilience of Jersey's water supply needs
- avoids options that are high risk or high impact on the island.

9.5 OUR RECOMMENDED WRDM PLAN

As shown in **Table 9-6**, our recommended WRDM Plan includes:

- water efficiency measures to provide around 0.4 Ml/d of demand savings by 2025
- measures to reduce leakage by around 0.5 Ml/d by 2025
- temporary customer water use restrictions in times of severe drought to achieve around 1 Ml/d of demand savings. These are expected to be implemented no more than once every 20 years for a temporary use ban and once every 50 years for a wider non-essential use ban, which we consider is likely to be acceptable to our customers. **This level of service for water supply reliability is consistent with many water companies in Southern England**
- targeted catchment protection initiatives to protect raw water quality and increase supply resilience to pollution
- extension of La Rosière desalination plant by a further 5.0 Ml/d by 2025
- working with the Government to agree a solution which addresses the historic PFAS pollution in the St Ouen's boreholes by 2030 so that abstraction can be increased and provide approximately 1 Ml/d of additional reliable groundwater supplies
- delivering additional reservoir storage to provide around 1.9 Ml/d of additional reliable supply by 2045.

Table 9-6 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

Our recommended plan compares favourably to the four strategic alternative programmes against the key decision-making criteria (**Table 9-7**). 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 shown in **Table 9-6**.

Table 9-7 Comparison of the performance of the recommended plan with the strategic alternative programmes

Strategic Programme	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	8.7						
(B) Bellozanne Indirect Treated Effluent Reuse	8.9						
(C) East Coast Desalination	11.9						
(D) Raw Water Storage Enhancement	7.5						
Recommended Plan	9.8						

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.

A balanced plan to deliver enhanced water supply resilience

Our WRDM Plan is built on a twin-track approach of taking action to reduce demand alongside enhancing reliable water supplies with a balance of additional freshwater and desalination solutions. It seeks to maximise the use of existing facilities and infrastructure on the island.

Jersey Water already leads the UK in reducing water leakage and our WRDM Plan will build on this success, alongside increased partnership with customers to increase efficiencies in water use. Together, this has the potential to save approximately 0.9 Ml/d by 2025.

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. Work is also 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.

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, in dialogue with Government about the Island Bridging Plan and infrastructure review, we have 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.

The targeted catchment protection initiatives do not create additional water supplies but provide resilience benefits by improving land use management to reduce pollution risks to our water sources. 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

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.

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.

Making it affordable

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.

We have 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 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. Details of the scenario testing are provided in **Appendix** J.

10. CONCLUSIONS

Our WRDM 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 WRDM 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.

We look forward to working with our customers, Government of Jersey and other stakeholders to deliver this Plan and secure reliable water supplies for Jersey over the next 25 years and beyond.

TECHNICAL APPENDICES

The following Technical Appendices are available as separate documents:

APPENDIX A. WATER RESOURCE ZONE INTEGRITY

APPENDIX B. WATER RESOURCE ZONE PROBLEM CHARACTERISATION

APPENDIX C. SOURCE YIELD ASSESSMENT

APPENDIX D. CLIMATE CHANGE ASSESSMENT

APPENDIX E. DEMAND FORECAST

APPENDIX F: UNCERTAINTY, RISK AND RESILIENCE

APPENDIX G. TARGET HEADROOM

APPENDIX H: DROUGHT MANAGEMENT

APPENDIX I: OPTION APPRAISAL

APPENDIX J: PROGRAMME APPRAISAL, DECISION-MAKING & RECOMMENDED PLAN