SOURCE STORE SUPPLY

Water for life

South East Queensland's Water Security Program

2016-2046

seqwater
WATER FOR LIFE

Version 2 | March 2017

Water is essential for life. At Seqwater, it is our job to produce water for communities across South East Queensland. Our employees live and work in the communities we serve, and our team is proud to deliver on our promise of water for life.
Pictured (front cover) at the Brisbane Botanic Gardens Mt Coot-tha is Jazmyn Sinclair, daughter of senior electrical and control systems engineer Brooke Sinclair.

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Translation and interpreting assistance

Seqwater is committed to providing accessible services to Queenslanders from all culturally and linguistically diverse backgrounds. Please contact us and we will arrange an interpreter to share this publication with you.

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Chairman's **foreword**

South East Queenslanders enjoy an enviable lifestyle. From the rural heartland to the rainforest-clad ranges and golden coastline, the region is home to diverse and vibrant communities. Sustaining these communities and underpinning our economy is a safe, secure and reliable urban water supply.

Over the past three decades the region has experienced unprecedented population growth, with nearly one in seven Australians now calling South East Queensland home. And while our subtropical climate is a driver of growth, the reality is we live in a climate of extremes – from drought to flooding rains.

At Seqwater we understand the essential role we play in providing water for life – no matter what the weather. Our interconnected water grid enables us to move water around the region to where it is needed, from the Gold Coast to Redland, to Greater Brisbane and the Sunshine Coast. The grid includes dams and weirs, conventional water treatment plants and climate-resilient water sources such as the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme. This diverse asset base and our ability to draw on different water sources is an investment in resilience.

We also work to improve the health of our green infrastructure. Effective management of the water supply system requires integrated planning from catchment to tap. Achieving this integration requires collaboration between Seqwater, planning agencies and water service providers.

This is our second Water Security Program. It builds upon the significant modelling and analysis undertaken for the first plan (published in July 2015), and details the factors we have considered to secure South East Queensland's bulk water supply, including our plans for climate extremes.

The memories and lessons of the Millennium Drought remain fresh in the minds of many and South East Queenslanders are to be congratulated for continuing to use water efficiently. The waterwise behaviours we adopted during that drought have helped defer the construction of new water infrastructure.

Today, our water security is medium-high and our research shows that apart from a severe drought or a sharp increase in demand, we have enough water to supply the region for the next 20 years. After that, we will need new water sources to meet growing demand.

We are fortunate to have the time to plan for our long-term water security needs and Seqwater is committed to engaging our stakeholders, customers and communities to shape our water future. This plan reflects the views and values of the many people who have been part of our water for life journey so far.

I thank the Board, executive leadership team and staff for the many thousands of hours of work that has gone into preparing this plan. I would also like to acknowledge the support and advice of the region's water service providers, the Department of Energy and Water Supply, and our Independent Review Panel. Finally, thank you to the South East Queenslanders who have shared their ideas with us so far. Together, we can ensure we have enough water now and for generations to come.

Dan Hunt
Chairman

Independent Review **Panel**

The Panel and its purpose

The Independent Review Panel (IRP) was established in August 2014 to review the development of version 1 of Seqwater's Water Security Program. Following the completion of version 1 the IRP (with slightly modified membership) was again commissioned to review the development of version 2.

The IRP for version 2 comprises nationally and internationally recognised industry and research leaders who cover a diversity of perspectives, as follows:

- **Rob Skinner**, former Managing Director of Melbourne Water, now Director of Monash Water Sensitive Cities and Director of Yarra Valley Water *(Chair of Panel)*;
- **Cynthia Mitchell**, FTSE, Deputy Director and Professor of Sustainability at the Institute of Sustainable Futures at University of Technology Sydney *(Co-Chair of Panel)*;
- **Mara Bun**, environmental and engagement strategist , Chair Gold Coast Waterways Authority; Director Enova Energy and Australian Ethical Investments;
- **Daniel Deere**, former Principal Scientist of Sydney Catchment Authority and water quality/science specialist;
- **Tony Kelly**, former Managing Director of Yarra Valley Water;
- **Rob Kennedy**, Group Director, Building Queensland;
- **David Stewart**, former Managing Director of Goulburn-Murray Water, dams specialist and currently Australia's representative on International Commission on Large Dams Technical Committee on Global Climate Change.

The Terms of Reference of the IRP state two major purposes for the IRP:

(i) *'to provide independent perspectives, advice, inputs, challenge and review to Seqwater during the development of the Program'*; and

(ii) *'guide Seqwater towards industry leadership, including consideration of the scope of future revisions of the Water Security Program'*.

A summary of the IRP's main conclusions with respect to these two major purposes is presented below.

Overarching observations and conclusions

The IRP met on three occasions to monitor and critique the development of version 2 of South East Queensland's Water Security Program. Before each meeting, the IRP was provided with comprehensive papers by the Seqwater Water Security Program study team that included requests for review of work related to the Program.

The study team supplemented these requests with presentations at meetings. Following each meeting, the IRP deliberated over cross-cutting themes drawing on diverse perspectives, and then provided an integrated response to the study team outlining the major issues raised in the work being reviewed, and recommended areas for improvement.

As an overall comment, the Panel is of the view that, given the specific brief and time constraints required to deliver version 2, the work program and activities being followed for version 2 are appropriate. In fact, as was the case in version 1, the Panel is of the view that some of the approaches to modelling and analysis exceed those undertaken elsewhere in Australia and internationally.

The Panel supports the major conclusions of this version of the Program, in particular:

- In the absence of a severe drought or a sharp increase in demand, the SEQ region has enough water to supply the region for 20 years. Beyond the 20 year horizon new water sources will be needed to meet growing demand, unless initiatives are introduced as part of version 3 that successfully encourage consumers to reduce their consumption.
- Within this 20-year timeframe some minor augmentations will be required including pipeline, pump stations and treatment plant augmentations primarily to better manage peak demand. Also it may be necessary to set aside land enabling future supply option.
- This improved situation is due partly to consumers who have maintained many of their water-efficient behaviours post-Millennium Drought.

- New water sources will inevitably be needed at some time in the future and no single option, such as a new dam, desalination plant or decentralised option, is likely to meet the region's or individual community's needs in all situations. This is particularly true if Seqwater continues with its vision of addressing wider water system outcomes linked to the UN definition of water security. This in turn reinforces the need to model the integration of decentralised and centralised sources of supply in version 3.
- Version 2 introduces sound drought security initiatives including improved and updated drought response triggers that provide better water security and cost outcomes than those previously adopted in version 1.
- The water security assessment of the off-grid communities shows that the Level of Service objectives over the 30-year planning period are met (with the exception of one community which is currently being addressed).

The IRP views the Water Security Program as a living document, which needs to continue to evolve. In version 3 there are opportunities for Seqwater to become a leader in innovation in the Australian water industry and possibly beyond.

Areas for consideration in the next version

The Panel is mindful of the statement first made in version 1 of the Program that: *'It will take time and commitment to develop a long-term plan that encompasses the scope of the UN definition of water security. Seqwater will work with the SEQ community and stakeholders to update and continually improve the Water Security Program, to create a long- term plan for water security in the region that reflects community values.'*

Consistent with this statement of intent, the Panel believes it is important to consider well ahead of the commencement of the version 3 program what is necessary to provide sustainable, resilient and liveable system outcomes that go beyond the narrower definitions related to 'compliance' that guided Seqwater's version 1 and now version 2 strategies. This will require some different starting points, rather than simply extending from versions 1 and 2.

The Panel has already provided advice on a number of the key elements that will underpin the wider scope of version 3. It is emphasised that to deliver this broader suite of strategic outcomes related to liveability and resilience the Water Security Program will need to undertake analyses and follow processes that will be pushing the frontier of international best practice. In this respect it is noted that the city of Brisbane has now endorsed the International Water Association's processes and Principles of Water-Wise Cities (http://www.iwa-network.org/projects/water-wise-cities/) that, if followed, will deliver the vision to be embedded in version 3.

The strategic issues that the Panel believes should be accorded high priority in version 3 (and which the Panel has already provided preliminary advice on) include:

- Improving Seqwater's influence over catchment management issues that affect water quality and supply security, noting the nexus between the two.
- Scenario planning to assess resilience of options and identify the factors having the most influence over long-term security.
- Increasing challenges in providing water of acceptable quality in the face of deteriorating source water quality combined with ever more stringent water quality requirements (noting that Seqwater's role is to provide a secure supply of water of the required quality, not merely to provide a secure physical water supply).
- Drought response approaches.
- Price considerations including willingness to pay and servicing of debt.
- Demand management including aligning incentives related to loss of revenue.
- More nuanced attention to and consideration of distributed infrastructure.
- Institutional arrangements that facilitate integrated water management.
- Considering Seqwater's role in enhancing the liveability of the communities it serves.
- Options assessment methodology and an inclusive process for its enactment that incorporates all of above.
- Stakeholder and community engagement to inform all of above and to enhance community understanding and ownership of the strategy.

Of all the strategic issues considered by the Panel the one that attracted the highest priority and most concern was *Stakeholder and Community Engagement*.

Comprehensive and authentic stakeholder and community engagement will be needed to underpin successful version 3 outcomes.

The shift towards engaging the community about 'liveability' and 'resilience' for version 3 will present new challenges, including the following.

- They will open conversations that span economic, social and 'place-making' dimensions in the context of human, built environment and environmental stresses as well as system shocks.
- Liveability stresses and shocks will play out against the background of long term population, demographic, technological and climatic changes that also need to be well understood for water security trade-offs to be considered in a meaningful way by the public and stakeholders.
- The changing nature of productive-consumptive relationships within cities and between cities and their surroundings will shift the ways water is used, creating new systemic challenges.

Added complexity will be introduced to the Program's community and stakeholder engagement when demand management is explored in greater detail following the publication of version 2.

The relationship between supply and demand options requires nuanced considerations, particularly when some social and environmental impacts of supply alternatives are experienced at a localised level where strong opposition to some options exists.

Seqwater desires a collaborative approach to community engagement which should include a strong partnership with the water service providers (retailers).

This is critical in order for an optimal 'whole of water value chain' solution to emerge from the Program that reflects maximum societal benefits relative to costs across a broad South East Queensland residential demographic.

Given the above factors, the panel recommends an evolving engagement model be developed over a five-year period, commencing with version 3 of the Program. The model needs to be open and deliberative.

- ***Open*** – starting with the principle that there are no right answers – only many questions.
- ***Deliberative and authentic engagement processes*** – involving customers, citizens and stakeholders becoming actively engaged in a process aimed at developing shared solutions and outcomes.

Executive **summary**

At Seqwater, it is our job to deliver safe, secure and cost-effective water and catchment services to our customers and communities across South East Queensland – everyday, always. We are committed to water for life and to working with our stakeholders, customers and communities to develop an adaptive plan for a sustainable water future.

We operate in a challenging and changing environment. Since the Millennium, our region has experienced two large floods and a lengthy drought. Our water supply catchments are degraded and our climate is expected to become increasingly variable.

It is within this context that we have prepared this second Water Security Program (the Program) for South East Queensland. The Program is our plan for providing the region's drinking water over the next 30 years (2016-2046).

Water security for South East Queensland

Seqwater owns and operates the region's bulk water supply system, including dams and weirs, conventional water treatment plants and climate-resilient water sources. The interconnected South East Queensland Water Grid enables us to move drinking water to where it is needed.

While most South East Queenslanders are serviced by the water grid, we also supply drinking water to about 55,000 people living in 16 off-grid communities – rural towns that are not connected to the grid, but form part of the bulk water supply system.

Our research shows that apart from a severe drought or a significant change in supply or demand, we are likely to have enough water until about 2040. After that, we will need new water sources to meet growing demand. This 2040 timeframe is an increase of five years on the timeframe presented in version 1 of the Program and is the result of updated data and an improved understanding of bulk water supply system performance. It means we have time to plan a water future that meets community needs and contributes to the liveability of our region.

South East Queenslanders have maintained their water-efficient behaviours since the Millennium Drought. Lower demand for water means we can defer future system augmentation. Our water security position can also be attributed to optimisation of the water grid. The grid allows us to:

- move treated water around the region
- use existing assets, including the Western Corridor Recycled Water Scheme, to maximum advantage
- help maintain supply during floods
- respond to drought and minimise its impact
- delay investment in new infrastructure.

Planning approach

Many influences impact the performance of the bulk water supply system – some change rapidly, such as technological advances, and others happen more slowly but can have significant impact, such as climate change.

This Program is adaptive. It does not propose one water security solution with a set timeframe. Rather, it identifies ways we can respond to changing influences and sets triggers for implementing options or reviewing and changing our response.

While our responses are planned in advance, investment decisions will be based on conditions at the time and depend on what options have been previously implemented. Adaptive planning aims to deliver the right option at the right time, leading to an optimised, whole-of-region solution.

As we continue to develop this Program, we aspire to achieve the United Nations' definition of water security:

'the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability'. (UN, 2013)

To achieve this definition in the long term, we will work with our stakeholders, customers and communities to continually improve the Program.

Our major customers are the South East Queensland water service providers, who source treated drinking water from bulk water supply points and deliver it to households and businesses. We partner with the water service providers to achieve regional water security goals.

Over time, we will create a plan to help realise the liveability aspirations of our communities. We are committed to listening to the views and values of the people we serve and working towards a shared vision of our water future. Community engagement has already provided us with rich insights that have shaped this version of the Program.

Planning process

The Program is a requirement under the *Water Act 2000*. The Queensland Government has given guidance on the long-term objectives for water security planning through a regulatory framework – the Level of Service (LOS) objectives. The LOS objectives provide a measure of performance that the bulk water supply system must meet. This Program is our plan to achieve those objectives.

We have developed the Program using an integrated planning process, which means that both the volume of water we can supply (LOS yield) and water treatment capacity (to meet peak demand) have been taken into account. Considering yield and treatment capacity in parallel enables us to optimise investment. The broad process is described below.

DEMAND FORECAST

Demand forecasts for the 30-year planning horizon were developed. The medium demand forecast was used for planning, with high and low demand forecasts used for scenario analysis.

SYSTEM ASSESSMENT

The existing system was assessed to determine LOS yield, including an analysis of the operating strategies planned to be implemented over time. Changing the operating strategy can maximise the yield from the existing system before major augmentations are required. The system yield for a number of scenarios was assessed.

MINOR SYSTEM AUGMENTATIONS IDENTIFIED

A number of relatively minor system augmentations were identified to improve system performance in meeting LOS and peak demand perspective. The efficiency of these augmentations meant they were included in all potential investment pathways.

TIMING OF MAJOR AUGMENTATIONS IDENTIFIED

The demand forecast and system yield (with optimised operating rules and minor augmentations implemented) were compared to determine when and how planning objectives could no longer be achieved. This is the point at which the first system augmentation will be required.

OPTIONS SHORT LISTED

A short list of augmentation options was developed, including options for demand management. These options may contribute to the system performance in meeting LOS objectives or peak demand, or both. Demand management options may delay the need for major infrastructure investment.

POSSIBLE INVESTMENT PATHWAYS TESTED

The short listed options were used to develop investment pathways – the sequence and timing of options, selected through an assessment framework, in accordance with differing investment strategies. There are many potential investment pathways and two example pathways were developed to test the framework and demonstrate that the planning objectives can be met. Scenario analyses were applied to the two pathways to test their robustness and identify triggers for implementation of options or review of a preferred pathway. The result is an adaptive Program.

This revised Program builds on previous research, incorporates the outcomes of technical assessments undertaken since the publication of version 1, and includes more sophisticated analysis of South East Queensland's drought response plan. Work undertaken since July 2015 and incorporated in this version 2 includes:

- community consultation and research based on version 1
- a review and update of the major inputs used as the basis for version 1
- the introduction of liveability to frame the Program's future direction towards achieving the United Nations' definition of water security and support development of a water sensitive region
- development of the options assessment framework, including an outline of our intention to extend the objectives and boundaries of the framework in version 3 of the Program
- a detailed review and revision of the drought response which meets LOS objectives and considers economic impacts on our communities
- a comprehensive water security assessment of all water supply schemes servicing off-grid communities
- further analysis of the cost and benefits of potential new supply options and demand management options
- development of possible investment strategies to demonstrate the different ways LOS objectives can be achieved (and the associated trade-offs required) without reaching any decisions on preferred options or investment pathways.

The plans outlined in this Program are the result of rigorous research, modelling and analysis, coupled with stakeholder, customer and community engagement.

Future needs identified

Our analysis shows no single option, such as a new dam, desalination plant or decentralised scheme, will be able to meet the region's future needs. Rather, a combination of options will be required.

Based on the medium demand profile, at least one source augmentation and at least two treatment capacity upgrades are required over the 30-year planning period to achieve water security to 2046.

To meet growing demand, a new water source is likely to be required by 2040. The northern sub-region will be the first area to require supply augmentation. The options selection and integrated planning process shows the most efficient way to address this need is a water supply solution located in the north. Seqwater has identified two water source types in the northern sub-region that meet the required objectives: surface water options associated with harvesting from the Mary River (with and without the raising of Borumba Dam wall) or a desalination plant.

It is important to note that this is early planning. No preferred options or sites have been identified. What we do know is that land is limited. We will need to work with the Queensland Government to secure sites when required.

Before we need the new water source we will need additional water treatment capacity to meet peak demand in the central sub-region (by about 2035). We expect to deliver this extra capacity by augmenting existing water treatment plants but other options may be available and will be considered.

These water source and treatment capacity timeframes depend on some minor augmentations to the water grid, including work on pipelines, pump stations and water treatment plants to maximise supply from our existing infrastructure. These minor system augmentations will be delivered over the next 20 years.

All but one of the 16 off-grid communities meet LOS objectives over the next 30 years. Beaudesert will be connected to the water grid to provide the security required.

Current system performance

A distinguishing feature of South East Queensland's bulk water supply system is the ability to consider operating strategies in conjunction with the traditional supply and demand balance. The region has access to a diverse range of supply sources during times of decreasing water security, while also being able to choose operating strategies to minimise cost when water security is high.

Our water security is driven by overall system performance, which is determined by three interdependent levers – demand, supply and system operation (Figure ES-1). There is opportunity to improve system performance by changing any one, or a combination of, these three levers.

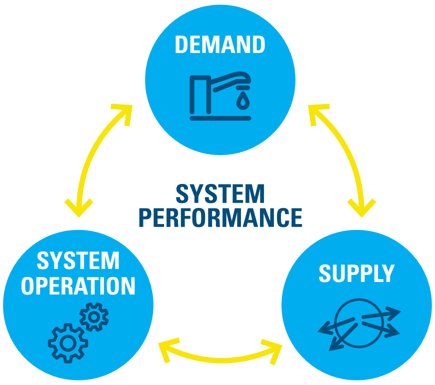


Figure ES-1 Interdependent levers of water security

Seqwater has conducted a comprehensive examination of the supply, demand and system operation levers to develop this Program. System performance is currently adequate to meet South East Queensland's needs.

One of the measures of system performance is Level of Service yield (LOS yield). This is the maximum annual average volume of water that can be supplied to urban and industrial customers by the bulk water supply system every year, while meeting the LOS objectives. The LOS yield of the water grid is estimated to be 440,000 ML/annum, based on current infrastructure with both the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme (WCRWS) being available to contribute to supply, in accordance with our system operation strategy (refer Chapter 5 – System operation) and our drought response plan (refer Chapter 6 – Planning for resilience).

As well as having enough water to meet growing demand, Seqwater must also be able to treat enough water to meet peak demand (higher demand generally experienced in hotter, drier periods). Another measure of system performance is Mean Day of the Maximum Month (MDMM). This is the peak demand that the bulk water supply system is designed to provide. The daily system capacity is 1,347 ML/day, which is sufficient for the region's current needs.

Planned minor system augmentations

To provide South East Queensland with water security over the planning period, system augmentations will be required. Fortunately, the interconnected water grid means simple actions can be taken to optimise existing water supply infrastructure, increasing the yield from the bulk water supply system and delaying the need for major new infrastructure.

We have identified two highly-efficient water treatment plant (WTP) upgrades and four system reconfiguration options to increase LOS yield and address peak demand. These options are common to all investment strategies and form the planned base case for future planning – the assumed starting point.

They include:

- North Pine WTP upgrade to 250 ML/day
- North Pine WTP pump station reconfiguration
- Mt Crosby WTP upgrade to 850 ML/day
- Sparkes Hill to Aspley pump station upgrade
- Northern Pipeline Interconnector to Landers Shute upgrade – Paynters Creek Connection
- Northern Pipeline Interconnector, southern section augmentation – North Pine to Narangba.

Treatment plant upgrades will be coupled with planned closures of some older plants that would otherwise require significant investment to update and connect them to the water grid.

The system options included in the planned base case improve the ability of the water grid to move water from the central sub-region to the northern sub-region and, combined with changes to operation of the water grid, increase the LOS yield from 440,000 ML/annum to around 495,000 ML/annum. This includes earlier operation of WCRWS in response to drought.

Under the medium demand scenario, these augmentations mean construction of a new supply source is unlikely to be required until about 2040 (Figure ES-2). Higher demand would mean a new source would be needed closer to 2031 but lower demand would push it out beyond 30 years.

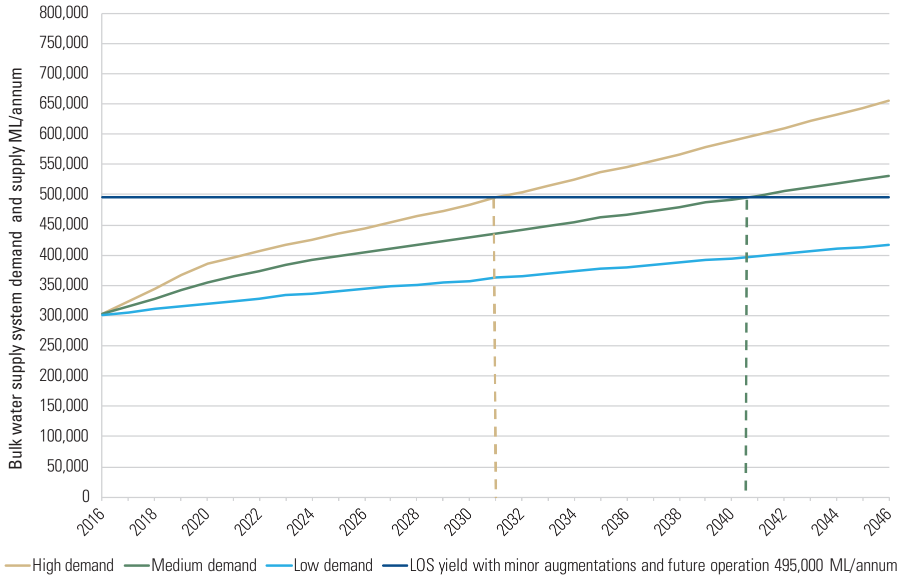


Figure ES-2 Impact of demand on augmentation year for existing system with the planned base case (yield of 495,000 ML/annum)

Options included in the base case also extend the timing of the next augmentation required to meet the MDMM demand. Based on the medium demand forecast, Figure ES-3 illustrates that base case augmentations move the requirement for additional treatment capacity from 2023 to 2035.

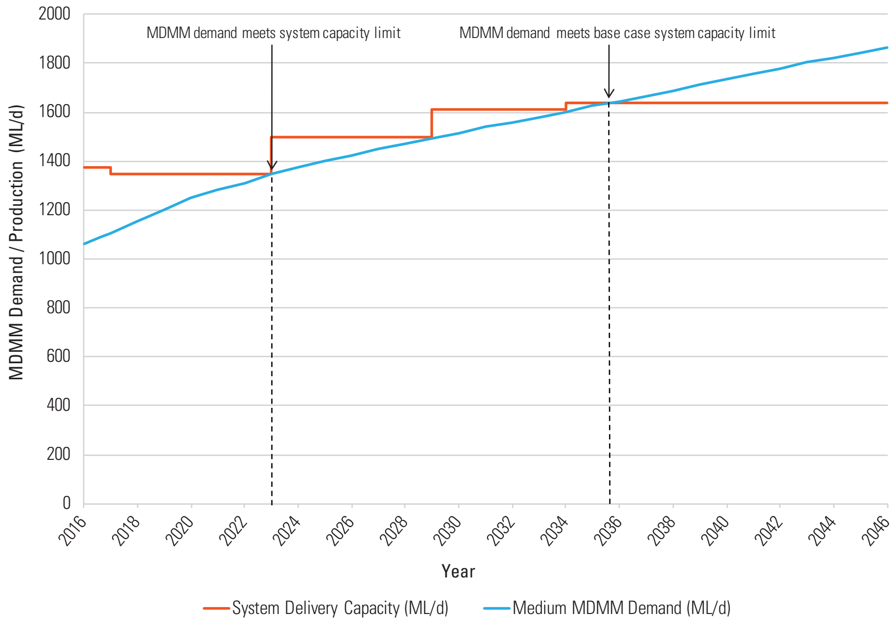


Figure ES-3 MDMM demand and treated water capacity for planned base case

As with LOS yield, the timing of the need for additional treatment capacity can change with changing influences. The timing of augmentations will ultimately depend on supply, demand and system operation.

Future water security options

Supply options considered included surface water, groundwater, seawater desalination, purified recycled water for drinking and decentralised schemes as well as treatment plant upgrades. Demand options included water-efficiency measures, education, rebates and retrofit programs. System operation options included changes in operation of the system to either minimise cost or maximise water security.

Modelling and assessment demonstrates there are many options and approaches available to maintain South East Queensland's water security. Each individual option, and combination of options, requires trade-offs. The scale and interconnectedness of the water grid means trade-offs may be between economic, environmental, people and place, and resilience outcomes, including the ability to respond to drought and flood.

The new water security options identified are listed in Table ES-1. They form a portfolio of options from which to select and are the starting point for future planning and discussion.

The future options have been assessed at a strategic level and will be subject to further assessment and community feedback.

Table ES-1 Water security options

Option type	Sub-region	Water security option*
Surface water	Northern	• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into the existing Borumba Dam • Upgrade the Noosa WTP
		• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into a raised Borumba Dam • Upgrade the Noosa WTP
		• Build a new weir on the Mary River in the vicinity of Coles Crossing • Raise the wall of the existing Borumba Dam to increase its storage capacity • Upgrade the Noosa WTP
	Central	Build Wyaralong WTP
WTP upgrade	Central	Upgrade the Mt Crosby WTPs to 950 ML/day (no LOS yield increase)
	Southern	Upgrade the Molendinar WTP to 190 ML/day (no LOS yield increase)
Desalination	Northern	Build a northern desalination plant
	Central	Build a central desalination plant
	Southern	Upgrade the Gold Coast Desalination Plant (Stage 2) (45 ML/day)
Decentralised schemes	All	Implement decentralised schemes where feasible
Demand management	All	Implement new permanent demand management options

** All options were identified in previous studies and desktop assessment and refined through detailed investigations and consultation. Changes to sites, site characteristics, terrain and/or routes for the construction of any of these infrastructure components may considerably impact the cost and therefore change the outcome of this assessment.*

The first water security objective to trigger investment will be treatment capacity requirements. The additional treatment capacity needed to meet peak demand will be in the central or southern region.

The first LOS objective that will need to be addressed is the minimum operating level of Baroon Pocket Dam. This highlights the vulnerability of the northern sub-region.

Assessment of the above options shows that new supply sources in the northern region will most efficiently resolve this issue. The efficient options to address the Northern sub-region vulnerability and meet the LOS objectives are listed in ES-1.

Purified recycled water for drinking may be an efficient new supply source option in the future. Further engagement with government and communities is required to better understand the potential role of purified recycled water in South East Queensland outside of drought conditions.

Once work has been done to resolve the northern sub-region challenges, any of the options listed in Table ES-1 may be implemented in subsequent stages of the investment pathway. The most efficient of these options will depend, in part, on which augmentation option is implemented first.

The two exceptions are demand management for infrastructure deferral and decentralised schemes. Demand management to defer infrastructure would need to be implemented well in advance of the need for new infrastructure.

Decentralised schemes are most efficient when incorporated in new developments at the planning and implementation phase; therefore such schemes would be best implemented opportunistically.

Where possible and efficient to do so, options will be staged to allow an incremental response and spread the cost of capital investment, reducing the impact on water bills.

An options assessment framework has been developed to assess the options and investment pathways required to meet the LOS and peak demand objectives. Assessment showed how the objectives can be met through different strategies for investment. Two example strategies were developed to test the framework. One strategy focused solely on large-scale infrastructure, the other considered investing opportunistically in decentralised schemes and incorporating permanent demand management measures to defer the need for large scale infrastructure investment before augmenting the existing system (noting that large scale infrastructure is still required, just not as soon). These example strategies demonstrate that we can achieve water security in different ways, with different liveability outcomes for our communities, depending on the trade-offs we decide to make in the future.

Managing climate extremes

Investment in the water grid, including the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme, was fast-tracked in response to the Millennium Drought water crisis. Subsequent events have also highlighted the important role these climate-resilient water supply assets play in times of flood. The desalination plant and water grid were essential to maintaining water supply during the 2011 and 2013 floods. The desalination plant was used to partially offset disruptions to other treatment plants, while the water grid enabled delivery of water to affected communities. This investment contributes to the resilience of the system and provides our communities with benefits and flexibility in the water futures that can be considered.

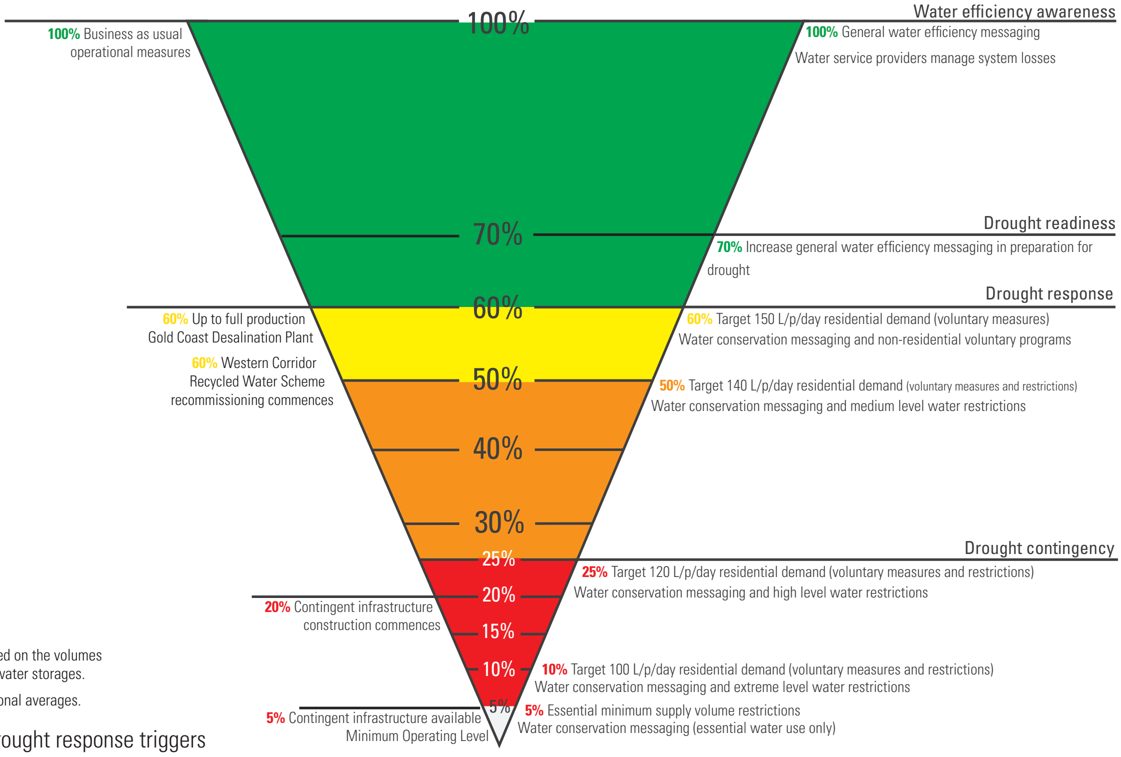
The Millennium Drought and subsequent floods highlighted the importance of planning for water supply well in advance, to prevent a crisis from developing. This Program has considered multiple scenarios, including those worse than experienced on the historical record. Our planning is also underpinned by community engagement and ongoing education to maintain awareness and preparedness to respond to extreme events.

RESPONDING TO DROUGHT

The unpredictable nature of drought means adaptive responses are needed. As a drought unfolds, our response will be proportional to its severity and duration and take into account influences, such as changing population, water use behaviours, infrastructure and technology.

Our drought response plan has been developed to balance cost, water security and community outcomes, and implement the lessons learned from the Millennium Drought. It includes triggers for actions to increase climate-resilient supply, decrease demand, and change the operation of the water grid to optimise available water resources. It uses existing Seqwater infrastructure and optimally applies the system operation, supply and demand levers to deliver the greatest value to our communities. Seqwater's drought response planning included:

- using historic data to develop and apply a design drought (a potential drought worse than the Millennium Drought), enabling robust drought response planning
- updating and expanding drought response input information, e.g. operating costs and societal economic impacts for drought demand management measures



Notes:

1. Percentages are based on the volumes of the SEQ key bulk water storages.
2. Targets are SEQ regional averages.

Figure ES-4 Drought response triggers

- considering probabilistic cost impacts
- revising triggers based on robust modelling
- continuing consultation with water service providers.

Drought response triggers align with combined key bulk water storage (KBWS) capacities. This method is easily measurable, representative of water security and reflects the connectedness of the water grid and our ability to transport water between areas to maintain supply.

The triggering of actions, as specified regional dam capacities are reached, also prepares our communities for future measures so they are informed and ready to conserve water when required. Figure ES-4 outlines our drought response, based on declining levels in the KBWS.

Fundamental to our drought response is the use of existing climate-resilient water supply infrastructure – the Gold Coast Desalination Plant and Western Corridor Recycled Water Scheme.

This drought response approach encompasses all communities drawing drinking water from the KBWS, including grid-connected communities and the off-grid communities of Kilcoy, Esk, Lowood and Somerset. All other off-grid communities have a community-specific drought response plan (refer Appendix N – Off-grid community fact sheets).

We recognise the impact of water restrictions on communities, especially the more severe water restrictions, and aim to optimise assets and implement voluntary demand management measures before introducing severe water restrictions.

INTERFACE WITH FLOOD MITIGATION

Recent floods in South East Queensland have impacted water supply by suddenly changing source water quality (reducing water treatment capacity), causing equipment to fail, breaking water mains, and cutting power (constraining water treatment and transport).

As with drought, flood response requires a planned, coordinated approach. The difference is that the time to respond and adjust the plan to conditions is significantly less. Long-term flood mitigation measures can however be introduced. Some measures – such as lowering the drinking water full supply levels in our water storage dams so we can hold more floodwater – can impact water security.

Seqwater's Dam Improvement Program, a plan to ensure our dams meet safety standards into the future, may also result in changes to dam full supply levels. Water levels in a number of dams have been temporarily lowered while further assessment of long-term arrangements is finalised. Analysis undertaken for this Program recognises these temporary measures.

To date, we have not investigated the trade-offs between water supply and flood mitigation. This work is now underway and outcomes will be included in future versions of the Program.

Future water security planning

The Program's 30-year planning horizon means the forecasts used in this document are certain to change, as are community views and values. Conditions will also change over time. For these reasons, the Program will be continually refined so that it remains adaptive to external influences and the expectations of South East Queenslanders. For future versions of the Program, we will:

- gather community views on planning for and responding to drought
- collaborate with water service providers and communities to manage demand, potentially further delaying infrastructure investment (where economically efficient)
- continue to refine the costs and benefits of water options
- further assess and quantify the costs and benefits of decentralised schemes
- investigate new and emerging options
- explore opportunities for using the Western Corridor Recycled Water Scheme for alternative uses when water security is high
- work with stakeholders, customers and communities to develop our options analysis and decision making frameworks
- explore the benefits of further segmentation and refinement of demand forecasts, particularly for the commercial and industrial sectors
- continue to monitor and review key trends that influence system performance.

The Department of Energy and Water Supply plans to review LOS objectives within the next five years. Seqwater will support this review. Changes to LOS objectives may drive changes to the Program, in particular, how we plan and respond to drought.

NEW WATER SECURITY OPTIONS AND THE OPTIONS ASSESSMENT FRAMEWORK

The LOS review and engagement with our stakeholders, customers and communities will provide an opportunity to revisit Program objectives in light of any changes to the LOS objectives and considering the region's broader liveability goals. It will also allow us to consider the integration of drought response planning in the options assessment framework and potentially include flood management and dam safety considerations as well.

The five-year period to prepare the next Program also provides time to consider broadening the scope to capture options that improve water security across the water cycle, from investing in catchments to optimising the system across institutional boundaries.

Additional demand management measures, different operational strategies, different supply options (such as catchment investment), as well as decentralised and non-structural solutions can also be further researched.

We intend to revise our options assessment framework and broaden option evaluation to consider both the cost of implementation to the customer (and ultimately end water users) and the total economic value. This work will be done in consultation with the water service providers and shaped by our communities so it can comparatively evaluate options in a transparent and consistent way.

Looking beyond the next five years, Seqwater intends to:

- work towards achieving the United Nations' definition of water security. In effect, this means that future versions of the Program will use an options assessment framework that considers the total economic value of water, including the contribution toward resilience, the effect on people and place, and the impact on the environment
- engage communities in more holistic processes to better understand views on the future of our region, so we can play our part in delivering liveability outcomes
- engage with stakeholders, customers and regulators in integrated planning processes.

THE ROLE OF DECENTRALISED SCHEMES

Decentralised schemes, such as rainwater and stormwater harvesting, have been implemented across the region with varying success. It will take time to better quantify the costs and benefits of these schemes, and to develop governance arrangements to help schemes remain viable once operational. We are committed to further exploring decentralised schemes and the role they may play in securing our water future.

VALUING NATURAL ASSETS

The management of natural assets, particularly in relation to risk management, is an area of increasing interest to the business community and one which may present future opportunities for collaborative investment. Catchments play a vital role in supplying safe drinking water. We will work to increase our understanding of the value of our catchments and how to best manage them to achieve multiple objectives, including water security.

LONG-TERM COMMUNITY ENGAGEMENT

Seqwater has started long-term planning with the premise that there are no 'right' answers, and we genuinely seek to understand the views and values of the people we serve. The challenges we face as a region are complex, and over the next five years we intend to use deliberative engagement processes to explore water options and opportunities. We aim for our engagement to be based on foresight rather than hindsight as we plan our water future. A phased approach to engagement will support the development and ongoing implementation of the Program. We will also extend our water education to increase community understanding of the water cycle, how water is sourced, stored, treated and supplied, and the water security options and trade-offs available to us.

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01 Introduction to water in South East Queensland

1.1 Healthy communities, prosperous region

Water is fundamental to a liveable region – a place where people aspire to live, work and visit. It underpins the health and wellbeing of the region's population and supports a prosperous South East Queensland.

What is a liveable region? At a minimum, a liveable region provides safety, security and a high quality of living. There is no single definition of what constitutes a liveable region because the elements that people consider important differ from person to person and place to place. It is therefore imperative that the people who live and work in South East Queensland are involved in defining the liveability of the region. We cannot plan our water future, if we do not fully understand community's vision for that future.

Many organisations contribute to the liveability of South East Queensland, including the Australian and Queensland Governments, councils, water, energy and transport service providers and other entities. Water provision is critical to liveability, with water security underpinning people's wellbeing, the health of our environment, the economy, and the resilience of the region.

Planning to achieve liveability outcomes requires an integrated approach across all of the jurisdictions that play a role in shaping the liveability of South East Queensland. We must consider the responsibilities and functions of each entity as they currently exist and how they interrelate. To maintain liveability in the short term and improve liveability in the longer term, emerging and potential opportunities must be considered in planning now.

1.1.1 THE QUEENSLAND PLAN

At the most aspirational level, Seqwater's planning is seated within the framework of The Queensland Plan. Developed in 2014, The Queensland Plan's 30-year vision is for Queensland to be home to vibrant and prosperous communities, supported by good planning and the right infrastructure, with growth across every region. It describes a Queensland where education is valued, our economy is competitive, and our brightest minds take on the world and work collaboratively for Queensland. It avows we will be the greatest state, a guardian of a sustainable natural environment, with community spirit and opportunities for all.

1.1.2 SOUTH EAST QUEENSLAND REGIONAL PLAN

At an integrated planning level, the South East Queensland Regional Plan lays out a path to manage growth and change to protect and enhance quality of life in the region.

The plan determines actions to address regional growth across all planning functions, capturing population and demographic change, connectedness, housing affordability, transportation, climate change, cost of living and employment.

Changing regional needs influence the role of water in urban communities – how much water is needed and where. Water security is a fundamental element of sustaining the region and enabling growth and prosperity.

The regional plan is under review, led by the Department of Infrastructure, Local Government and Planning. Seqwater is working with the department, particularly in the areas of infrastructure planning and location and population growth projections.

1.2 Water security

The United Nations defines water security as *'the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.'* (UN-Water, 2013).

UN-Water highlights four requirements to achieve water security:

- **Good governance**
  Adequate legal regimes, institutions, infrastructure and capacity are in place.
- **Transboundary cooperation**
  Sovereign states discuss and coordinate their actions to meet the varied and sometimes competing interests for mutual benefit.
- **Peace and political stability**
  The negative effects of conflicts are avoided, including reducing water quality and/or quantity, compromised water infrastructure, human resources, related governance, and social or political systems.
- **Financing**
  Innovative sources of financing complement funding by the public sector and micro-financing schemes.

While the United Nations is focused on water security at a global level, the definition of water security and the ways to achieve it, are relevant to South East Queensland.

1.2.1 QUEENSAND'S WATER SECURITY – WATERQ

Developed by the Queensland Department of Energy and Water Supply (DEWS), WaterQ is a 30-year vision for Queensland's water sector. It sets out a high-level framework of priorities and actions to address challenges and changes facing water supply in Queensland over 30 years.

The WaterQ vision is for a water sector that 'supports increased productivity, economic growth, strong and healthy communities and a natural environment that is valued', and the plan sets seven strategic priorities:

- increased customer empowerment and community education
- equitable and affordable water
- efficient and productive water use
- responsible and productive water management across Queensland
- a skilled and sustainable water sector
- smart regulation that encourages private sector investment
- innovative technology and infrastructure.

1.3 Water Security in South East Queensland

This Program provides a plan for how water security can be achieved for South East Queensland for the period 2016-2046.
It applies to a defined South East Queensland geographical region comprising the following Local Government Areas (LGAs), as shown in Figure 1-1.

- Brisbane City Council
- City of Gold Coast
- Ipswich City Council
- Lockyer Valley Regional Council
- Logan City Council
- Moreton Bay Regional Council
- Noosa Shire Council
- Redland City Council
- Scenic Rim Regional Council
- Somerset Regional Council
- Sunshine Coast Regional Council

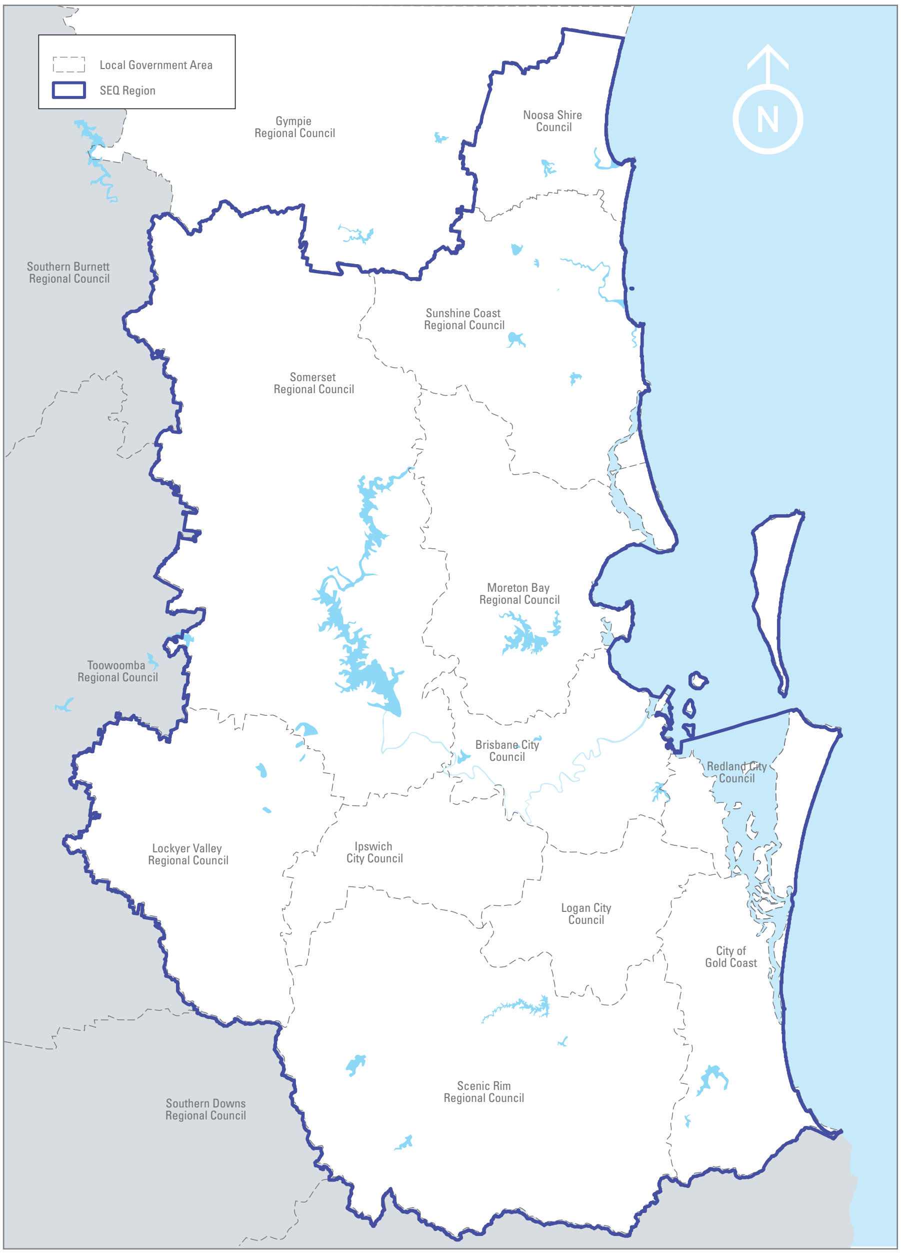


Figure 1-1 Regional map

The four specific areas highlighted by the United Nations for achieving water security – governance, transboundary cooperation, peace and political stability and financing – are outlined with relevance to South East Queensland below.

1.3.1 GOVERNANCE

The safe and secure supply of water in South East Queensland has been subject to significant governance, investment and institutional reform over the past 20 years, particularly in response to the Millennium Drought (2001-2009). Reform is likely to continue, with an increasing focus on private sector involvement in the provision of water services and arrangements for decentralised schemes. Institutional arrangements for water management in South East Queensland are such that no single organisation has responsibility across the whole water cycle.

1.3.1.1 Infrastructure investment

Significant capital investment (around $6 billion) was made to increase regional water supply in a very short timeframe during the Millennium Drought. Major pipelines were constructed to interconnect existing and new supply sources and transport water around the region. Infrastructure investment included:

- Gold Coast Desalination Plant
- Western Corridor Recycled Water Scheme comprising advanced water treatment plants to produce purified recycled water (PRW) and pipelines
- Northern Pipeline Interconnector (NPI)
- Southern Regional Water Pipeline (SRWP)
- Eastern Pipeline Interconnector (EPI)
- Hinze Dam raising
- Wyaralong Dam
- Bromelton Off-stream Storage
- Cedar Grove Weir
- Bribie Island and Brisbane aquifer treatment plants.

1.3.1.2 Institutional reform

On 1 January 2013, Seqwater in its current form was established through the merger of the following statutory authorities:

- **Water Grid Manager**
  Responsible for operational decisions relating to the water grid, and selling bulk water to retail customers.
- **Seqwater**
  Owner/operator of most bulk water supply infrastructure, i.e. dams, weirs, groundwater infrastructure and water treatment plants.
- **LinkWater**
  Owner/operator of the major regional pipeline interconnectors.

Seqwater assumed the key functions of these authorities and now owns and operates the region's bulk water supply, treatment and transport assets. We are also responsible for long-term water security planning.

1.3.1.3 Seqwater

Seqwater is the Queensland Government statutory authority responsible for providing a safe, secure and cost-effective water supply for South East Queensland, today and into the future. Our vision is healthy communities, prosperous region and our promise to South East Queenslanders is water for life.

We are the sole bulk supplier of treated and untreated water in South East Queensland and our role is to source, store, treat and supply water from catchments and alternative sources, and provide reliable, fit-for-purpose water to customers.

Seqwater also provides essential flood mitigation services through the operation of Somerset, Wivenhoe and North Pine dams, irrigation services to more than 1,200 customers, and recreation services on and around many of our water storages. More than 2.5 million people visit Seqwater's dams, lakes and parks every year.

We are one of Australia's largest water businesses, with a large geographical spread and a diverse asset base. Our operations extend from the New South Wales border to the base of the Toowoomba ranges and north to Gympie.

Seqwater manages $11.9 billion of water supply infrastructure and parts of the natural catchments of the region's major water supply sources. Assets include dams, weirs, bores, water treatment plants (including the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme), reservoirs, pumps and pipelines and some catchment areas.

Across Australia, catchment management forms a crucial role in achieving water security, particularly water quality management. Some entities, such as Melbourne Water and Western Australia's Water Corporation, retain closed (protected) drinking water catchments, restricting activities to manage water quality risks. Others, including Seqwater, have open catchments which are subject to third party land use and ownership. While Seqwater owns and operates significant infrastructure, it only owns and manages 4.4% of its catchment area. This percentage is much lower than similar water providers in Australia, as shown in Table 1-1.

Table 1-1 Australian bulk water providers with open catchments

Bulk water provider	Catchment area	Proportion of catchment area owned	Main land use type
Seqwater	16,600 km^2	4.4%	Agriculture (including grazing) Industry Urban development
Water NSW	16,000 km^2	21.0%	Agriculture (including grazing) Forestry Urban development
SA Water	4,190 km^2	13.1%	Agriculture Forestry Urban development
Hunter Water Corporation	2,086 km^2	6.8%	Urban development Agriculture Forestry Mining

1.3.1.4 Seqwater's customers

Seqwater's major customers are the South East Queensland water service providers: Unitywater, Queensland Urban Utilities and the water businesses of Redland, Logan and City of Gold Coast councils. The water service providers source treated drinking water from bulk water supply points and deliver it to households, businesses and industry via local reservoirs, pump stations, mains pipes and reticulation systems.

While the City of Gold Coast, Redland City Council and Logan City Council provide reticulated water to their respective LGAs, Unitywater and Queensland Urban Utilities reticulate water to more than one LGA, as follows:

- Unitywater supplies the Noosa, Sunshine Coast and Moreton Bay council areas.
- Queensland Urban Utilities supplies the Brisbane, Scenic Rim, Ipswich, Somerset and Lockyer Valley council areas.

The reticulated water system supplies both residential (people's homes and gardens) and non-residential customers (commercial and industrial).

Other direct customers of Seqwater include power stations, Toowoomba Regional Council (drought contingency supply only), Gympie Regional Council, and more than 1,200 irrigation customers in seven water supply schemes.

1.3.1.5 Seqwater's stakeholders

Seqwater relies on close working relationships with a range of stakeholders to plan for water security.

Queensland Government

The Queensland Government oversees water management and regional planning in Queensland through:

- water regulation including the setting of the Level of Service (LOS) Objectives
- pricing
- institutional arrangements
- allocations and licencing.

Local and regional councils

Local and regional councils implement integrated water management initiatives, oversee and approve planning and development within their boundaries and work directly with communities to understand and deliver liveability outcomes.

Catchment managers

There are a variety of catchment owners and managers in South East Queensland, resulting in significant complexity when it comes to managing catchments, as each of the owners and/or managers have different drivers and needs.

Seqwater actively pursues partnerships with local government, non-government organisations and Queensland Government departments to reduce risk in water supply catchments. We also work collaboratively on investments to improve catchment health and resilience. Through these partnerships, regional Catchment Action Plans are progressively being developed for all major catchments in South East Queensland. These plans identify collaborative investment opportunities that will deliver multiple benefits to different stakeholders.

Property developers

Developers often drive growth in the residential sector. They influence where development occurs as well as the type and nature of development. Greenfield and infill developments provide opportunity for integrated water cycle management. By working with councils, water service providers and Seqwater, developers can drive decentralisation and new and innovative ways to deliver water.

The agricultural sector

Food security is underpinned by a strong agricultural sector, which relies on water security for viability. Water supply to Queensland's agricultural sector occurs through licences and allocations administered by the Department of Natural Resources and Mines. Seqwater supplies untreated water to some irrigation customers in accordance with water licencing arrangements set by the department.

1.3.2 TRANSBOUNDARY COOPERATION

Integrated planning is a necessary precondition for the implementation of the Water Security Program. The regional planning system must take into account the potential water security impacts of urban and industrial growth.

Integrated water management, which spans catchment management, water storage, treatment and distribution, wastewater services, stormwater and flood management, needs to be considered in a systematic way across jurisdictions and therefore requires a significant degree of cooperation.

Collaboration is increasing as the needs of the region, the integrated nature of service provision, and the importance of developing a systems approach to planning and building a resilient, liveable South East Queensland become apparent.

1.3.3 PEACE AND POLITICAL STABILITY

South East Queensland has not experienced conflict in recent times, but it has been subject to political change. As such, it is imperative that water security planning is undertaken in a robust and transparent way to achieve outcomes that align with community needs. As community preferences often influence political drivers, it is important that the needs, values and preferences of South East Queenslanders are reflected in this Program.

1.3.4 FINANCING

Costs for South East Queensland's water infrastructure are being recovered through water charges. Investment in, and funding of, water supply services in Queensland is overseen by an independent economic regulator, the Queensland Competition Authority.

Valuing natural capital, such as waterways and ecosystems, is a growing area of interest. The commercial and banking sector is becoming increasingly aware of the importance of healthy ecosystems and secure water supplies in achieving a safe and resilient community.

'The 2016 World Economic Forum global Risk Survey rates biodiversity loss and ecosystem collapse, water and food crises, extreme weather events and a failure of climate change adaptation and mitigation as major risks facing the world……The need to address these risks is reflected in the United Nations' new sustainable development goals released in September last year' – Dr Ken Henry AC – 'Advancing Australia's Natural Capital' address to Sustainable Business Australia's Fiona Wain Oration, 27 May 2016.

Banking institutions, such as the NAB are now embedding management of natural capital into their credit risk assessment process and intend to include it in their credit modelling within the next 3–4 years.

New ways of valuing natural assets and incorporating natural asset management are being explored. Opportunities for value capture financing, as occurs in the transport industry, are also emerging. The historic approach to consideration of cost is quickly changing to viewing investments through the lens of their value proposition.

A key consideration in recovering costs through pricing is the impact on affordability for communities. This needs to be balanced with consideration of the ongoing cost to operate and maintain levels of service to communities. Any new approaches to financing will need to be considered by multiple parties, with reference to the governance and regulatory arrangements in place.

1.4 Seqwater's bulk water supply system

Seqwater owns and operates the bulk water supply system for South East Queensland. Our interconnected water grid includes dams and weirs, conventional water treatment plants and climate resilient sources of water through the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme. A 600 kilometre bi-directional pipeline network enables us to transport drinking water around the region. Each day we supply water to 3.1 million people.

The South East Queensland bulk water supply system has a high reliance on surface water (water stored in dams, weirs and off-stream storages) sourced from catchments. Compared to other bulk water authorities, Seqwater has limited control over activities that occur in the region's water supply catchments. It is vital that we work in partnership with land holders and communities to improve land management. We must also recognise the risks these open catchments present and design treatment plants to manage those risks.

Most South East Queenslanders are serviced by the water grid. We also supply drinking water to about 55,000 people living in 16 off-grid communities – rural towns that are not connected to the water grid, but form part of the bulk water supply system. The water for off-grid communities is sourced and treated locally.

In addition, there are 186,000 South East Queensland residents who are without reticulated drinking water and are reliant on rainwater tanks and private bores. In times of low rainfall, carting of water from the bulk water supply system to rainwater tanks supplements their water supplies. Residents are responsible for organising and paying for carting. These independent water supplies are outside of the scope of this Program.

The bulk water supply system is shown in Figure 1-2.

Seqwater major assets

Legend

- Northern Pipeline Interconnector
- Western Corridor Recycled Water Scheme
- Southern Regional Water Pipeline
- Eastern Pipeline Interconnector
- Network Integration Pipeline
- Other bulk water pipelines connecting the SEQ water grid
- Local government boundary
- Reservoirs
- Water Treatment Plants (WTP) – connected to grid
- Water Treatment Plants (WTP) – off-grid
- Water Treatment Plants (WTP) – other
- Western Corridor Recycled Water Scheme
- Desalination plant

Water Treatment Plants (WTP)

1 Amity Point WTP
2 Atkinson Dam WTP
3 Banksia Beach WTP
4 Beaudesert WTP
5 Boonah Kalbar WTP
6 Borumba Dam WTP
7 Canungra WTP
8 Capalaba WTP
9 Dayboro WTP
10 Dunwich WTP
11 East Bank (Mt Crosby) WTP
12 Enoggera WTP
13 Esk WTP
14 Ewen Maddock WTP
15 Hinze Dam WTP
16 Image Flat WTP
17 Jimna WTP
18 Kenilworth WTP
19 Kilcoy WTP
20 Kirkleagh WTP
21 Kooralbyn WTP
22 Landers Shute WTP
23 Linville WTP
24 Lowood WTP
25 Maroon Dam WTP
26 Molendinar WTP
27 Moogerah Dam WTP
28 Mudgeeraba WTP
29 Noosa WTP
30 North Pine WTP
31 North Stradbroke Island WTP
32 Petrie WTP
33 Point Lookout WTP
34 Rathdowney WTP
35 Somerset Dam (Township) WTP
36 West Bank (Mt Crosby) WTP
37 Wivenhoe Dam WTP

Western Corridor Recycled Water Scheme

38 Bundamba Advanced Water Treatment Plant (AWTP)
39 Gibson Island AWTP
40 Luggage Point AWTP

Desalination Plant

41 Gold Coast Desalination Plant

Reservoirs

42 Alexandra Hills Reservoirs
43 Aspley Reservoir
44 Camerons Hill Reservoir
45 Ferntree Reservoir
46 Green Hill Reservoirs
47 Heinemann Road Reservoirs
48 Kimberley Park Reservoirs
49 Kuraby Reservoir
50 Molendinar Reservoir
51 Mt Cotton Reservoir
52 Narangba Reservoirs
53 North Beaudesert Reservoirs
54 North Pine Reservoirs
55 Robina Reservoir
56 Sparkes Hill Reservoirs
57 Stapylton Reservoir
58 Wellers Hill Reservoirs

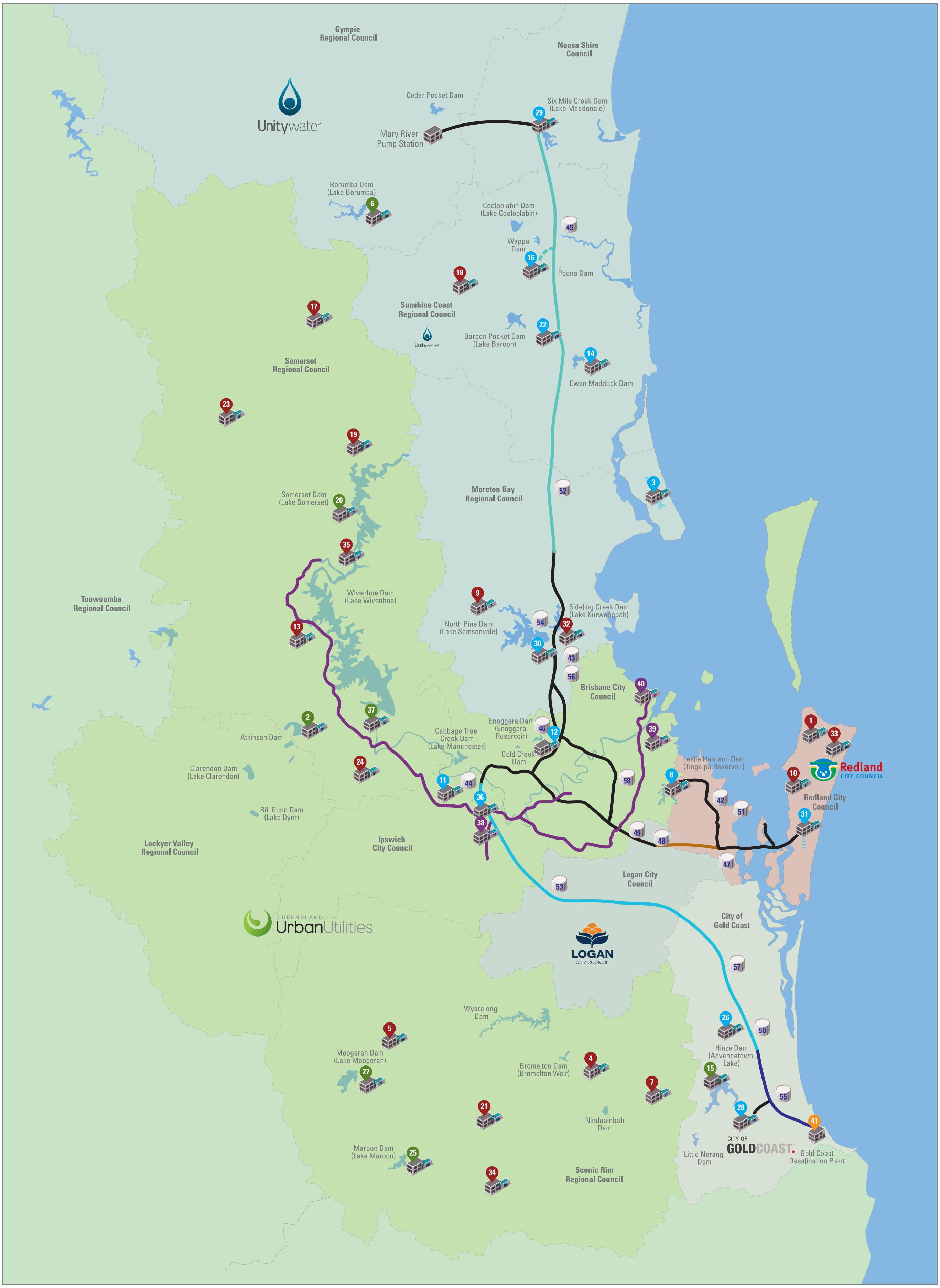


Figure 1-2 Seqwater's bulk water supply system

Although the region is interconnected, the water grid is operated to a large extent at a sub-regional level. Each of the sub-regions – northern, central, eastern and southern – are centred on a specific water storage, with the means to balance cost effectiveness and water security. Chapter 5 – System operation provides more information about how the water grid is operated. The sub-regions are defined below and shown in Figure 1-3.

- *Northern sub-region*
  Bulk water supply assets from Noosa to North Pine WTP; interface with the central sub-region.
- *Central sub-region*
  Areas supplied by Wivenhoe and Somerset dams via the Mt Crosby WTPs (i.e. Brisbane, Ipswich, Beaudesert and Logan).
- *Eastern sub-region*
  Assets from the transfer interface between the central sub-region through to Capalaba and North Stradbroke Island WTP.
- *Southern sub-region*
  Encompasses the Gold Coast supply area and interfaces with the central sub-region.

With interconnection of the water supply systems, the total yield of the water grid is greater than the yield of individual systems operating independently. When one supply source is being depleted, the water grid can be operated to allow other supply sources to be substituted, resulting in a higher overall yield.

Figure 1-4 illustrates the comparative yield of the system with and without the regional interconnectors. For example, with all water grid assets available and operating, the yield is about 440,000 ML/annum, and without interconnection the yield drops to about 355,000 ML/annum. This means that the grid can meet growing demand for considerably longer, delaying the need for additional water supply infrastructure.

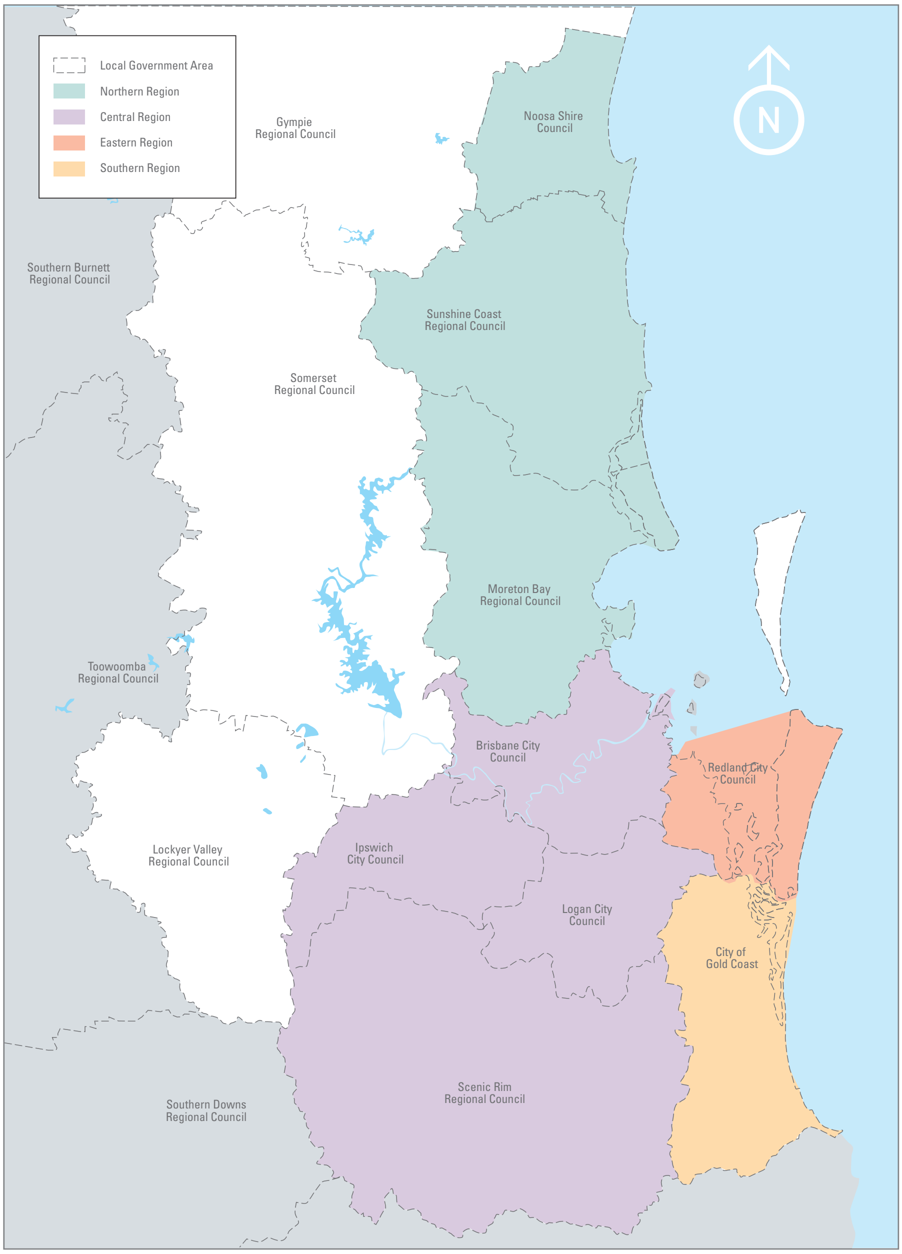


Figure 1-3 Sub-regions of the South East Queensland Water Grid

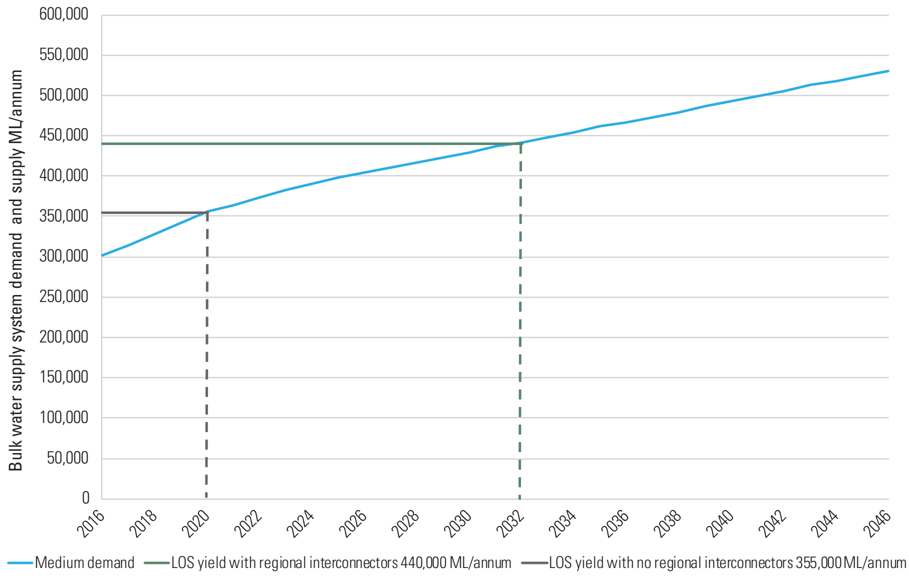


Figure 1-4 Impact of interconnection on overall water grid yield

1.5 About the Water Security Program

Since January 2013, Seqwater has been responsible for South East Queensland's long-term water security planning.

The *Water Act 2000* requires Seqwater to develop a Water Security Program to facilitate the achievement of the Level of Service (LOS) Objectives for water security for the next 30 years. The Act specifies the broad content of the Water Security Program. DEWS developed a guideline for Seqwater for the preparation of the Water Security Program.

The Program must include information about arrangements, strategies or measures for:

a) operating the designated water security entity's assets for providing water services in the region or part of the region to which the water security program relates; and
b) addressing future infrastructure needs, including building new infrastructure or augmenting existing infrastructure; and
c) managing the infrastructure relevant to the designated water security entity's operations; and
d) managing demand for water; and
e) responding to drought conditions;
f) any other matter prescribed under a regulation.

The Program will remain in force until such time as it is updated through a review. A review must occur at least every five years.

Seqwater developed the first version of the Program in 12 months and released it in July 2015. Version 1 included:

- the projected demand for bulk water supply in South East Queensland
- a detailed strategy for the bulk water supply system, including information on new bulk water supply sources for the water grid, and water supply shortfall risks for off-grid (standalone) communities
- information on the arrangements for operating bulk water supply infrastructure
- a broad outline of demand management measures
- an overview of drought risk and drought preparedness activities.

This document, version 2, includes:

- an update of the planning undertaking for version 1
- improved modelling outputs which have resulted from supply model enhancements to increase the accuracy of the existing system
- a review of the projected demand for bulk water supply in South East Queensland
- detailed strategies for all off-grid communities
- an options assessment framework, including initial customer and community views on options and the considerations that should be taken into account when planning for water security (this will be further developed in future versions of the program)
- the direction for further development of the options assessment framework
- information on the operation and management of bulk water supply infrastructure
- an economic impact assessment of demand management measures
- a detailed drought response plan and drought response plans for the off-grid communities.

While Seqwater is responsible for developing the Program, it relies on close collaboration with the South East Queensland water service providers, who make an invaluable contribution to its development and implementation.

We have focused on developing a Program that achieves the regulated objectives in addition to treatment objectives for the entire region (grid-connected and off-grid communities), with the intent of working towards the UN definition of water security.

1.6 Program scope

The Water Security Program focuses on meeting LOS objectives for South East Queensland set by DEWS. The Program covers urban use only and does not assess water security for irrigation customers.

This document addresses the requirements set by DEWS in the 'Water security program for South East Queensland – Guideline for development, Version 3 – November 2015'. Seqwater has extended the scope of the Program beyond achieving the LOS objectives to consider water treatment requirements to maintain suitable water quality.

In the past, Seqwater worked to achieve these objectives over the longer term and for critical off-grid communities only. Building on the previous Program, this version has extended the analysis to all off-grid communities and in particular, developed an optimised, adaptive, staged approach to responding to drought that balances cost and water security.

1.6.1 LEVEL OF SERVICE OBJECTIVES

The Queensland Government provides guidance on the long-term objectives for water security planning through a regulatory framework – the LOS objectives. The LOS objectives, prescribed by the *Water Regulation 2016* via an amendment in July 2014, provide a measure of performance that the bulk water supply system must meet. The Water Security Program is Seqwater's blueprint for achieving those objectives.

LOS frameworks are now the accepted industry standard for water security planning. The LOS framework used to determine the supply yield for South East Queensland takes a risk-based approach, in which the supply and demand models are based on projections for a much wider range of potential water inflows to our surface water storages, as well as how often these may occur.

This approach enhances water security because planning is based on theoretical droughts worse than those previously experienced by the region.

We have taken a systems approach underpinned by significant modelling to assess which demand, supply, and operational options achieve the LOS objectives and determine when LOS objectives cannot be met.

The LOS objectives (refer Appendix A) prescribe three key outcomes:

- The bulk water supply system must be able to supply enough water to meet the projected regional average urban demand. Note that urban demand is made up of residential (people's homes) and non-residential (commercial and industrial premises) water uses, and applies to both grid-connected and off-grid water supply communities.
- As the region enters a drought, the water grid must be able to supply enough water so that medium level restrictions on residential water use will not happen more than once every 10 years, on average, and under those restrictions, the grid will still be able to supply at least 140 litres of water to each person each day.
- The probability that any of the following three dams would run out of water must be no greater than a one-in-10,000 probability each year:
  - Wivenhoe Dam
  - Hinze Dam
  - Baroon Pocket Dam.

Seqwater has developed this Water Security Program to comply with the LOS objectives.

1.6.2 ASSESSING COMPLIANCE WITH THE LOS OBJECTIVES

The bulk water supply system consists of a number of subsystems, each with its own characteristic hydrology. The WATHNET simulation program was customised to develop the Regional Stochastic Model, which encompasses all the major storages, major demand zones, climate-resilient water sources and interconnecting pipelines in the water grid.

The Regional Stochastic Model is used in the adoption of a LOS approach to yield estimation, which requires statistical data on the operation of the system. As WATHNET can perform simulations using a large number of replicates of climate data, it can generate the large amount of data required for the LOS yield determinations. Section 4.2.2.2 provides further information about LOS yield.

The Regional Stochastic Model is used to obtain statistics for operation of the system with a fixed demand forecast and infrastructure composition.

The LOS objectives that are assessed for compliance using these statistics are shown in Table 1-2. For further information about the Regional Stochastic Model, refer to Appendix K.

Compliance assessments for the remainder of the LOS objectives are detailed in Table 1-3.

Individual options are also assessed for their contribution to LOS objectives. This is based on:

- their contribution to system yield or demand reduction in the case of demand management options
- their ability to supply water in an extreme drought (contribution to essential minimum supply volume).

Table 1-2 LOS objectives assessed using Regional Stochastic Model

LOS objective		Current operating strategy and drought response
LOS yield		440,000 ML/annum[1]
Criteria	**Complying value criteria statistic**	**Value achieved**
Key bulk water storages reaching 50% (Medium level restrictions trigger)	Less than once in every 10 years on average	Once in every 11 years on average
Key bulk water storages reaching 5% (Essential minimum supply volume trigger)	Less than once in every 10,000 years on average	Did not occur
Brisbane storages reaching minimum operating level	Less than once in every 10,000 years on average	Did not occur
Baroon Pocket Dam reaching minimum operating level	Less than once in every 10,000 years on average	Once in every 12,333 on average
Gold Coast storages reaching minimum operating level	Less than once in every 10,000 years on average	Once in every 110,987 on average
Average duration of medium level restrictions[2]	Less than or equal to 1 year on average	10 months on average

1. The LOS of 440,000 ML/annum has been determined based on the current operation of the system

2. Average time key bulk water storages (KBWS) remain below 50%

Table 1-3 Compliance approach for remaining LOS objectives

LOS objective	Value	Compliance
The bulk water supply system can meet the projected average residential and non-residential demand	LOS yield is greater than regional demand	Planning will be done to augment supply at an appropriate time before projected demand will exceed the LOS yield
Medium level restrictions will not restrict the average water use for the South East Queensland region to less than 140 litres per person per day	Medium level restrictions residential target rate	Set to keep it at or above 140 litres per person per day
The bulk water supply system will be able to supply the essential minimum supply volume (EMSV) – the volume needed to supply an average of 100 litres per person per day for residential and non-residential water use	EMSV yield	To meet EMSV requirements prior to the next augmentation, temporary desalination has been identified as a possible supply source

1.6.3 PLANNING CRITERIA

The LOS objectives are developed to plan for the amount of water available under a range of conditions. To achieve water security, the ability to deliver water of a suitable quality for drinking must also be considered.

This means the system must be able to treat, store and transport enough water to provide drinking water to meet demand including in periods of very high consumption, usually during the hotter, drier months.

Seqwater and the water service providers have developed planning criteria to meet these objectives, which are outlined in Appendix B.

1.6.4 WATER CONSIDERATIONS

In assessing water security options, Seqwater uses water considerations (assessment criteria) which are grouped into the categories of economic, resilience, environment and people and place.

The water considerations were initially developed by Seqwater and the South East Queensland water service providers, drawing on criteria used in water security planning both internationally and nationally, including liveability indicators developed by the Water Services Association for the Australian water industry (May 2016).

The water for life community engagement program then sought to understand whether the criteria align with community views and values and whether the criteria will ultimately help achieve the community's vision for future liveability of the region. The final water considerations are included in Appendix C.

1.7 Planning for water security

1.7.1 KEY ELEMENTS OF WATER SECURITY

Within the context of South East Queensland's bulk water supply system, water security is driven by overall system performance, which is made up of three interdependent levers – demand, supply and system operation (Figure 1-5). System performance can be changed by changing any one, or a combination of, these three levers.

Demand for water is directly influenced by:

- how much water every individual uses
- how the South East Queensland population changes over time
- how much water is lost during storage, treatment, and distribution
- changing needs of large industries
- development and uptake of water-efficient technologies and building standards.

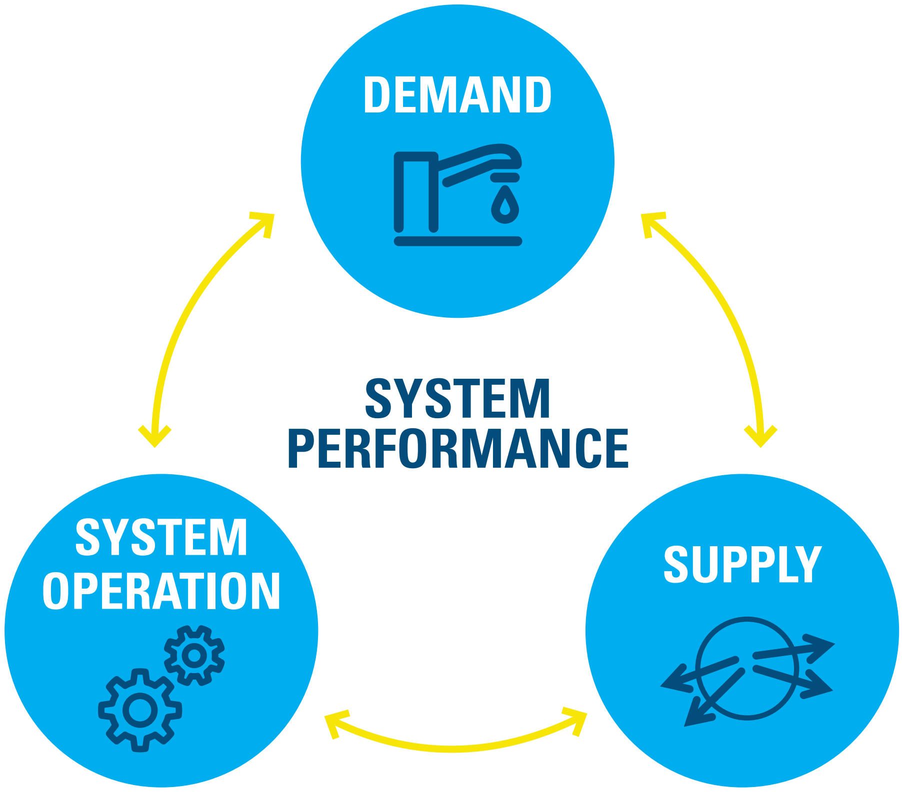


Figure 1-5 Interdependent levers of water security

Supply is directly influenced by:

- the amount of rainfall collected in dams and weirs
- evaporation from dams and weirs
- the condition of the water supply catchments
- the condition and capacity of water treatment and transport infrastructure
- the availability of recycled and desalinated water.

By managing the system operation, Seqwater:

- optimises the water grid to meet daily demands across the region and within sub-regional supply zones
- uses the most efficient supply sources at any given time
- can incrementally upgrade particular supply infrastructure to meet growing demands in particular supply zones, enhancing overall system performance and delaying the need for new large-scale infrastructure.

Demand, supply and system operation are influenced by a range of social, economic, environmental, political and technological factors. These factors are discussed in Chapter 2 – Influences, and highlight the interdependency of water with most aspects of liveability, and the challenges of long-term water security planning. There are many ways the levers can be altered to change system performance, all resulting in different liveability outcomes. This means trade-offs must be considered.

When choosing which levers to alter and when, we must understand liveability objectives across the region, along with preferences and values.

The methodology used to determine potential options for the bulk water supply system from storage through to managing demand are described in the sections that follow. Proposed solutions are underpinned by extensive hydrologic, hydraulic, economic and financial modelling and analysis.

The Program integrates operational planning with long-term water supply planning. There is considerable benefit in this integration, as it allows robust operational management of the bulk water supply system to maximise efficiency before major augmentation of water supplies.

1.7.2 STAKEHOLDER, CUSTOMER AND COMMUNITY ENGAGEMENT

Seqwater is committed to engaging with our customers and community to achieve a shared vision for the region's water future.

Section 355 of the *Water Act 2000* requires Seqwater to 'make reasonable endeavours to consult with each of the designated water security entity's customers likely to be affected by the water security program'. In the context of the *Water Act 2000*, Seqwater's customers are the South East Queensland water service providers (Section 1.3.1.4). The water service providers have been actively involved in the development of this version of the Program, and will continue to be involved in the preparation of future versions. In particular, Seqwater will seek to broaden the water service provider's involvement in ongoing development of the options assessment framework, which will shape future versions of the Program, and further development and implementation of the drought response approach.

The staged delivery of the Program, as outlined in Section 1.5, enables Seqwater to seek community views on the potential water futures outlined later in this program. Our approach to community engagement is outlined in Chapter 7 – Planning for the future.

We are committed to gaining a deeper understanding of whole-of-community benefits and costs associated with various demand, supply and system operation options.

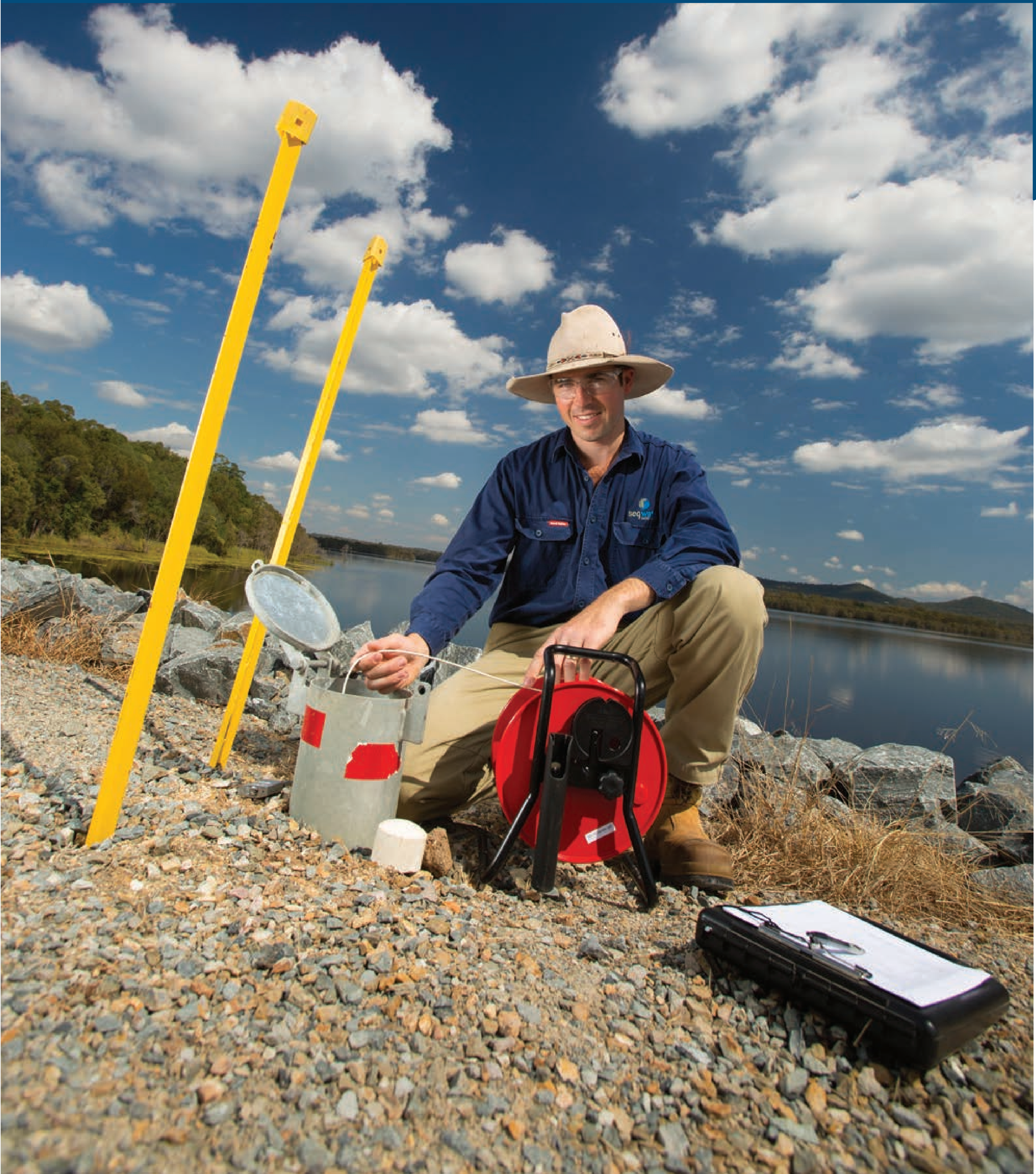
In developing this version of the Program, Seqwater has sought to understand community views on liveability, water security planning considerations and potential supply options. Engagement activities have included two rounds of community forums, surveys, information sessions and community events. Throughout this document are 'Your Say' information boxes, providing community views and insights on specific areas of water planning.

1.7.3 INDEPENDENT REVIEW PANEL

Since 2014, a group of seven industry professionals has provided Seqwater with independent advice on the approaches being taken and progressive outcomes of Program planning. The Independent Review Panel has played a very important role in challenging our thinking and sharing experiences of similar water security planning in other large cities in Australia and overseas.

The panel's varied backgrounds – water utilities, universities, water sensitive cities, economic development, investment framework development, engineering, social and environmental organisations – have been invaluable in helping Seqwater to better understand the competing demands for water now and in the future, as well as providing insights into different assessment methodologies, areas for collaboration and future opportunities to consider now.

02 Influences



02 Influences

Seqwater monitors external influences so we can respond as change occurs. The Water Security Program plans 30 years into the future, so factors likely to have a significant impact must be regularly assessed. Future demand, the future performance of the system, the development of management strategies and even the definition of water security itself, are all subject to external influence.

To identify the key influences on water security in South East Queensland, Seqwater commissioned the CSIRO to identify trends likely to impact on water security in South East Queensland.

The trends and external influences outlined in this chapter have the potential to impact future water security and must be carefully monitored.

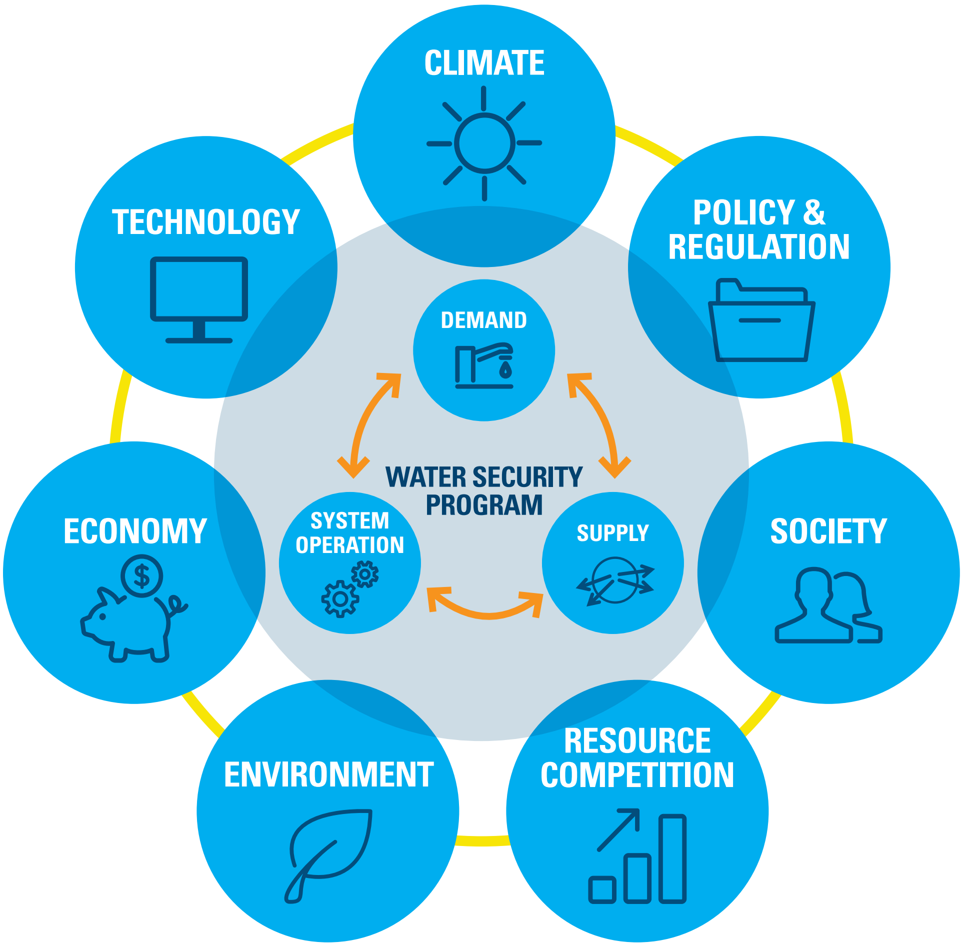


Figure 2-1 Interrelationships between Water Security Program and external influences

2.1 Climate

Future planning must take into consideration the extent to which the climate is likely to change and the impacts this will have on water security. In future, increasingly variable weather patterns are predicted, characterised by longer dry periods between inflow events, more severe rain events, and higher average temperatures.

Research institutions have developed a number of climate models that provide a range of climate change predictions for South East Queensland. Modelling by CSIRO (2014) predicts the following changes:

- an average annual temperature rise of 1°C (to 21.5 °C) by 2030 and by a further 0.6 °C to 2.1 °C (to between 22.1 °C and 23.6 °C) by 2070
- an increase in the average number of days per year hotter than 35°C from one per year (1971–2000) to two per year by 2030 and between three and 21 per year by 2070
- a 7% decrease in average annual rainfall by 2030 (from 1971–2000 average), and up to 9% decrease by 2070
- more intense rainfall when rain does occur, resulting in more flood events and deterioration in raw water quality
- fewer tropical cyclones overall, but a greater proportion in the more intense categories (three to five); by 2030 a 60% increase in storm intensity is projected, and by 2070 this rises to 140%
- a 200 km southward shift in the zone that generates cyclones, resulting in a greater impact on southern Queensland and northern New South Wales.

Climate and climate change can significantly impact on the ability to supply safe and secure water. The combination of droughts, bushfire and floods can cause long lasting catchment damage, which may reduce the availability of water and/or lead to water quality incidents overwhelming the treatment capacity of the current system. Although the probability of these events, especially multiple events occurring at the same time, is low, the likelihood is expected to increase with climate change. Long recovery times mean that the region's water supply may be exposed for several years at a time. Given the long life of water supply assets, climate change needs to be taken into account if the water supply system is to be optimised for the future environment.

A rise in sea level is also predicted to increasingly impact the South East Queensland coastline. A higher mean sea level elevates the risks of coastal inundation and, under the highest sea level rise modelled, inundations that previously occurred once every 100 years could occur several times a year by the middle of this century (Australian Government, 2009). Rising sea levels may impact existing infrastructure and needs to be considered when planning new infrastructure.

Ongoing climate change can affect both demand and supply. Higher temperatures lead to increased water usage by individuals, businesses and industry while reducing overall water availability due to higher evaporation rates from surface water storages. This may also impact on water quality because there is a higher likelihood of algal growth. This combination clearly impacts how long existing supplies can last while continuing to meet the LOS and treatment objectives.

Potential risks to Seqwater's business model caused by climate change are summarised in Table 2-1 below.

Table 2-1 Climate associated risk to bulk water supply

Risk	Description
Financial	A changing climate will increase the frequency and severity of droughts, which will put pressure on the volume of water per person sold as well as potentially bringing forward capital expenditure for new sources.
Service disruptions	External drivers beyond Seqwater's control including blackouts following storms and bushfires, loss of communication, loss of road access and loss of downstream retailer function may cause service disruptions.
Supply and demand instability	Climate change could result in the region's precipitation levels decreasing by 9% in average annual rainfall by 2070. Our understanding is based on recent historical climate records and emerging paleo-climate evidence that these records reflect only a small range of potential climate changes. Climate change can also impact on demand for water as people use more water in hotter, drier periods and less water in wetter periods.
Water quality threats	Climate related events including droughts, bushfire and floods causing long lasting catchment damage that may lead to incidents overwhelming the current system.
Ecological change	Climate change is already altering land and water ecology. Impacts are hard to predict and can be devastating. As an example, new species both flora and fauna may invade Seqwater's area of responsibility, from pest species to tropical disease carriers.

Inherent weather variability and longer-term climate trends mean South East Queensland's bulk water supply system should be:

- suitably located and robust enough to withstand multiple impacts or environmental stressors
- resilient enough to withstand and minimise the impact of weather events and resume normal operation after weather events
- less reliant on rainfall as the predominant source of supply.

Seqwater recognises the potential impact of climate change on water security and has a plan to enhance its understanding of the impacts of climate change and manage those impacts, with short-term activities outlined in Table 2-2 below.

Table 2-2 Planned response to climate influences

Objective	Key actions for the next 5 years
Enhance Seqwater's knowledge on climate and climate change impacts to effectively manage future impacts on bulk water supplies	Finalise a risk assessment and quantify high priority extreme weather and climate change risks
	Determine an Seqwater resilience target and adaptation pathway and assess implications
	Quantify interdependent risks and develop collaborative adaptation pathways with external agencies
	Provide guidance to government in relation to developing regional resilience in the water supply industry
	Develop and implement adaptation strategy to ensure long term planning and investment takes into account the risk of climate change and appropriately factor the risk in forecast expenditure and demand

2.2 Policy and regulation

Changing trends in policy and regulation will have a significant impact on our region's future water security. Policy and regulatory changes can impact all aspects of water security, including institutional arrangements, pricing, water quality standards, safety standards and the availability of options.

Water resource regulation, such as the *Water Act 2000* can change the amount of water available for use and the specific uses for water in the region.

Land use planning by state and local government impacts the extent of development in water supply catchments, the siting of bulk water infrastructure assets and the location and size of populations that will need to be serviced.

While Seqwater has some limited capability to influence local government planning through the *Sustainable Planning Act 2009* (Qld) it has no regulatory ability to enforce planning controls on other areas of development such as mining or state development.

Economic regulation and policies will affect the cost structure of the industry, the financial sustainability of water service providers and the price that end water users pay for water.

Environmental regulation policies will dictate the siting and operation of new and existing infrastructure. The ongoing monitoring and control of the impact of developments on water quality relies heavily on environmental protection legislation. However, regulatory controls on the ongoing impact of development, such as that captured in the *Environmental Protection Act 1994* (Qld) or federal environmental legislation, do not always provide specific protection of water quality for drinking purposes.

Water regulation and policies will impact on the availability of water and the way it is shared between sectors in the region. Health, and water quality regulations will drive the type and extent of treatment technologies adopted and may increase the cost of maintaining water security in the future.

Government policy on development and use of catchments can impact water quality and treatment requirements. Historically, Seqwater has had very limited control over the land within our catchments. A variety of urban, peri-urban, recreational and agricultural pursuits have been undertaken in our drinking water catchments for a long time. Controlling land use after-the-fact can be very challenging. At the same time, a growing population in the region increases levels of activity. It also presents further challenges in controlling the nature of new development to accommodate population growth. Increasing urbanisation and industrial development in water catchments presents new risk to source water quality and could trigger investment in water treatment upgrades just to maintain current supply levels while also increasing the cost of new supply options. Impacts on water quality through increased urbanisation and the establishment of high risk industrial developments could present new risks during extreme events which may also result in the interruption or loss of water supply.

The viability of different water supply options relies on policies and regulations that support their implementation and the cumulative consideration of these policies. For example, dam safety regulation incorporates analysis of the consequence of dam failure and risk to human life and property. Land use policies and plans dictate where population growth may occur. Queensland Government regional planning determines where large industrial development will be located, and this process is not governed through the *Sustainable Planning Act*. If population growth occurs in areas which increases the risk to human life and property from a dam, this may result in increased costs to improve dam safety to accommodate population growth and new development.

As technology advances at a rapid rate, new regulations may be needed to facilitate their safe inclusion in the water source, treatment, distribution, demand management or system operation mix. The timing of such policy may impact the feasibility of certain options and will be considered when developing and revising the Water Security Program.

Seqwater has a role in influencing policy change toward achieving safe, secure and reliable water supply. Involvement in key land use planning decisions will help to ensure that policy development in different areas does not result in conflicting planning objectives or adverse outcomes to water supply. We will maintain strategic advocacy and ensure legislative development is a key part of our ongoing environmental scanning activities.

Seqwater's plan for addressing policy and regulation influences over the next five years are outlined in Table 2-3 below.

Table 2-3 Planned response to policy and regulation influences

Objective	Key actions for the next 5 years
Support the formulation of local, state and national policy and regulations in relation to bulk water supply, catchments and other Seqwater related matters.	Maintain strategic engagement with Queensland Government on reviews of planning policy, state development master planning and with local government on local plans, so that development in our catchments considers water supply impacts
	Review and update the Seqwater development guidelines to provide guidance to government on the assessment of development applications
	Provide informed input to the State Government processes that review economic regulation of water prices to ensure the impact of regulatory regimes on long term asset and supply sustainability is appropriately considered
	Provide information and contribute to national guidelines on water and recycled water quality and state based legislative frameworks so water quality continues to be protected within an efficient regulatory regime
	Participate in research at a national level (WSAA and Water Research Australia) about alternative water sources

2.3 People and place

Population growth, changing demographics and associated changing needs are trends that will influence water security.

South East Queensland is the third largest urban area in Australia and is currently home to 3.3 million people. The Queensland Government's most recent population projections indicate that the region is expected to grow to around 5.5 million people by 2041. Overseas migration, interstate migration and natural population increases account for the predicted population growth.

Trending population growth is a key issue for Seqwater – ensuring there is enough water to supply demand drives most of the planning for supply augmentation and system resilience outlined in this document. Multiple-unit dwellings accounted for 37% of the 240,000 new housing stock built between 2001 and 2011. The median size of new residential lots has decreased over the past decade and is now approximately 524 square metres. This pattern of new development influences the demand for water with smaller lots and multiple-unit dwellings typically requiring less water per capita to maintain outdoor areas.

Increasing densification could require more water supply infrastructure in already established areas; however it could also result in better use of existing infrastructure in those areas. The impact of growth and development patterns on demand is a key aspect considered in Chapter 3 – Demand.

The pattern of population growth is unlikely to be uniform across the region. This will result in demand for water and other municipal services increasing significantly in greenfield development areas such as the Caloundra South, Caboolture West, Flagstone, Yarrabilba and Ripley residential communities, and state development areas such as Bromelton. Urban infill and replacement of single dwellings with multiple-unit apartments/townhouses, particularly in the Brisbane City Council area, may cause incremental increases in residential water demand over the long term. Ongoing research is required to quantify the water demand impacts of urban infill and densification. The development of new regional centres and cities in South East Queensland provides the ideal opportunity to understand, test and learn from the implementation of water sensitive urban design. It also provides an opportunity to test and understand new technologies and their relationship to liveability considerations and the broader challenges of water security in the region.

As the region's urban centres grow, they are likely to experience increased urban heat island effects where the built up area is hotter than nearby rural areas, due to human activity. It is not known what influence urban heat island effect will have on demand for water, nor is it known what supply would be required for plans – such as increased tree canopy cover or green roofs – to counter its effects. It is expected that urban cooling will play some role in driving demand in the future.

Where and how people live and how they use and value water in the future will have important implications for water security in South East Queensland. Increasing demand for water and increasing urban density pose challenges to the liveability of the region and to water security.

It is critical to continue to engage with the community about these challenges. Table 2-4 outlines the actions Seqwater will take over the next five years to maintain the liveability needs of our region.

2.4 Resource competition

Understanding and managing the complex interaction between water, land, energy and food requirements at a regional level will be critical to the sustainability and prosperity of the region. Demand for each of these resources will increase significantly over the coming decades, under pressure from population increases and mobility, economic growth and climate change.

The interrelationship between water and energy is becoming increasingly apparent as the demand for, and cost of, water and energy production increases. Growth in demand for electricity will increase demand for water if traditional energy sources, such as coal-fired power stations, remain dominant. Renewable energy sources use much less water. Traditional water supplies from reservoirs use much less energy than water from recycling and desalination processes – suggesting water and energy demands should be planned in parallel.

The growing urban centres of South East Queensland will require greater volumes of water in the future. It is important that the requirements of the urban sector are met with a sympathetic awareness of the requirements of other sectors. The concepts of 'integrated urban water management' and 'water sensitive cities' that are growing in acceptance in Australia's cities are critical to the water, energy and food security nexus.

Urban growth can limit the land available for the construction of water infrastructure. Additionally there is a need to balance the competing interests of flood mitigation for urban areas and water security.

Flood mitigation measures can reduce water stored in dams, which may impact adversely on water security, yet may enable land to be developed to accommodate a growing population.

Agriculture is a land intensive activity that can impact water quality and quantity when it exists within drinking water catchments. There is an emerging demand trend for locally grown produce instead of mass-produced commodities that are transported long distances for distribution. Higher demand for local food production in the region could result in additional water demand from existing storages and necessitate the release of more water for agricultural needs. This may increase competition for water between urban and rural sectors.

In future, there may come a time when the region is asked to make a decision on the importance of food security – how much water is required to supply the agricultural sector to maintain food security and who bears the cost of water supply to the agricultural sector?

Recreation on and around surface water storages can also impact water quality. Seqwater needs to balance recreation needs with maintaining raw water quality that is treatable by specific water treatment plant technology to safe drinking water standards.

Seqwater will need to be involved in integrated planning at a state and local government level to achieve an efficient allocation of resources for best community outcomes, including water security.

Table 2-5 outlines the actions Seqwater will take over the next five years to address the competition of resources.

Table 2-4 Planned response to people and place influences

Objective	Key actions for next 5 years
Understand how a changing society will affect the water security objectives for South East Queensland, delivery requirements for drinking water from different sources, and how Seqwater engages the community on the Water Security Program.	Continue to engage the community to inform and shape water security for the region
	Conduct research and collaborate on research projects to better understand how the public value drinking water and perceive water quality risks
	Participate in case studies of water sensitive developments (e.g. Aura development at Caloundra South) to determine the impact of water sensitive and climate adaptive development principles on demand and liveability

Table 2-5 Planned response to resource competition influences

Objective	Key actions for next 5 years
Maintain a balance of the competing needs for water resources in the region, supporting growth while ensuring water security	Work with Queensland Government departments to identify a process for securing sites to maintain flexibility to adapt to changing water security needs of the region
	Complete the current quantitative assessments of the impacts of water-based recreation and grazing on water quality and use this information to apply policy decisions
	Engage with the electricity sector to understand the future electricity sources and how this may impact on demand

2.5 Environment

Source water catchments are critical because the majority of the bulk water supply is sourced from surface water run-off captured in dams and weirs. The condition of our catchments significantly impacts the quality of source water and the costs of water treatment. A substantial decline in catchment health would have a sizeable impact on supply and demand options identified in this Program and on the region's economy.

Approximately 70% of all South East Queensland land is drinking water catchment but Seqwater only owns 4% of that catchment land (Table 2-6).

Table 2-6 Water supply catchments in South East Queensland

Water supply catchments in South East Queensland	
Land	Area (hectares)
South East Queensland region	2,280,000
Storage catchment area	1,750,000
Seqwater landholdings	73,500 (19,000 under water)

To add to this challenge, we manage predominantly open catchments, where people live and where agricultural production and processing, recreation and resource extraction take place. Most catchments, including those of our largest water supply storage dams, Wivenhoe and Somerset, receive run-off from intensively used land.

Catchments are the first step in the multiple-barrier approach to water treatment. The role of natural vegetation in filtering run-off enhances that first step, and has led to it being described as 'green infrastructure'. Catchment land use clearly influences raw water quality. Current catchment conditions are in need of repair to improve raw water quality. If development and land degradation increase over time there is potential for an incremental decline in raw water quality.

If unchecked, this will require upgrades to existing water treatment plants so they can produce the same or greater volume of drinking water. Ongoing research and data collection on the impacts of land degradation on water quality and success of rehabilitation projects implemented will inform catchment management decisions.

Catchment land use and the stability of creek and riverbanks in particular, influence the transport of sediment and associated nutrient loads into surface water storages. Silting of dams and weirs can reduce storage volumes over time and impact water quality, thus reducing the yield of the system. A better understanding of both gradual and event-based siltation trends, forms part of Seqwater's long-term adaptive planning.

In the past the most common response to catchment management challenges has been to increase investment in built infrastructure such as dams and water treatment plants.

However, there is an increasing global trend toward green infrastructure solutions that can protect source water quality and support the performance of built infrastructure assets as part of an integrated system to cost-effectively deliver a secure regional water supply.

The natural environment is also an important consideration in evaluating new water supply infrastructure. All infrastructure options have potential environmental impacts that require mitigating, managing, or at worst, offsetting. Seqwater will work to research, assess and manage environmental influences, taking a whole-of-water-cycle approach and partnering with government and other organisations to improve catchment health.

Table 2-7 provides an overview of actions Seqwater will take to improve our knowledge of the environment and its interaction with water security, and how we can best manage this interaction.

Table 2-7 Planned response to environment influences

Objective	Key actions for next 5 years
Ensure Seqwater understands the impacts of potential changes in our environment when considering water security and future water supply options and scenarios	Continue research to model future changes in catchment land use under various scenarios to better understand impacts on catchment-based water supplies
	Develop the quantitative risk assessment tools used for impact assessment over the past two years to aid the ongoing identification, quantification and management of risks to drinking water quality from all potential sources
	Continue research to investigate and quantify how investment in catchments can improve drinking water quality outcomes
	To better understand potential risks to water security continue modelling how water quality in our storages may be affected by catchment degradation and a changing climate over the long term and use the outcomes to inform long-term catchment planning
	Examine the paleoclimate record to determine whether our current projections of rainfall and catchment yield are based on data that is representative of the climate extremes that could occur in the future

2.6 Economy

Water security has historically been a major driver of economic growth in our region. The existence of a safe, affordable and reliable water supply is a recognised global competitive advantage in attracting and retaining business in the region.

According to the Department of State Development Infrastructure and Planning, South East Queensland has a real gross regional product estimated at more than $170 billion annually which is just under two-thirds of the total for Queensland. The largest contributions came from manufacturing (9.0% of gross value added), financial and insurance services (8.9%), construction (8.4%) and professional, scientific and technical services (8.1%). The region is a major transport and export hub and one of Australia's most popular tourist destinations. The region is a key agricultural production area in Australia servicing a large local and export market. The 3000 square kilometres of alluvial soils of the Lockyer Valley are recognised as some of the most fertile in the world and produce around 35% of Queensland's vegetable supply valued at more than $160 million annually. Grazing is the major land use in the region supporting a large cattle-based industry.

The vibrant regional economy is dependent on the secure provision of water. Changing patterns of economic production and consumption and external negative or positive influences in terms of changing business conditions will have far reaching impacts on the water economy of the region. Population growth – both regionally and globally – will drive economic growth in the major employment sectors of the region over the longer term, provided the competitive foundations of the regional economy such as a safe, secure and affordable water supply are preserved.

Attraction of water-intensive industries can change the supply and demand projections outlined in this program. A change in the balance of trade and value of the Australian dollar may increase demand for products grown or manufactured in the region. Intensification of industry and agriculture in water supply catchments can potentially impact water quantity and quality and the cost of treatment. A fall in the value of the Australian dollar will increase the attractiveness of the region for tourism from both domestic and international markets, further increasing demands on the water supply system.

Growth in the tourism and recreation sectors can influence bulk water supply in several ways. Long-term growth in tourism and peak tourist seasons impacts overall annual demand, and the capability of water treatment plants to handle increasing seasonal peak loads for drinking water supply.

Climate change may also impact the economy and the regional water balance. Climate shocks such as droughts, bushfires and floods may increase the cost of lending and reduce the capacity of financial institutions to lend the capital required to construct new bulk water sources.

Water pricing can also influence the regional economy. An overly high price may deter industrial and commercial investment, while a price set too low will affect the ability to pay for the infrastructure required to support future economic growth.

Management of water infrastructure to maintain water quality and environmental health are also critical to the economy of the region. Many large manufacturing industries require water within defined quality parameters for production process and significant variations in product quality will decrease the attractiveness of South East Queensland as an industrial production area and therefore reduce demand. Maintaining water of a consistent quality and considering treatment investment requirements can also contribute to the economy of the region.

A significant economic downturn could also impact water security. Extensive regional unemployment could impact on the ability of consumers to pay for water. A decrease in regional agricultural productivity or the implementation of a water-trading regime could change the fundamental economic and planning assumptions underlying this Program. Other external economic influences such as a large increase in energy prices or the implementation of a carbon price can impact on the cost, and therefore selection, of supply and demand options.

Economic influences, particularly changes to pricing regulation in the shorter term, can have long-lasting impacts on water security. Seqwater's plan to address economic influences in the short term are outlined in Table 2-8 below.

Table 2-8 Planned response to economic influences

Objective	Key actions for next 5 years
Prepare for potential transformational changes in local and national economies	Review information gaps and legislative opportunities to collaborate with local government and water service providers to develop common objectives in investing in a future based on total economic value for the region
	Further investigate the economic impacts of supply, demand and system operation options
	Monitor trends in the local and global economy that may influence water security in the region

2.7 Technology

Rapid technological development can be expected over the planning horizon of this Water Security Program. Advances in a broad variety of technologies will drive a number of opportunities and risks for the region's water supply. Advances in environmental monitoring and modelling technologies will more easily quantify gains from enhanced catchment management. New environmental knowledge and restoration technologies and techniques will help maintain the quality of raw water, underpinning the cost effectiveness of our water supply.

Advances in technology along with improved cost effectiveness have the potential to increase the viability of some water supply options. For example advances in filtration, nanotechnology, membrane chemistry and bio mimicry may increase the viability of purified recycled water and seawater desalination.

Smart monitoring, increasing automation of control systems and real-time data monitoring of bulk water supply system performance can improve efficiency and reduce ongoing costs. At the consumer end, water-efficient technologies in homes and businesses can change the demand profile over time. The internet of things, greater sophistication and accessibility of instantaneous communication and big data, will enable households and suppliers to better understand water use and influence ongoing behaviour.

Seqwater and the water service providers could also use these technologies to engage the community and involve them in decision making and planning, particularly in relation to their own water use in real time. Additionally, increased sophistication and reliability of weather forecasting will assist operational planning and communication with customers. Technological advances in other areas such as irrigation and manufacturing may increase the availability of water for urban development.

Technological criteria were important in assessing the various supply and demand options for the Water Security Program. These included:

- overall impacts of technology on cost of developing and maintaining infrastructure
  - the ability of new technology to be integrated into an option
  - the potential for an option to be adaptable to changing standards
- influence of renewable energy on the design, size and costs (capital and operating) of water infrastructure, particularly the energy-intensive sources
- the role of water-efficient devices in reducing demand
- how technological advances can enhance understanding of existing assets, how they are currently used, and how they may be better used to improve efficiency and extend asset life
- the impact of technology on the reliability of water supply assets
- how technology can improve dam safety and potentially reduce the costs of dam upgrades
- the potential for increases in cyber security risk.

Seqwater's approach to monitoring and responding to technological change are outlined in Table 2-9.

Table 2-9 Planned response to technology influences

Objective	Key actions for next 5 years
Understand the potential benefits and impacts of technological change on the provision of water security for the region	Developing better water quality monitoring and analytical methodologies to inform risk assessment and reduce costs associated with different water supply options
	Developing models and decision support tools that utilise the latest technology to guide investment planning
	Seqwater will continue to participate in quarterly technology reviews with its peers in the water industry through WSAA and to participate in technology trials with water service provider partners. The following areas of technology implementation has been highlighted for the next two years: • utilising the latest technological innovations to accurately quantify reservoir storage capacity and understand the factors that reduce capacity • investigate and trial advances in water treatment technology for all types of water sources
	Using advanced measuring and modelling techniques to accurately measure and predict asset condition
	Continue to work with water service providers to understand the role and benefits of smart metering, monitor consumption trends, incorporate results in future planning and consider how best to use the technology to increase the community's water efficiency awareness

03 Demand

03 Demand

The Water Security Program aims to optimise system performance. Demand is one of the three interdependent levers that can be used to influence system performance (Figure 3-1). Demand consists of two distinct elements – demand forecasting and demand management.

- Demand forecasting is the process of understanding historical and current demands, possible population growth and influences on demand and modelling a potential future demand scenario. This scenario is then used to understand when changes to system operation may need to be made and when new or upgraded water supply infrastructure may be required. The demand forecast provides a per person demand and a total demand (Section 3.4.2).
- Demand management is the action of actively managing demand to maintain a level of demand including reducing demand in times of drought and managing peak demands. In future it may be possible to defer investment in infrastructure through demand management. The benefits of demand management were demonstrated during the Millennium Drought by providing significant demand reductions.

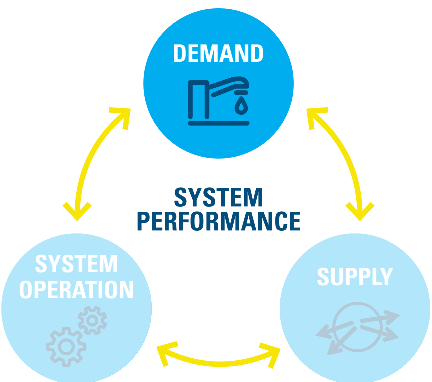


Figure 3-1 System performance – demand

Seqwater works closely with the region's water service providers to understand and forecast demand and develop and implement demand management programs.

One of the primary drivers of demand is the population to which water is supplied, including both the number of people and how they use and value water.

Seqwater's bulk water supply system supplies water to around 95% of the SEQ population, through the water grid and through off-grid community water supply schemes. By 2046, the South East Queensland population connected to the bulk water supply system is forecast to grow to about 5.1 million. Approximately 5% of the community will continue to rely on their own sources of supply outside of the bulk water supply system, e.g. rainwater tanks, farm dams and groundwater bores.

The South East Queensland community has remained water efficient since the Millennium Drought. This efficiency has contributed to delaying the need for future water supply infrastructure. While the population will grow over time, increasing total demand, it is unlikely that demand per person will return to pre-Millennium Drought demands of over 300 L/p/d.

While agricultural and horticultural users typically draw raw water from the same surface water supply sources and are also customers of Seqwater, their water consumption is governed by specific legislated water-sharing rules developed by the Department of Natural Resources and Mines. Irrigators receive an Announced Allocation each July, which specifies the percentage of their allocation they are entitled to use.

It is dependent on the dam levels and typically results in earlier and more severe reductions for irrigation, compared to urban water which is prioritised over irrigation.

This chapter outlines demand trends, current demand, future demand forecasts and demand management options for urban water supply.

3.1 Demand trends

Demand can be influenced by many factors. The Millennium Drought made lasting changes to the way people use water and our region is setting new demand trends based on their water efficient behaviours and devices. When considering demand trends, it is important to consider per person demand and total demand (a combination of per person demand and population), along with an understanding of potential peak demands on the system.

DEMAND PER PERSON PER DAY

Post Millennium Drought there has been a significant reduction in the per person demand due in part to the demand management activities during the drought. There was an increase in per person demand after the severe Millennium Drought water restrictions were lifted but demand did not return to previous levels. In recent times the per person demand has not changed significantly, with changes generally aligned with changes in climatic conditions.

TOTAL DEMAND

Queensland is currently experiencing slower population growth than what was projected due to reduced migration from both overseas and interstate. Queensland's population grew at only 1.3 per cent in 2015, lower than the national growth rate of 1.4 per cent (Australian Bureau of Statistics, 2015), lowering the total demand growth for that period. In the medium to long term, Queensland's population growth is expected to grow broadly in line with expected national growth, again increasing the total demand projected.

PEAK DEMAND

Within a water supply system, there are typically cyclical variations in demand throughout the day and throughout the seasons of the year. These cyclical variations are generally in response to the water-consuming activities of people's normal daily routine – operating hours of commercial and industrial users and climatic variations with the seasons. Sustained hot, dry weather can also cause less frequent, but persistent peaks in demand.

South East Queensland's bulk water supply system is planned to treat and transport water during sustained high demand, such as high summer demands. The planning criteria (refer Appendix B) includes the requirement to continuously treat and transport the highest 30 day average daily water demand during a year (referred to as MDMM which stands for Mean Day of the Maximum Month). MDMM demand is normally expressed as a 'peaking factor', or ratio of the peak demand to the average demand over a given year. The peaking factors are determined from analysis of the region's historical water consumption data.

INFLUENCES ON DEMAND

In addition to the slowing population growth, a range of factors influence demand and need to be monitored regularly by Seqwater and the water service providers. Demand can be influenced by:

- population size, location and demographic
- changes in housing density and type
- changes to how people use and value water
- climatic conditions
- energy consumption – amount of energy and the type of energy
- economic growth
- liveability outcomes
- changes in regulation to water efficiency device requirements
- new water efficient technology which may reduce demand
- technological advances in how we monitor water use and manage use of appliances
- new devices that may use more water.

Further detail on influences can be found in Chapter 2 – Influences.

Given sustained residential water efficiency, the future total volume of water consumed within South East Queensland is likely to be driven by population growth (i.e. total demand), rather than the per person demand. This is assuming there is no significant change in community water conservation attitudes, regulation, water efficient devices or other influences.

DEMAND MANAGEMENT TRENDS

Post-Millennium Drought the intensity of demand management has reduced in terms of community messaging. Water efficiency information is generally available on water service provider websites and on consumer water accounts. Water efficient taps, showers and toilets continue to be installed in new homes and the non-residential sector continues to maintain and where possible improve water efficiency. Seqwater and the water service providers also continue to find efficiencies through pressure and leakage and other operational programs. There are also a range of new water efficient technologies being developed and tested. Where effective, these technologies could provide new demand management options.

MONITORING TRENDS

To assist with monitoring demand trends and improved demand forecasts, Seqwater and the water service providers have collaborated to implement a Demand Forecasting Validation Project using smart metering technology. This project is in its early stages and there is not yet enough data to provide meaningful results.

The outcomes of the project will be explored in future Water Security Programs. As technologies and systems advance, so too will our knowledge of demand and how demand can be met and managed under a range of conditions, in addition to how we use technology can be used to improve the community's water literacy.

DEMAND FORECASTING INPUT VALIDATION PROJECT USING SMART METERING TECHNOLOGY

Since January 2014, 190 smart meters have been installed on households across the region. Seqwater distributed data loggers to the water service providers to attach to existing residential water meters. Water consumption is being monitored and analysed to provide an understanding of the variation and patterns of water use in South East Queensland residential properties. This information will be used to underpin demand forecasting models on a local and regional scale.

The project aims to:

- determine end-use based demand forecasting inputs and develop a better understanding and monitoring of residential-use behaviour patterns and their changes over socio-demographic, weather and climatic conditions
- determine demand growth (volume and timing)
- enable water service providers to better understand peaking at the household level
- enable water service providers to examine non-revenue water from meter losses and inform residential water meter replacement programs
- demonstrate potential household benefits from smart metering, i.e. water leak detection capability.

The project builds on the South East Queensland Residential End Use Study commissioned in 2010 to gain a greater understanding of end-use consumption. It will provide data to validate the demand forecast inputs and trial smart metering in the region. Seqwater and the water service providers can now consider the impact of climatic conditions, socio-economics, water efficient devices and lot size in a way not previously possible.

3.2 Current demand

South East Queensland continues to maintain a water demand that reflects efficient water usage, helping to delay the need for future water supply infrastructure. The demand per person remains low, and the total demand has reduced compared to the previous forecast due to a change in population projection.

In 2014-15, the total water supplied by Seqwater for consumption by households, industry and businesses was 289,639 ML. This demand serviced 1,099,009 water connections in the region. Of this total, 1,044,518 were residential connections. The balance was held by industry, businesses and government (non-residential users).

Demand is apportioned to different types of use based on land-use type. Residential consumption accounts for the largest portion of urban water use in South East Queensland. Approximately 74% of all water consumed in the region is for residential use (Figure 3-2), with single residential dwellings (i.e. houses) representing the dominant (72%) household type (Figure 3-3).

The average residential consumption for South East Queensland is 169 L/p/d (1 July 2015). Research has shown that average internal water consumption is within the range of 120 to 150 L/p/day, which indicates a relatively low level of external water use (Urban Water Research Alliance, 2011). Actual external water use varies depending on sub-regional differences, such as residential lot size, rainfall and soil type.

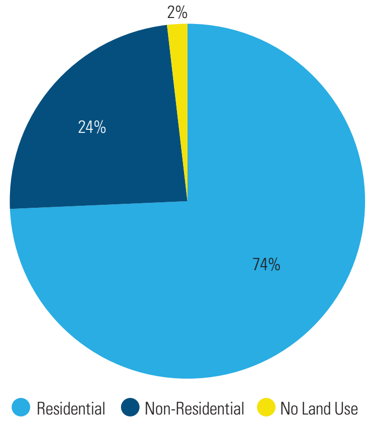
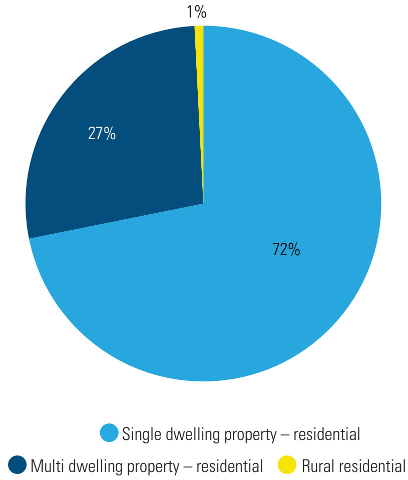


Figure 3-2 Breakdown of overall water consumption



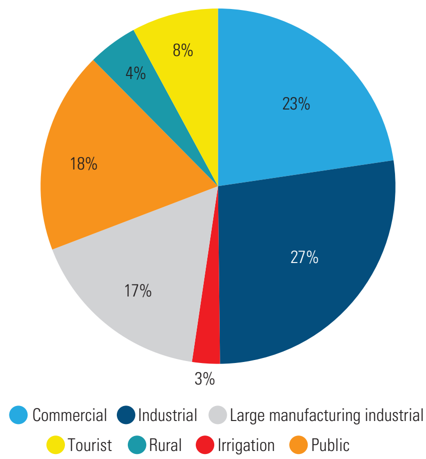


Figure 3-3 Breakdown of residential and non-residential consumption

3.3 Future water demand

Forecasting demand is critical to planning future water supply. It involves a number of assumptions and a robust methodology, including continuous assessment and review. This section describes key aspects of the methodology and the demand forecast adopted for the Water Security Program and the modelled demand forecasts used. Figure 3-4 provides an overview of the demand forecast review process. More detail about the demand forecast is provided in Appendix E.

3.3.1 DEMAND FORECASTING METHODOLOGY

Key aspects of the demand forecasting methodology are:

- reviewing each of the demand influences to build up the demand profile
- considering the principal influences of demand and assuming the level of efficiency achieved by ongoing demand management will continue
- constructing the demand forecast through main input factors, such as forecast residential and non-residential per capita usage, population growth and potential consumption growth driven by changes to water use behaviours
- employing robust historical demand analysis to determine cyclical usage patterns to forecast monthly demand
- forecasting demand at the local government area (LGA) level using specific input factors (population growth and per capita consumption), this provides separate demand profiles for each LGA which are totalled to provide a consolidated SEQ demand profile
- taking a consistent and structured approach to distribution of the LGA-based demand forecasts to a level of granularity that allows planning at the individual water treatment plant level
- assessing sub-regional demand to develop appropriate monthly operational peaking factors to inform operational system modelling
- seeking agreement and validation of the demand forecast by the SEQ water service providers – if there is disagreement on the demand forecast the process to reach consensus will be determined through the water service providers Joint Working Group
- practising quality control measures and quality assurance to achieve robust demand forecasts.

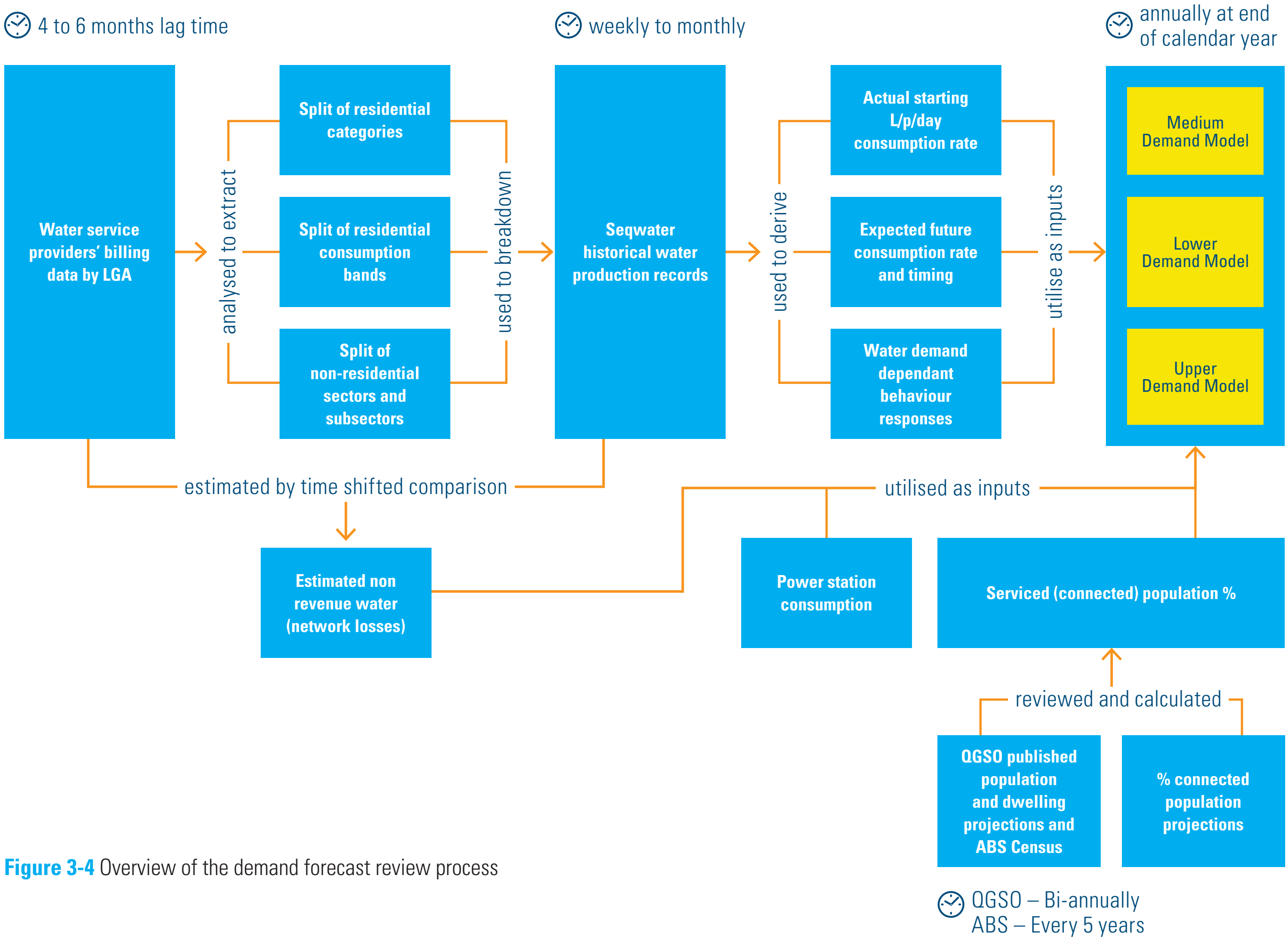


Figure 3-4 Overview of the demand forecast review process

Adopting the methodology outlined below, Seqwater has developed three urban water demand forecasts – low, medium and high – which combine per-capita consumption with projected population growth.

The medium demand forecast is used for the planning assessments undertaken to develop this Water Security Program. Low and high demand forecasts are used for scenario analysis to assist planning for a range of possible changes to demand. These forecasts will continue to be assessed in future versions of the Water Security Program.

3.3.2 DEMAND FORECASTS (LOW, MEDIUM, AND HIGH)

Demand forecasts are developed by combining the forecast per person demand with the forecast population growth.

The average per capita usage is forecast to increase over the medium term from 169 L/p/day to 185 L/p/day for the residential sector (refer Figure 3-5). The projected average future per capita usage of 185 L/p/day builds on observed water usage.

The average per capita usage is predicted to stabilise by the end of 2019–20. This usage is predicated on studies undertaken post-Millennium Drought which indicated that behavioural change after the implementation of drought demand management measures may continue for five years or longer.

The forecast population growth is now lower than previously planned. This has resulted in a revised demand forecast. Figure 3-6 shows the low, medium and high population growth projections.

Previous planning showed a larger predicted population growth than has been realised. Following discussions with the Queensland Government, the demand forecast for the short term has adopted a lower population growth. In the medium to long term, the population growth follows the government's forecast medium population growth.

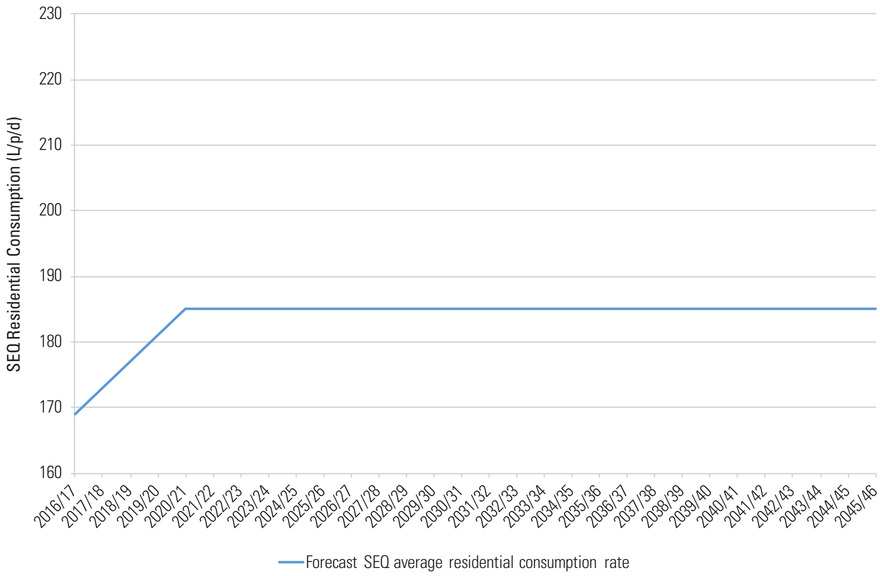


Figure 3-5 Per capita consumption for the next 30 years

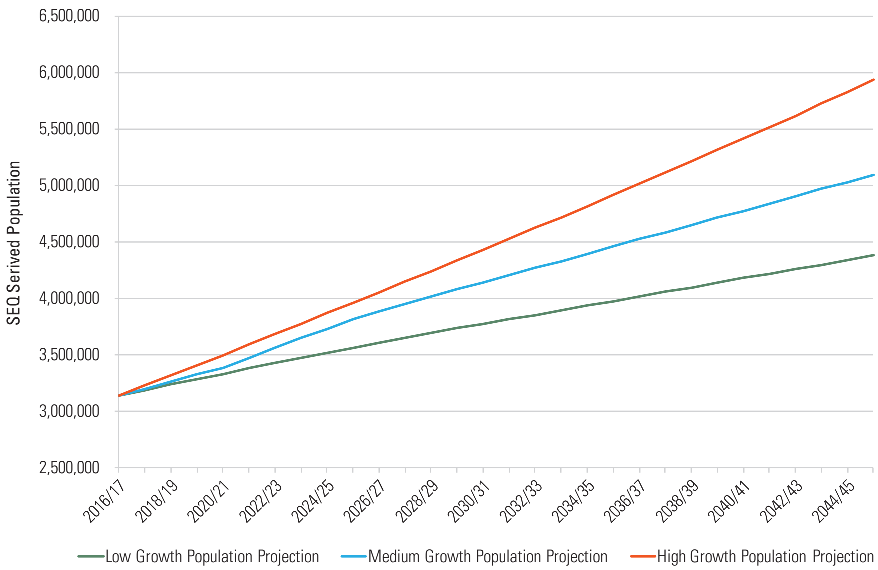


Figure 3-6 Low, medium and high growth population projections

Figure 3-7 shows the low, medium, and high demand forecasts for South East Queensland, expressed as water consumption in megalitres (ML) per annum. One megalitre is equal to one million litres of water.

By 2046 the forecast medium total bulk water demand for the region is 525,349 ML. This is the figure used for planning to achieve LOS objectives until 2046. This figure is 221,322 ML higher than the 2015–16 demand, representing an increase of 74% over 30 years. This increase is a result of increases to per capita usage and population growth.

The slow demand growth observed over the past 18 months suggests it is unlikely that demand will stabilise until the end of the decade.

The forecast for the non-residential sector (inclusive of power station demand and accounting for system losses) is forecast to stabilise at 100 L/p/day by the end of 2019–20.

Growth in demand has slowed over the 18 months between 2014–15 and first half of 2015–16, mainly because of lower than expected population growth (including lower than expected overseas and interstate migration rates) coupled with higher rainfall total in 2014–15. The long term historical water demand growth trend shown in Figure 3-8, in contrast to the 18 months short term downward trend, suggests that further observation will be needed before adopting the current consumption level as the future consumption rate. However, the possible continuation of lower than expected consumption growth and the lower population growth rate have been incorporated into the development of the medium demand projection.

Slowed demand growth over the past 18 months appears to be a temporary reduction.

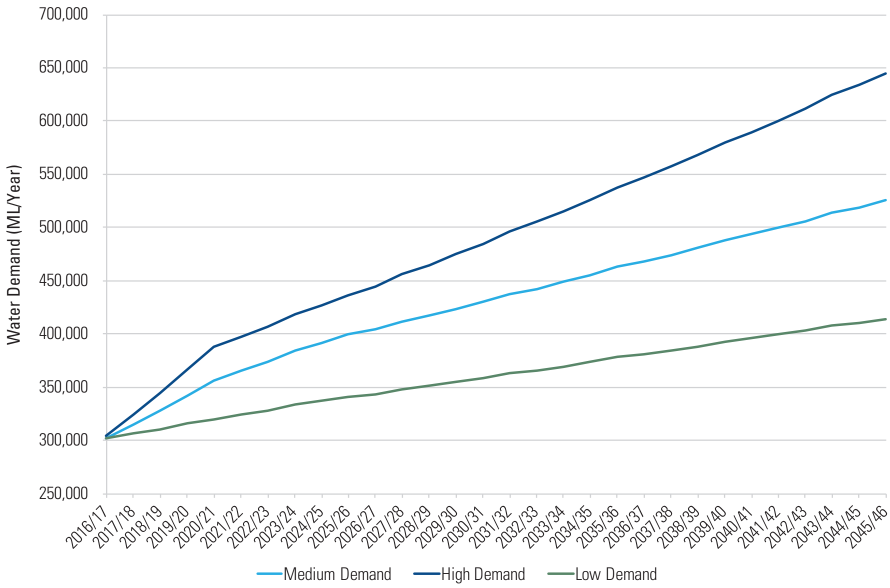


Figure 3-7 Low, medium and high planning demand forecast profiles

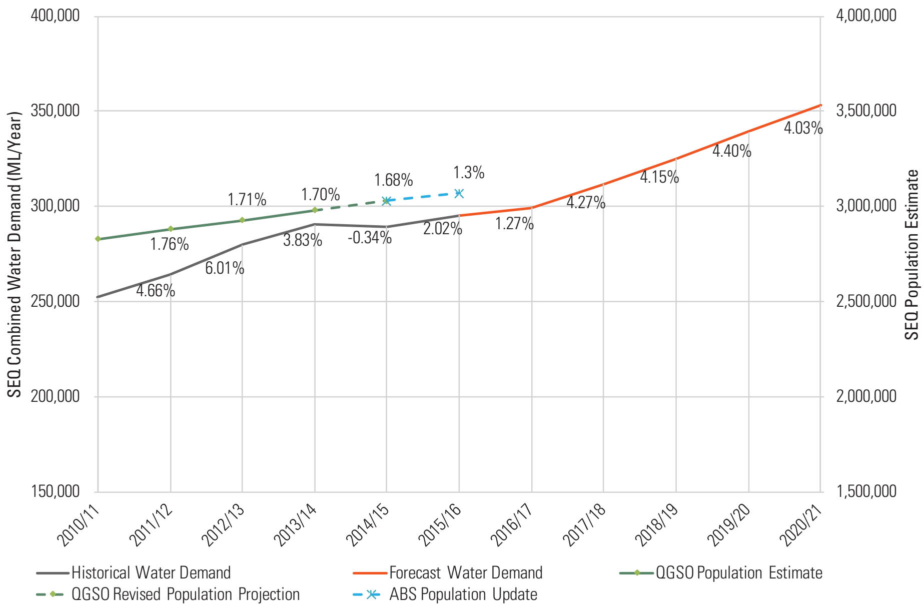


Figure 3-8 South East Queensland historical and forecast population and demand trends

3.3.2.1 Forecast peak demands

To plan water treatment and transport capacity requirements, MDMM demand is forecast by applying sub-regional MDMM peaking factors to the forecast average annual demand. The forecast MDMM demand corresponding to the low, medium and high demand forecasts are shown in Figure 3-9.

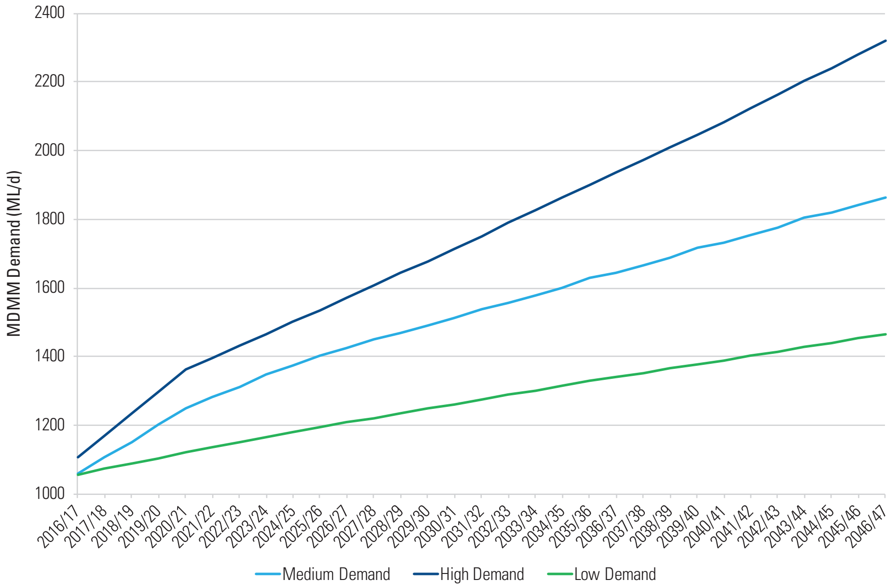


Figure 3-9 Mean Day Max Month (MDMM) forecast demands

Seqwater will continue to work with the South East Queensland water service providers to improve demand forecast inputs and develop systems make the demand forecast increasingly robust.

3.3.3 ESSENTIAL MINIMUM DEMAND

A severe drought is unlikely however Seqwater must be prepared for such situations.

In times of extremely severe drought (for example when KBWS levels fall below 5%, refer to Chapter 6 – Planning for resilience for detail), the LOS requires that, as a minimum, Seqwater can continue to supply water to meet essential needs. The volume of water supplied at this KBWS level is called essential minimum supply volume (EMSV) and is the volume required to meet the essential minimum demand, notably basic domestic needs and water needs for essential services such as power generation, health and safety needs.

The demand to meet essential needs (the essential minimum demand) is considered to be an average of 100 L/p/day for residential and non-residential customers combined. As the population grows, so too does the essential minimum demand, noting the medium population projections are used to calculate the essential minimum demand. Appendix I details how the total essential minimum demand was determined.

3.4 Demand management

The demand lever is different to supply and system operation levers due to its reliance on community participation and the partnership of South East Queensland water service providers. Within the demand lever there are a range of demand management options which can span non-structural options such as changes to regulation or operational activities (e.g. pressure and leakage management), to small-scale infrastructure options (e.g. water efficient devices). Demand management is the proactive and adaptable management of end-use water consumption. With the support of the community, demand management can have many benefits including:

- providing customers with a greater understanding of their water use and the ability to make informed choices about how they use water
- extending the period before drought response triggers are reached
- reducing peak demands therefore delaying operational and infrastructure investment costs
- reducing water business operational costs, such as electricity pumping costs and pump maintenance
- delaying the need to invest in new bulk water supply infrastructure.

Demand management can also have costs including social impacts from loss of garden amenity, cost of purchase and installation of devices and cost of program implementation. Seqwater will work with the water service providers to gain a better understanding of these costs, including consulting with the community. Demand management may also require changes in everyday behaviours.

As detailed earlier in this chapter, demand is not likely to return to pre-Millennium Drought demands due to demand management programs including installation of water-efficient devices, entrenched behavioural change, water price increases and changes to housing stock (e.g. smaller lot sizes and the increased number of units versus detached house development).

your **say**

"It changes behaviour in the long term. You become conscious of the value of water."

Demand management programs are developed and implemented by Seqwater and the water service providers, local, state and federal governments (i.e. regulatory requirements and programs), community groups, schools, businesses and industry associations. Table 3-1 lists current water demand management activities in our region.

your **say**

"Whenever you get a rebate on something the price shoots up."

3.5 Demand management options

3.5.1 DEVELOPING THE OPTIONS

Seqwater collaborated with the water service providers to develop and assess the demand management options. The process was robust and builds upon earlier planning work. Previously planning had only considered the cost of implementation. This has now been expanded to consider options within a framework of wider economic impact which includes costs and benefits to society. The full details of the assessment process are provided in Appendix F.

Demand management is described in three different categories.

- Business as usual – demand management that occurs at all times, even when water storage levels are high. Seqwater and the South East Queensland water service providers recognise the importance of an affordable water supply. We focus on improving our efficiency and effectiveness in the first instance to make water as affordable as possible for the community. Business as usual demand management activities improve the efficiency of water supply and therefore the cost. They also help maintain water efficient behaviours in the community. These demand management activities are generally already in place and have been implemented because they improve efficiency, or are required by regulation. Examples of business as usual demand management activities include water efficiency education and operational activities such as pressure and leakage management.
- Drought – demand management options implemented during drought, requiring larger community involvement and water restrictions or other regulated requirements on water efficiency. Voluntary water efficiency such as rebates may also be included. Examples of drought demand management options include drought communication, rebate and retrofit programs and water restrictions.
- Permanent demand management options to defer new infrastructure – demand management options such as rebates which reduce demand with the intention of delaying the need for new infrastructure. Examples of options in this category include regional rebate and retrofit programs. The Southern Californian case study details benefits of their demand management measures to defer infrastructure.

Table 3-1 Overview of the current key demand management activities in South East Queensland

Organisation	Demand management activity
Seqwater	• Collaboration with the South East Queensland water service providers to develop and implement demand management options, particularly during drought • School and community education programs (including stakeholder engagement) • System loss programs
South East Queensland water service providers	• Information and community education about indoor and outdoor water efficiency • Pressure and leakage management • Metering and billing • Water carter facilities such as fixed fill stations and metered hydrant standpipes to account for water use
Local government	Water conservation education and water efficiency in Council buildings, facilities and operations
Queensland Government	Legislative requirements such as: • water efficient taps and showers – requirement in all new residential buildings • water efficient toilets in all new buildings
Australian Government	• Water Efficiency Labelling and Standards (WELS) Scheme (Australian Government, 2015) – requiring certain products to be registered and labelled with their water efficiency in accordance with the standard set under the national *Water Efficiency Labelling and Standards Act 2005*

THE SUCCESSFUL IMPLEMENTATION OF DEMAND MANAGEMENT TO DEFER INFRASTRUCTURE IN SOUTHERN CALIFORNIA

The Metropolitan Water District of Southern California (Metropolitan) delivers water to 19 million people in 26 cities and municipal water districts, including Los Angeles and San Diego. With California's climate variability from inundation to drought, including two severe droughts in the last 10 years, it was critical for Metropolitan to establish a long term, comprehensive and adaptive water resources strategy for a reliable and affordable water supply.

Demand management has been used to reduce the water supply capital improvement, operating and maintenance costs. Demand management and local water supplies have successfully contributed to the deferral of additional infrastructure for an estimated 4–25 years including the Central Pool Augmentation Project and the San Diego Pipeline No. 6. This has resulted in estimated savings of $300 and $900 million.

Demand management included financial rebates and incentives for customers, and changes to plumbing codes and regulations. Some examples include:

- Conservation credits program – a regional program providing financial incentives and rebates to residential and commercial customers for installing water saving fixtures.
- Turf removal program – financial incentives to replace turf with 'California friendly' landscapes.
- Code-based conservation – legislation of water efficiency requirements (e.g. water efficient toilets).
- Price effect conservation – encouraging water use reductions through tiered pricing.
- Water-use efficiency strategy – a state wide reduction in demand of 20% per capita by 2020.

Seqwater plans to work collaboratively with the water service providers to further develop and implement demand management programs and move towards the development of an adaptive demand management strategy inclusive of community feedback.

3.5.2 ASSESSING THE OPTIONS

Options were assessed based on their ability to reduce demand, their economic impact, impact on people and place, their resilience, and environmental performance.

In assessing the options, the following assumptions are made.

- More efficient technology will continue to be used and installed after the completion of a rebate or retrofit program because the market adapts to the new water efficient devices. This results in ongoing and improved savings. Following the Millennium Drought, water efficient washing machines became the standard when replacing an older machine.
- Government standards or regulation may change to require installation of efficient technology for new or renovated buildings, just as water efficient shower heads were regulated for new residential properties during the Millennium Drought.
- Once the rebate or retrofit program has been implemented, per person usage will be reduced and the savings will be retained.

Demand management options were assessed using the water considerations outlined in Appendix C. All demand management options shortlisted through the gated assessment process performed positively against the categories of economics, people and place, environment and resilience.

- All options have an implementation cost and a societal economic impact. Generally the voluntary options have a smaller economic impact on communities.
- All options have the ability to reduce demand (or in the case of the business as usual options, maintain current demand for an extended period).

  A reduction in demand results in a decrease in energy use from water treatment and distribution. In addition, there will be a reduction in energy use from customer water heating. Outdoor water efficient devices will reduce runoff and erosion due to more efficient garden watering.
- The options are resilient as they are adaptable to technology and can commence and cease relatively quickly. However, they do rely on implementation, often voluntarily, by individuals on their properties.
- The community are generally accepting of demand management as demonstrated during the Millennium Drought. Community engagement undertaken during 2015 and 2016 indicated the community's ongoing support for demand management and water efficiency.

3.5.2.1 Business as usual demand management options

Seqwater and the South East Queensland water service providers have invested in improving the efficiency of the water supply system, minimising system losses to improve affordability for customers.

Business efficiency programs, such as pressure and leakage management programs are already in place and will be ongoing. No further assessment of these options is required unless a review triggers a change in approach. At that time, a business assessment would be undertaken to determine effectiveness of options.

3.5.2.2 Drought demand management options

There were many drought demand management options considered. For comparative purposes, all drought demand management options were reviewed and considered in relation to the categories of economics, people and place, environment and resilience.

A stepped approach has been developed for the management of demand in response to drought. It was developed by analysing the comparative economic impact of demand management options (i.e. costs and benefits to the community).

This approach allows the community to participate in the drought response journey. Having an understanding of the changes in drought severity at each step and the actions required will allow the community to play a real part in reducing the long term impact of drought.

Drought demand management options were characterised against the considerations outlined in Appendix C.

- Available yield – for demand options this relates to how much demand is reduced, therefore reducing the need for additional supply.
- Economic – communication options (including water efficiency education) were more favourable than water restriction options as they are voluntary, with a reduced economic impact on the community. Implementation costs are also lower.
- Environment – water restrictions have an impact on outdoor water use and therefore water available to water the garden, with potential impacts on urban heating. Water efficient devices can reduce greenhouse gas emissions due to reduced electricity used for water heating.
- Resilience – rebates and retrofits can be adapted to suitable technology available at the time of the program and programs can be ceased within months if required. They are therefore adaptive.
- People and place – during the Millennium Drought water efficiency communication programs were generally accepted by the community. Drought communication provides the community with the ability to voluntarily choose the actions they implement. Regulated water restrictions may be less favourable as the choices are limited and there is a compliance cost. There may also be social costs due to the loss of amenity from reduced irrigation of gardens and public spaces, as illustrated in the Melbourne sporting grounds drought water restrictions case study.

MELBOURNE SPORTING GROUNDS DROUGHT WATER RESTRICTIONS

During the Millennium Drought, Melbourne implemented progressive water restrictions to preserve their water supply. As the drought progressed, restrictions became more severe, with four stages of restrictions ranging from minor reductions in outdoor water use through to completely banning outdoor water use. At the height of the drought, Melbourne introduced Stage 3a water restrictions which lasted for a period of approximately 3 years. During this time, Melbourne aimed to reduce water use on sports grounds by 80%. To achieve this reduction, Stage 3a water restrictions required that only one in four sporting grounds could be watered, or that water use was reduced by more than 75% on watered grounds.

Subsequent studies of the Melbourne restrictions on sporting grounds found that imposing water restrictions on sporting grounds resulted in direct and indirect impacts on the local community. This was due to the high value placed on turf-based sports by the community. Water restrictions reduced the accessible turf-based sporting spaces available in Melbourne, whilst demand for participation increased. The socioeconomic benefits of sport include: health improvement and promotion, cultural values, environmental and physical development, social capital development, building of communities, and economic development. Studies also show participation in sport reduces stress, improves general well-being and helps with mental health conditions. As such, the severe Melbourne water restrictions caused indirect socioeconomic and potential health impacts on the Melbourne community.

In general, restrictions had a direct impact on smaller clubs, new clubs and social sports. Established clubs had capital funding to purchase recycled water to irrigate grounds, but this was not feasible for clubs with less funding. In response to the restrictions, many clubs reduced the duration of sports season, changed the structure of pre-season training, imposed caps on the number of teams and had fewer 'home' games. Water restrictions resulted in many clubs focussing only on competitive high grade football. This resulted in cuts to women's, social and junior teams, creating significant equity issues in terms of participation and access to local sport, which undermined government policies encouraging participation in sport for health, well-being and social engagement.

Due to these negative impacts on the community and the focus of Melbourne on improving liveability, Melbourne is determining new ways to manage droughts without such severe water restrictions on sporting grounds.

During the Millennium Drought South East Queensland also imposed water restrictions on sporting grounds. While these were stringent water restrictions, they were not as severe as those introduced in Melbourne and focussed on efficiently maintaining the active playing area. South East Queensland water restrictions for future droughts will be developed in consultation with the community, will consider lessons learned from previous droughts and other jurisdictions, and will consider the broader impacts on the region.

3.5.2.3 Permanent demand management options to defer future new infrastructure

In assessing the demand management options to defer infrastructure it was found that no one option is currently more effective than the other when comparatively assessed against the criteria within the categories of economics, people and place, environment and resilience. The characteristics of a region-wide retrofit or rebate program against the criteria are as follows:

- Available yield – for demand options this relates to how much demand is reduced, therefore reducing the need for additional supply. For both retro-fit and rebate programs, the resulting reduction in demand will be dependent on the level of uptake of the programs.
- Economic – both rebate and retrofit options result in similar cost implications.
- Environment – water efficient devices can reduce greenhouse gas emissions due to reduced electricity use for water heating, and reduced water supply treatment and distribution.
- Resilience – rebates and retrofits can be adapted to suitable technology available at the time of the program and programs can be ceased within months if required.
- People and place – the community can choose to participate in one or both programs. Both programs have been generally well received by the community in the past.

3.5.3 PARTNERING TO DEVELOP AND IMPLEMENT DEMAND MANAGEMENT

Seqwater continues to work closely with the water service providers to develop demand management options and work towards implementation when required. The water service providers have direct connection to the community through their water and sewerage billing processes and customer service activities. Seqwater, the bulk water supplier, has little direct contact with the community, other than through recreation activities and the water for life community engagement program.

Seqwater is committed through its Strategic Plan 2016–2021 to partnering with customers (including South East Queensland water service providers), community, government and industry. Seqwater works with our industry partners to achieve best whole-of-system solutions and provide industry leadership in our region. Given these commitments and the involvement of the water service providers in developing the demand forecasting and management components of the Water Security Program to date, it is expected that collaboration will continue into the future and most importantly throughout droughts.

3.5.4 NEXT STEPS

Seqwater will continue to collaborate with the water service providers to further develop and assess demand management options and monitor and review the demand forecast. This may include further analysis of demand management options including environmental impacts, costs to the community, water service provider implications and community feedback.

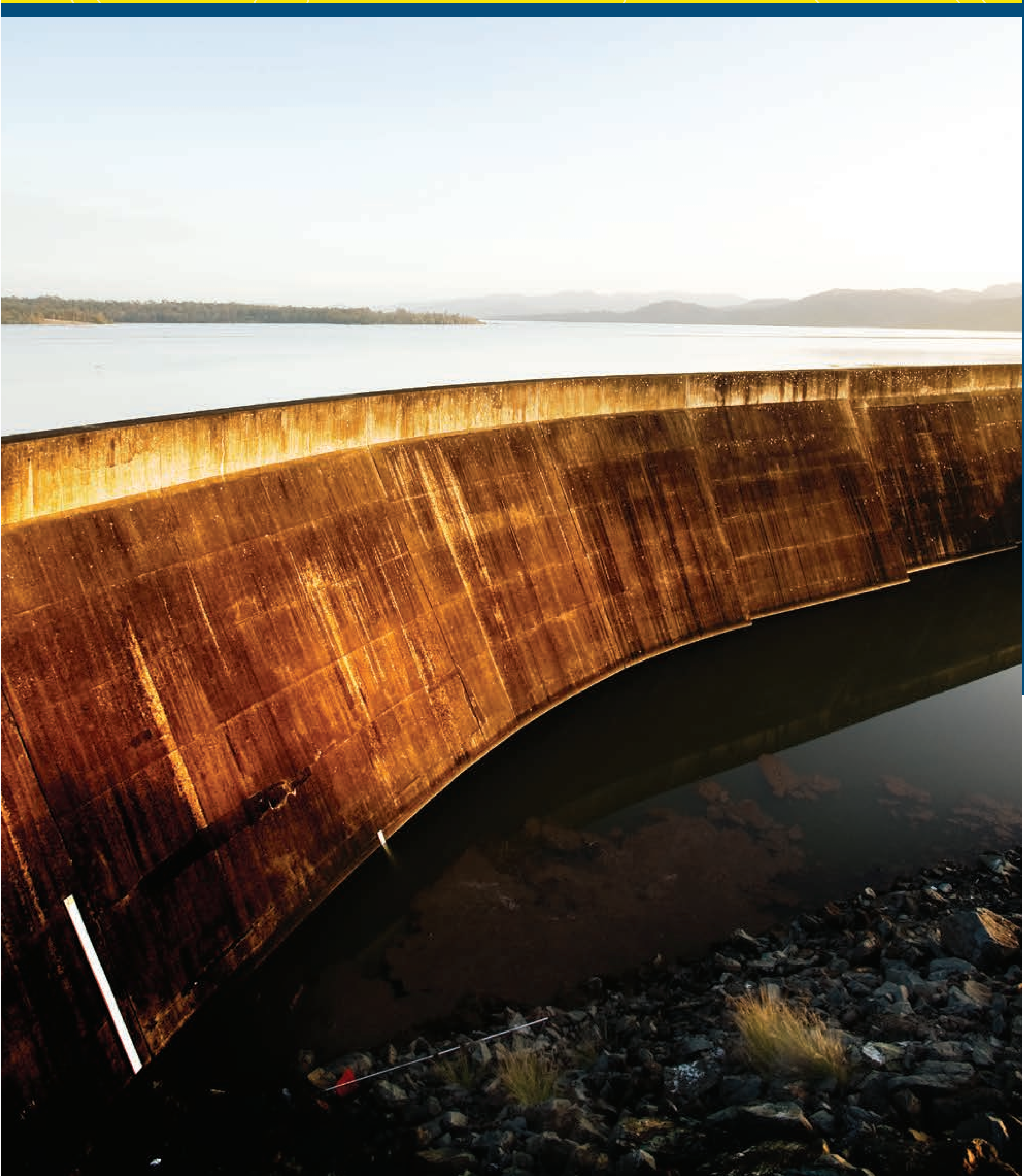
This may include:

- ongoing monitoring of demand and refinement of demand forecasts, including enhancement of the demand forecasting and monitoring methodologies
- continuing development and assessment of demand management options
- coordination with the water service providers to maintain awareness of water demand in the community and ensure consistency of community demand management messaging
- management of all demand categories, including unmetered water use and system losses.

For future versions of the program Seqwater may seek to enhance the way demand is managed by:

- consulting with the community to understand their liveability expectations and how they may influence demand and demand management
- understanding the impact that technology will have on demand and the ways in which technologies can help consumers and Seqwater understand and manage demand.

04 Supply



04 Supply

Supply is one of the three interdependent levers that can be used to influence system performance (Figure 4-1). Seqwater sources, stores, treats and supplies bulk water from a diverse range of supply sources.

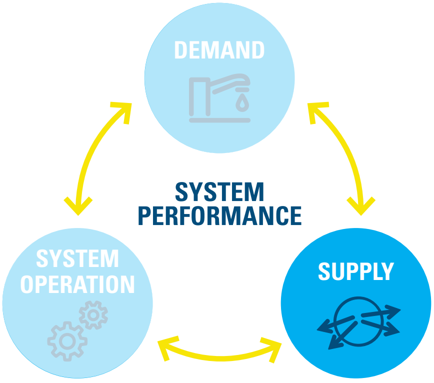


Figure 4-1 System performance – supply

The need for new supply options is driven by the capacity of the existing system to source, treat and supply enough water to meet demand. It is also dependent on how the system is operated to move water to where it is needed.

In preparing this Water Security Program, Seqwater has reviewed the capacity of the existing system, revisited potential future supply options considered in previous planning, and looked in more detail at decentralised scheme options including rainwater or stormwater harvesting, sewer mining and water recycling. Revisiting and reviewing each of the supply options ensured current information was taken into account when assessing the costs and benefits of each option.

Investigations into decentralised schemes included a review of their current role in securing water for the region, in addition to considering the role they may play in the future. While decentralised schemes may not currently supply water of a quality suitable for drinking, they can supply fit-for-purpose water for irrigation and other non-drinking purposes. This can help defer the need for major drinking water supply augmentations and potentially provide community benefits such as supplying water for parks and gardens.

In considering new supply options to secure the region's water future, Seqwater will work with our communities to understand their water supply preferences. Community engagement relating to the Water Security Program commenced in July 2015 and has begun to gather feedback on water supply options at a category level. Understanding community and stakeholder views about supply options is important for deciding future supply augmentations.

This chapter provides an overview of the existing supply system, the various influences on water quantity and quality, as well as future water supply options available, with consideration of their trade-offs.

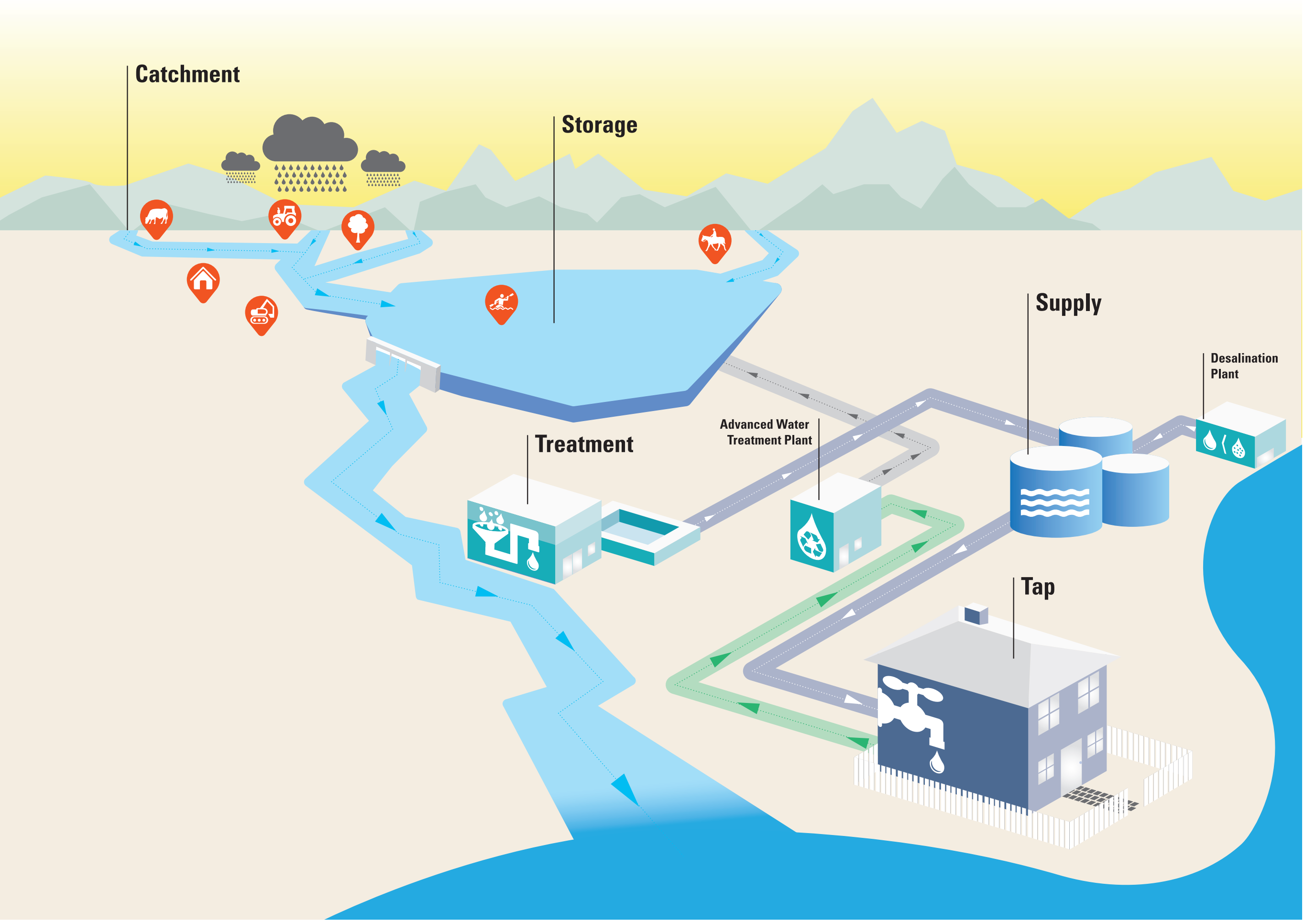


Figure 4-2 Managing water supply from catchment to tap

4.1 Catchment to tap

Current best practice for managing water supply systems is to plan and operate 'from catchment to tap' (Figure 4-2). This means that long-term supply planning needs to consider investments required in all parts of the system for security of supply. Seqwater works in partnership with government and the broader community to promote a catchment to tap approach to water quality, quantity and environmental management.

A multi-barrier approach to managing water quality from catchment to tap is also critical to managing the quality and safety of water we supply. There are four major stages in the water supply chain, which provide opportunities to introduce barriers against impurities. These are the protection of source water, storage of raw water, drinking water treatment and the drinking water distribution stages.

The multi-barrier approach to managing drinking water, from the protection of source water through storage, treatment, and distribution of drinking water takes local conditions and challenges into account. It offers a system to reduce the occurrence, or to remove impurities from drinking water supplies.

PROTECTION OF SOURCE WATER

Source protection is critical to consider in surface water, groundwater and stormwater sources as land use and development in our catchments impacts raw water quality. For example, livestock and agriculture can contribute to erosion and impact water quality and storage capacity. Land degradation and clearing can contribute to higher sediment loads to receiving waterways, particularly during rainfall events. Impacts of climate change can exacerbate these issues leading to greater variability of water quality and quantity. This variability of water quality could result in the need for significant investment in treatment infrastructure. Additionally, increased sedimentation within our storages may reduce the volume we can store.

The catchment, and potential changes to the catchment, which may impact on water volumes and quality over time need to be considered when planning new water sources. For example, when siting and designing the Gold Coast desalination plant the source was carefully considered to ensure the best quality seawater possible. If the seawater quality was prone to influences from river discharges, additional pre-treatment, such as micro filtration, would have been required.

STORAGE OF RAW WATER

How we manage our storages has a direct impact on water quality. Surface water from our catchments is stored in dams, weirs or off-stream storages. Seqwater manages these storages to meet a range of purposes including securing water for our supplies, mitigating floods and recreation. Some of the storages may be used for one of these purposes only, whereas others may be used for all purposes, each with competing objectives. For example increasing recreational use may reduce water quality and drive the need to invest in additional treatment infrastructure.

DRINKING WATER TREATMENT

The next step in the multi–barrier approach to managing water is water treatment systems and processes. Seqwater's water treatment plants are located throughout the region (refer to Figure 1-2). Treatment processes are designed based on the quality of the raw water, which is influenced by the source of the water, the management of the catchments and storages. The poorer the raw water quality, the more treatment it requires. Increased treatment requirements result in increased cost to reliably supply water of suitable quality.

DRINKING WATER DISTRIBUTION

Control of the transfer of water and distribution 'to tap' is equally important to ensure water quality and security of supply. Seqwater does not control this part of the system. Security over this part of the system requires solid and enduring collaborative planning and operational processes with South East Queensland's water service providers and the local councils that are responsible for planning for communities served by the system.

4.1.1 WATER QUALITY

Drinking water quality in Queensland is regulated through the *Water Supply (Safety and Reliability) Act (2008)* and subordinate guidelines. This Act applies to drinking water sourced from surface water and has special requirements for drinking water schemes that may include planned water recycling. Drinking water quality standards are specified in the Public Health Regulation (2005) which also refers to the health guideline values in the Australian Drinking Water Guidelines. All drinking water supplied by drinking water service providers must comply with these requirements regardless of the source.

These guidelines are regularly reviewed as technology and knowledge improves, often resulting in the introduction of more stringent guidelines. As guidelines become more stringent, additional treatment may be required, driving water treatment plant upgrades.

your **say**

"Quality of water is a big one. The quality of water needs to be assured."

4.2 Existing supply system

When planning for long-term water security, it is critical to understand the existing system, its current performance and how this performance may change with different influences. This requires understanding how much water is available in our storages and from climate resilient supplies, the capabilities of our assets, and the contribution of existing decentralised schemes to water security.

Seqwater has undertaken extensive investigations to develop accurate and consistent supply information to be used for current and future planning and in managing risks. These investigations have included:

- an assessment of the impact of some influences on the existing system
- assessment of catchment conditions and risks
- a review of the volume of water available from the system
- a review of existing asset information and technical reports
- assessment of the capacity of the assets
- assessment of the capability of the assets to meet the required performance for drinking water quality and quantity
- identification of critical attributes of infrastructure relevant to assessment of major process limitations
- assessment of the role of existing decentralised schemes in securing water for South East Queensland.

Changes to influences (refer Chapter 2 – Influences), may change the results of these assessments and drive the need for additional investment in catchments, storages, existing treatment plants or the network. So influences, such as climate, regulation and technology, need to be considered when assessing the existing system performance and the need for future supply options.

4.2.1 CATCHMENTS

Most of South East Queensland's drinking water is harvested from surface water sources which capture water that has flowed through open catchments – land where land-use and access is not limited or prohibited. Water sourced from open catchments can be susceptible to variations in quantity and quality and could contain more impurities than water sourced from closed catchments. The impact of different industrial, agricultural and domestic activities in catchments can disturb natural ecosystems. Healthy catchments (where ecosystems are healthy) aid in reducing water treatment costs through natural treatment and retention of impurities which benefits the community.

This means in South East Queensland, water treatment begins at the catchment. Seqwater plays an active role in investing and collaborating with stakeholders and communities in our surface water catchments to maintain catchment health. A well-vegetated catchment is effective in filtering runoff to reduce sediment and nutrient loads. Catchment improvement programs such as erosion sediment control and revegetation are important to maintain good raw water quality within water supply storages.

CATCHMENT MANAGEMENT

Seqwater has developed a program of work in collaboration with Healthy Waterways to assess future water quality risks to both our drinking water supply catchments and the wider region. This collaboration builds on catchment modelling work already undertaken. The project will use outputs from research identifying future land use projections (2046) and the climate change forecasts developed by the Department of Science, Information Technology and Innovation. The research will be used to model a future catchment scenario to assess estimated water quality impacts to surface water supplies over the next 30 years.

The work will assist in predicting current and forecast sediment loads into our water supply storages and how this may impact the capacity and lifespan of the built infrastructure.

The model will also enable Seqwater to trial different investment scenarios within a catchment to target sources of high pollutant loads for remediation. It will also help us assess the load reduction relative to the water treatment plant.

There is a strong relationship between the condition of catchments, the amount and quality of water available, and the reliable capacities of the associated water treatment plants, particularly during high rainfall events. Some examples are highlighted below.

- Hinze and Little Nerang dams have catchments that are assessed as being in ‘good’ condition. Consequently Mudgeeraba and Molendinar water treatment plants benefit from relatively stable raw water quality and are rarely subject to events that significantly affect plant capacity.
- The Mt Crosby water treatment plants source water from ‘poor’ condition catchments (Somerset, Wivenhoe, mid-Brisbane River and Lockyer) and therefore experience significant variations in raw water quality which can considerably reduce plant capacity. This was evidenced during the January 2011 floods and the January 2013 weather event associated with ex-Tropical Cyclone Oswald.

Catchment land use directly affects water quality and quantity and impacts the capability and performance of the bulk water supply system. Seqwater’s adaptive planning approach includes ongoing assessments of the condition of regional water supply catchments, including the potential for active intervention in catchment decline through management and improvement programs.

4.2.2 SOURCES

Seqwater owns and operates water sources including surface water, groundwater, seawater and purified recycled water. The amount taken from each source depend on conditions such a drought.

The predominant source of water for urban supply in South East Queensland is surface water. Seqwater owns and operates 26 dams, in addition to a number of weirs and off-stream storages to store surface water for both irrigation and urban water supply. Appendix D provides details of the dams related to urban water supply. Some of these underpin the region’s bulk water security and are known as key bulk water storages. The total combined storage capacity of the key bulk water storages for water supply purposes is 2,185,488 ML. This capacity is equivalent to 874,000 Olympic-sized swimming pools. In addition to the surface water storages, Seqwater also owns and operates two groundwater borefields located on North Stradbroke Island and Bribie Island.

The Millennium Drought significantly reduced the water supply storage levels of the region’s main dams.

Figure 4-3 shows the decline in combined storage capacity of Wivenhoe, Somerset and North Pine dams during the worst of the Millennium Drought (2005 to 2008) and after the drought to January 2015. The extent of the drought changed the thinking of government as well as water users, highlighting the need for efficient use of water and diverse sources of supply.

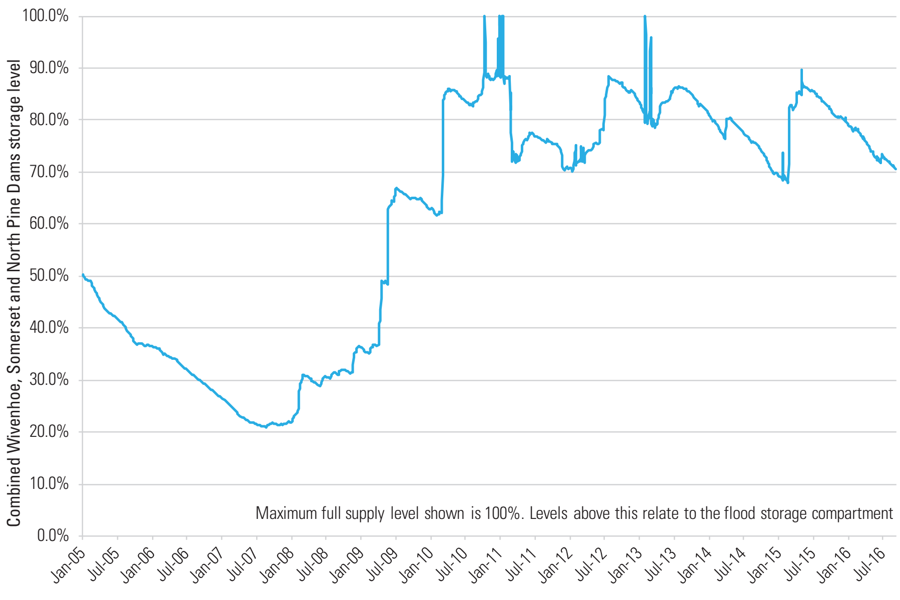


Figure 4-3 Percentage of storage capacity Wivenhoe, Somerset and North Pine dams, 2005–2016

In response to the Millennium Drought, two climate-resilient water sources, the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme were built. These sources are able to supply 133 ML/day and up to 182 ML/day respectively.

The Western Corridor Recycled Water Scheme comprises advanced water treatment plants at Bundamba, Gibson Island and Luggage Point, which treat water using micro-filtration, reverse osmosis and advanced oxidation processes. In addition to supplementing drinking water supplies, the scheme supplies purified recycled water for industrial use.

When the drought ended, the Western Corridor Recycled Water Scheme ceased operating and was placed in care and maintenance mode, owing to the higher cost of this source compared with surface water sources in SEQ.

Based on assessments to date, the most efficient use of the scheme in the short-term is to maintain its function as a drought response asset. It will be recommissioned to supplement water supplies by pumping into Wivenhoe Dam when water security is low, in accordance with the drought response plan (refer Chapter 6 – Planning for resilience). The Western Corridor Recycled Water Scheme will remain a significant potential contributor to water supply in future droughts.

The makeup of supply capacity before and after the Millennium Drought is illustrated in Figure 4-4.

Prior to the drought the region was 98% reliant on surface water. The addition of climate-resilient sources enables Seqwater to better adapt to changing demand and supply needs.

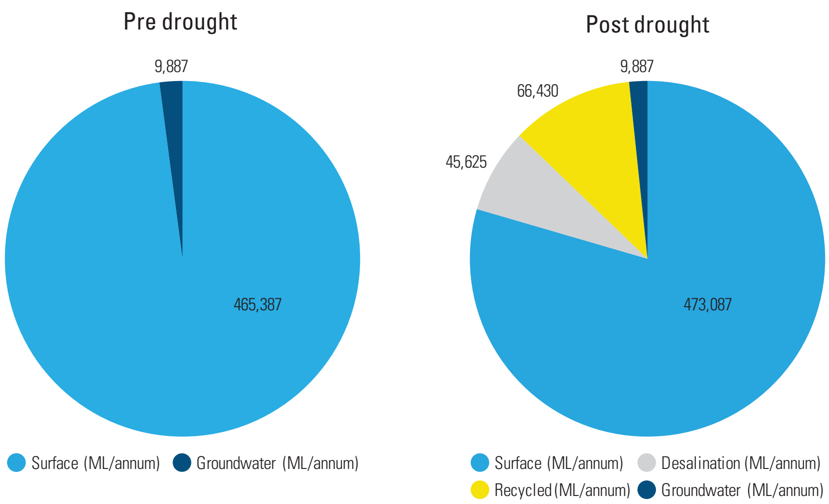


Figure 4-4 Maximum annual volume that can be supplied by each source pre and post-Millennium Drought

4.2.2.1 Decentralised schemes

Decentralised water supply schemes provide fit-for-purpose water for localised uses and can reduce demand on the bulk water supply system. Options include local collection of stormwater and rainwater, sewer mining and recycled water for non-potable use (e.g. irrigation of major sporting fields). These schemes often provide broader benefits, including environmental improvements, community well-being, visual amenity, improved system resilience, and/or local flood reduction.

Greenfield developments that promote localised alternative water supplies for non-potable use are often desirable to buyers attracted to liveability aspects of the development including the availability of alternative water sources for green space and gardens.

While enthusiastically adopted during the Millennium Drought, many of these schemes are in various states of decommissioning across South East Queensland, with the following reasons cited:

- higher operational and maintenance costs than originally anticipated
- perceived or assumed benefits overstated
- significantly lower demands for alternative sources than originally forecast
- onerous and costly regulatory requirements (such as requirements for additional ongoing monitoring and reporting)
- requirements for duplication of assets to accommodate potable and non-potable water, increasing costs of servicing
- limited engagement with providers of connecting services resulting in incompatible design and risk management approaches
- complexity in managing the schemes, resulting in risk to the water service provider being greater than the benefit of implementing the scheme
- unresolved long-term governance arrangements.

While the experience of decentralised schemes in South East Queensland has been less than favourable to date, they do play a role in providing fit-for-purpose water to end water users and contribute to the overall amount of water the system can supply. They can reduce demand on the bulk water supply system and contribute to liveability outcomes for local communities. But the costs and benefits of proposed decentralised schemes require in-depth analysis early in the decision-making process. Governance arrangements need to be resolved upfront so decentralised schemes can continue to provide benefits to the communities they serve long after construction.

RESEARCH, TRIALS AND DEVELOPMENT

Seqwater is progressing research into decentralised schemes in South East Queensland to clarify their costs and benefits. The Aura and Fitzgibbon Chase developments are examples of how Seqwater is working with developers and water service providers to better understand the future role of decentralised schemes.

CREATING A SPATIAL ANALYTICAL MODEL

Seqwater is planning to create a spatial analytical model that integrates region-wide data to evaluate the cost-effectiveness of alternative supply options and their environmental, resilience, people and place and economic impacts. To develop such a resource, Seqwater needs to better understand the potential of decentralised schemes including their costs and benefits. Once this has been done, a geospatial model can be developed to help identify potential sites for future decentralised schemes.

FITZGIBBON CHASE

Fitzgibbon Chase is located near Carseldine in Brisbane. It is a compact residential estate with 1,300 dwellings. The aim of the development was to meet sustainability requirements at the time of approval by implementing stormwater treatment for irrigation and indoor non-potable use, as well as for direct injection of treated stormwater into potable mains. Two schemes were implemented:

- potable roof water harvesting which uses micro-filtration technology to treat roof stormwater from 500 properties to inject into the reticulation system (the scheme is called PotaRoo)
- stormwater harvesting to supply a third pipe network to 1,300 properties (the scheme is called FiSH).

Each scheme has a treatment capacity of less than 500 kL per day, inflows permitting. The schemes have been constructed although have been unused for the last 18 months while outstanding planning and long-term governance issues are resolved.

Positive aspects of the Fitzgibbon Chase development include the adoption of well-equipped treatment assets and an alignment with an overall 'sustainable' theme for the development. Issues are mainly around the complexity of long-term governance, including management, of the scheme. There are also some inconsistencies with the specifications to which the scheme was constructed and local planning requirements, posing a potential risk to future scheme managers for long-term service provision. Economic viability of the scheme is another potential issue.

What we have learned from the Fitzgibbon Chase scheme is the value of:

- establishing clear governance structures
- working through specifications and approvals for the scheme at the initial planning stage of developing a scheme
- clearly identifying scheme costs and benefits to understand the economic viability of the scheme and potential risks to this viability.

Further, where it is identified that costs may exceed revenue, funding mechanisms to recover costs should be resolved prior to decisions being made and the scheme being implemented.

AURA – A COLLABORATIVE RESEARCH PROJECT

The Aura development located in Caloundra South will provide around 20,000 new homes over the next 20 to 30 years. The developer is looking for innovative ways to harvest and reuse stormwater. They propose to harvest stormwater and discharge it into Seqwater's Ewen Maddock Dam for possible subsequent reuse.

Seqwater and the developer have entered into a collaborative research agreement to explore the feasibility of opportunities for stormwater harvesting and reuse and better understand the risks and opportunities that a stormwater harvesting scheme may provide.

Other water harvesting and saving initiatives (including water tanks) have already been implemented at Aura. Seqwater is particularly interested in quantifying the costs and benefits of these initiatives for consideration in future assessments of decentralised schemes, noting the costs and benefits of decentralised schemes will be dependent on location and the type of solutions considered for the scheme.

4.2.2.2 LOS Yield

The LOS yield is the maximum annual average volume of water that can be supplied to residential, commercial and industrial customers by the bulk water supply system every year, while meeting the desired LOS objectives. The LOS yield assumes all water supply assets can operate at full capacity when required. It is dependent on, among other factors, the LOS objectives, the supply infrastructure and demand forecast, but is independent of current storage levels. Its determination considers the widest variability in inflows possible (i.e. stochastic data). The Regional Stochastic Model is used to test a large number of demand, supply and operational scenarios and determines whether they meet the LOS objectives.

The LOS yield is determined by undertaking supply system modelling that incrementally increases the annual average demand volume, until any of the LOS objectives fail. The modelling keeps the existing infrastructure constant and therefore tests the system's capability to meet demand without incorporating system augmentations.

When modelled on existing infrastructure and current operation of the system (including current temporary lowering of Wivenhoe and Somerset dams), the LOS yield is 440,000 ML/annum. The increase in existing system yield to 440,000 when compared to previous planning estimates of 400,000 ML/annum can be attributed to the combined effects of the following key variables:

- a new version of the Regional Stochastic Model with:
  - improved simulation of the operation of Lake Macdonald
  - improved simulation of the drought response
- updated infrastructure arrangements and associated transfer rules (Appendix D)
- updated demand distributions throughout the region.

The LOS yield increased to 495,000 ML/annum when the above modelling approach was applied for the existing infrastructure plus the following planned system modifications:

- restoration of Wivenhoe and Somerset dams to normal full supply levels, and
- the planned base system augmentations (outlined in Section 7.8),
- future earlier operating trigger for WCRWS

In this scenario the Baroon Pocket Dam minimum operating level was the first LOS objective to fail. Based on this failure, the total annual average demand volume that can be met while still complying with the LOS objectives is estimated to be about 495,000 ML/annum. Therefore 495,000 ML/annum represents the derived LOS yield once the planned base case has been implemented.

The planned base case includes an earlier operating trigger for the WCRWS. If this change cannot be made the LOS yield will be 485,000 ML/annum.

Figure 4-5 demonstrates that to be compliant with the LOS objectives and meet a demand greater than 495,000 ML/annum, additional system yield augmentations will be required.

Figure 4-5 shows the outcome of the supply demand analysis in which the LOS of 495,000 ML/annum is compared with the projected medium demand to determine the approximate year when supply will match demand. Augmentation would be required about one year prior to this time. If there is no change to the LOS yield of 495,000 ML/annum and water consumption tracks along the medium demand forecast, supply will approximately equal demand by 2040.

The augmentation date will vary with changes to influences. For example if demand forecasts change, and if a higher demand occurs, augmentation may be required closer to 2031 and a lower demand would push it out to beyond 2055. If the changed operation of the WCRWS cannot be made, the augmentation date will be approximately 2039. To achieve a LOS yield of 495,000 ML/annum a decision needs to be made to change the WCRWS operating trigger. A decision on this will be made in future versions of the Program.

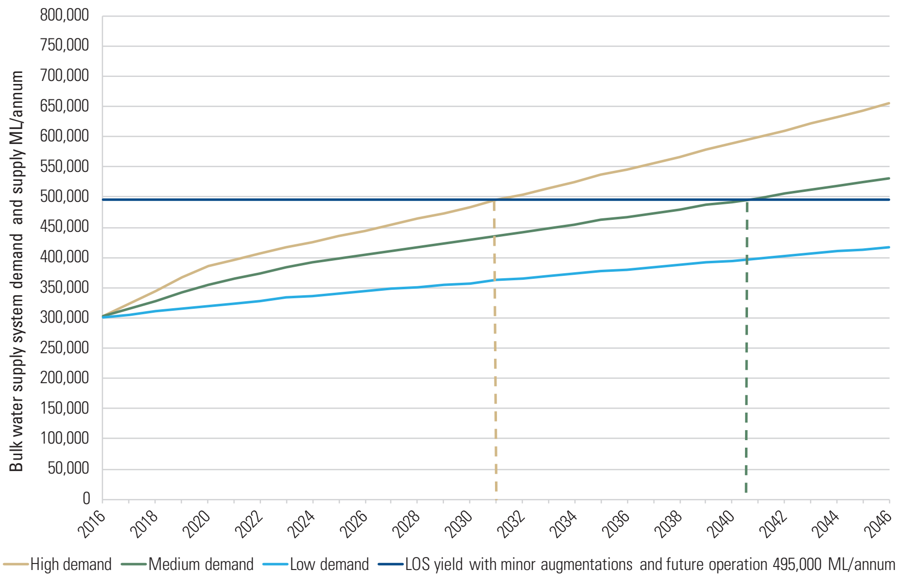


Figure 4-5 Impact of demand on augmentation year for the planned base case (yield of 495,000 ML/annum)

One of the key influences on available supply and therefore on system performance is climate change. Projections of climate change impacts are dependent on a number of factors including emission scenario, general circulation model (GCM) outputs, projection year and regional and seasonal behaviour.

In preparing climate data which has been adjusted for climate change for use in the Regional Stochastic Model (RSM), the Department of Innovation, Science, Technology and Industry (DSITI) adopted the emission scenarios (published by the Intergovernmental Panel on Climate Change in its Fourth Assessment Report, 2007) for projection years 2030 and 2050 that closely matched those along which emissions have been tracking. From the global circulation models that develop monthly scaling percentages for rainfall for each emissions scenario, those that resulted in the 10th, 50th and 90th percentile annual rainfall totals were selected for generation of low, medium and high inflow climate changed data.

Using the low inflow, 2030 climate changed data, the LOS yield decreased by 45,000 ML/annum to 450,000 ML/annum which would bring forward the time supply would approximately equal demand by about six years if demand follows the medium projection.

Another influence which may have an impact on the available yield of the system is dam safety work requiring either temporary or permanent lowering of dams. Only permanent lowering of a dam has the potential to reduce the LOS yield. Somerset Dam is one of a number of dams across the region to be upgraded, as part of Seqwater's Dam Improvement Program. Work is in progress to finalise the scope and timing of further improvements of the dam. Following extensive modelling to determine the flood mitigation and dam safety benefits, as well as water security impacts, of various scenarios for temporary full supply levels, Somerset Dam will remain lowered to 80% and Wivenhoe Dam to 90% subject to the completion of any upgrades. Assumed for modelling purposes to be by 2021.

The WCRWS is a vital component of the drought response. Water supply security would be reduced if it was not available to supplement supplies prior to 2026, and as demands increase beyond 2026 the benefit of the WCRWS becomes even greater. Without the WCRWS the LOS yield decreases by 35,000 ML/annum.

Figure 4-6 shows the impact of the influences of climate change and availability of the WCRWS on the LOS yield.

4.2.2.3 Essential minimum supply volume

The LOS requirements for the essential minimum supply volume (EMSV) are that:

- the probability of reaching the trigger to reduce supply to a mandatory 100 L/p/d should be no greater than 1:10,000
- once the trigger is reached, supply of 100 L/p/d can be guaranteed.

The trigger for EMSV has been calculated at 5% of KBWS (refer to Appendix I). Once storage levels reach 5%, it was determined that with the current infrastructure plus the planned network modifications, the bulk water supply system will be able to supply about 145,365 ML/annum. This is estimated to be able to meet the EMSV demand until 2026 (see Figure 4-7). Construction of contingency temporary desalination plants will have commenced earlier in order to boost supply once the KBWS reach 5%.

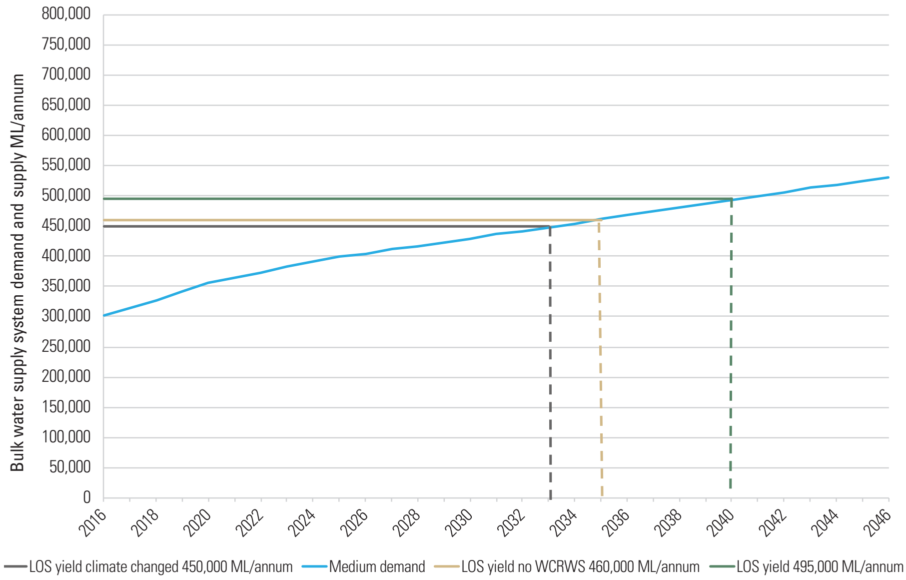


Figure 4-6 Impact of climate change and no WCRWS on LOS yield

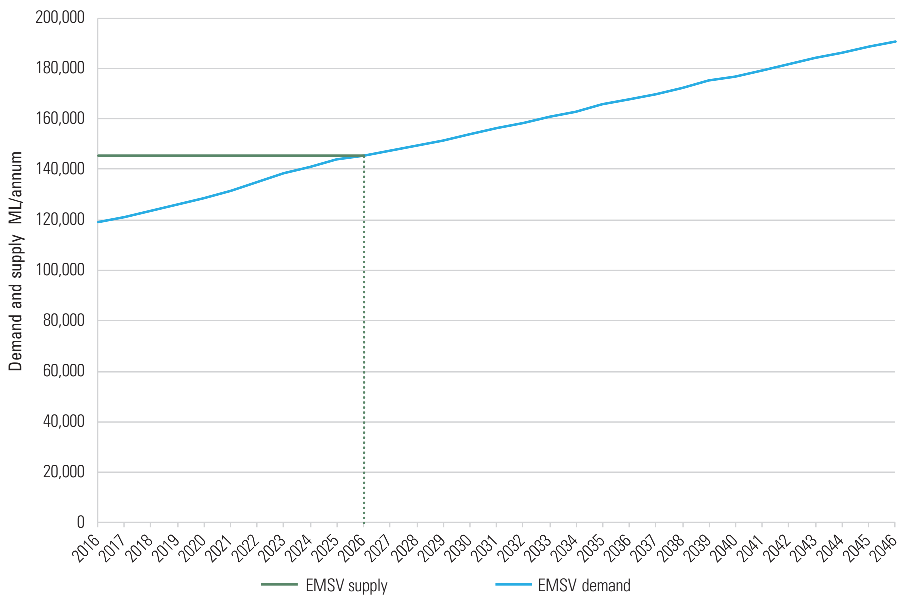


Figure 4-7 Essential minimum supply volume with existing infrastructure

4.2.3 TREATMENT

Water from all sources requires at least some treatment before it is suitable for drinking. The level and number of treatment processes required depend on how much the water is exposed to contaminants and its intended end-use. Once captured, raw (untreated) water is released or pumped from dams, underground aquifers, or the sea and transported to water treatment plants where it undergoes physical and chemical treatment processes, including disinfection.

Seqwater applies a multi-barrier approach to producing safe drinking water. The number and kind of barrier depends on the type and level of impurities in the raw water. At the very least all water should be filtered and disinfected before use even if the source contains very little impurities.

Most Seqwater water treatment plants were designed at a time when water quality legislation was not as stringent as it is today. The original design capacity of many of these plants is greater than can actually be achieved while complying with water quality standards.

Appendix D provides a summary of Seqwater's water treatment plants.

Innovative and advanced water treatment technologies are becoming increasingly important in responding to the challenges associated with some of Seqwater's raw water sources. Advanced water treatment usually includes processes such as ozonation or advanced oxidation, biological or non-biological activated carbon filtration, microfiltration, ion exchange, and even reverse osmosis to enhance the removal of salt, toxins, organic matter, pesticides and disinfection by-products. Ozonation and biological activated carbon are used at the Landers Shute, Ewen Maddock and Noosa water treatment plants on the Sunshine Coast and at Banksia Beach WTP on Bribie Island.

Membrane treatment processes such as microfiltration and reverse osmosis are typically used for desalination and recycled water treatment to remove finer particles and molecules. Membranes are used at the Gold Coast Desalination Plant and at the Western Corridor Recycled Scheme's three advanced water treatment plants at Bundamba, Luggage Point and Gibson Island. Microfiltration is also common in surface water treatment due to the reliability of this process for sources with high variability in source water quality and has been considered for Seqwater water treatment plant upgrades.

Demand for treated water varies seasonally, with short term weather conditions and throughout the day in response to people's usage habits. Water treatment plants, and the regional bulk water transport networks connecting them to users, need to be capable of reliably providing safe drinking water during persistent demand peaks.

Historically in South East Queensland, the bulk water supply system has been planned to reliably treat and transport potable water during the sustained high demand period coinciding with a particularly high demand summer. For planning purposes this has been defined in Seqwater's Bulk Water Supply Planning Criteria as being able to continuously treat and transport the highest 30 day moving average daily water demand during a year, referred to as a Mean Day of the Maximum Month (MDMM).

4.2.3.1 Treatment capacity (MDMM)

Mean Day Maximum Month (MDMM) is used as a measure of the peak demand that the bulk water supply system is designed to provide. Figure 4-8 shows the existing MDMM and the current performance of the bulk water supply system. Currently the WTP capacity and system capacity exceeds the MDMM demand. In the future, as the population of the region grows and MDMM increases, it will become harder for the existing WTP infrastructure and system to meet MDMM demand.

The water treatment plants connected to the bulk water supply system currently have a total adopted planning capacity of 1,488 ML/day. Some of this treatment capacity will be removed when the Petrie WTP is decommissioned in the next few years as it reaches the end of its useful service life. At this time the total adopted planning capacity for treatment plants connected to the bulk water supply system will reduce to 1,460 ML/day.

The total MDMM demand that can be supplied by the bulk supply system is less than the total treatment capacity due to capacity and operational constraints within the bulk transfer network. The hydraulic capacity of pipelines and the need to maintain minimum flows to maintain water quality in some cases, restrict the ability to transfer water from treatment plants where capacity is available to required locations to meet demand.

The magnitude and location of these constraints vary over time as population and demand grows at different rates across the region. The capacity of the bulk water supply system is estimated at 1,347 ML/day after the Petrie WTP is decommissioned. Bulk water balance modelling predicts that the capacity of the bulk water supply system to supply MDMM demand will be exceeded in approximately 2023 as shown in Figure 4-8.

Changes to drinking water quality regulations or deterioration of raw water quality due to changes in catchment conditions can reduce water treatment capacity. This would result in the need to augment treatment plants to either maintain a desired capacity and/or bring forward and increase the size of a proposed augmentation.

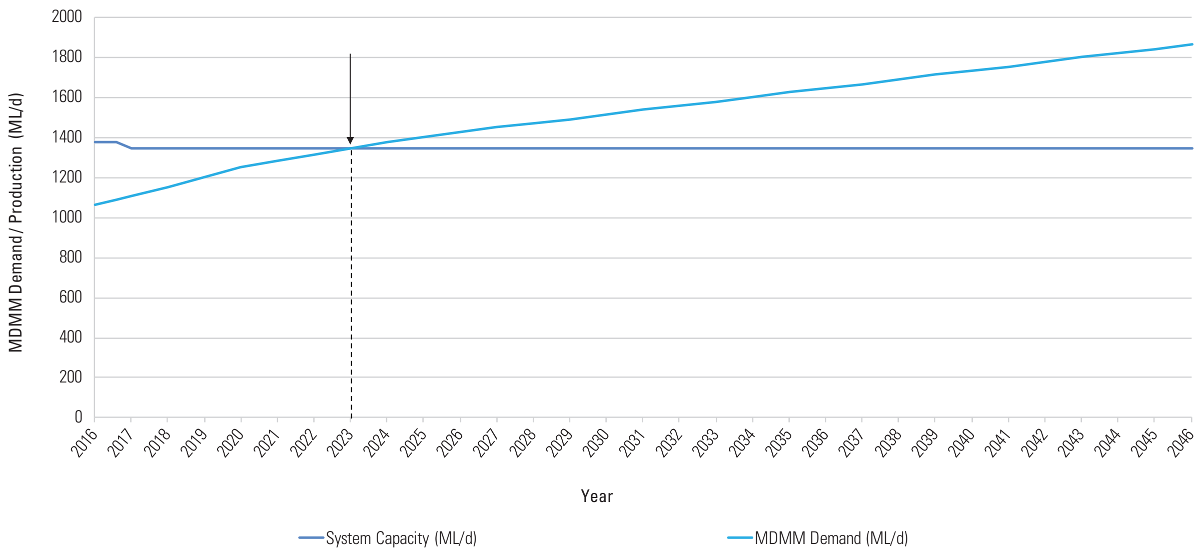


Figure 4-8 Existing MDMM performance of bulk supply system

4.2.4 TRANSPORT

4.2.4.1 Bulk water transport network

The bulk water transport network is the last stage in the drinking water supply chain where the final barrier is applied. After treated water leaves the water treatment plant, a residual disinfectant is added. These disinfection residuals are then maintained through the bulk water system for ongoing protection. The process of maintaining adequate disinfection residuals in the network is balanced against maintaining disinfection by-products, at safe levels. Two different disinfection regimes –chlorine and chloramine – are maintained in various parts of the network. The type of residual is dependent on the time water needs to stay in the distribution system before it is used, as these two residual disinfectants have different stability.

Regional interconnectors are a feature of Seqwater's water grid (refer Appendix D). The interconnectors efficiently transport bulk water to distribution networks owned and operated by South East Queensland water service providers. The transfer of responsibility to the water service providers occurs at designated bulk water supply points.

The water grid is particularly important when long-term supply is challenged (i.e. during drought), or when there are short-term supply disruptions (e.g. where water quality issues arise or the water level of storages has been lowered for operational or maintenance reasons). This allows supplementation of water from sources that are more secure to locations where supplies are low.

The water grid is integral to achieving both the LOS and persistent peak demand (MDMM) objectives.

Water supply management across the region benefits from multiple sources of supply. This integrated operation is a significant change from the traditional approach, where there is a dependency on individual water treatment plants. Sophisticated controls and collaboration is required to manage one system being supplied from different sources, requiring different disinfectant residuals. Seqwater and the South East Queensland water service providers have developed a 'catchment to tap' water quality strategy and are implementing a bulk disinfection strategy that aims to increase the reliability and cost effectiveness of the distribution system's residual disinfection.

The integrated structure of the water grid has significantly increased the reliability and resilience of South East Queensland's water supply.

4.2.4.2 Reticulated supplies to end water users

The South East Queensland water service providers are responsible for the distribution of treated drinking water to end water users, including off-grid communities with reticulated water supplies. Treated water is conveyed by gravity or pumped through bulk water supply pipelines to service reservoirs, which are strategically located. Service reservoirs maintain a constant supply and pressure of water to the mains that distribute water to households and businesses. The South East Queensland water service providers are responsible for maintaining water quality throughout their reticulation networks.

4.3 Supply options

As demand for water grows in the future, new sources of water supply and treatment capacity will be required within 30 years to continue to achieve long term water security. Different water supply options provide both different quantities and qualities of water. They are also impacted differently by changes to influences on the system. Some sources also contribute to additional treatment capacity of the system. This section provides a high level overview of potential new water supply options and their characteristics.

4.3.1 SURFACE WATER

Surface water supply options are those that capture and store runoff produced by rainfall in a catchment, which is subsequently treated at a water treatment plant to meet drinking water quality requirements, prior to supply to end water users.

Surface water is the conventional method of supplying water, and the primary source of water supply in South East Queensland. Surface water options can contribute to volumes of water in the system through storage of water in dams or weirs but storages on their own do not contribute to additional capacity to treat water. Additional treatment capacity will require augmentations to existing treatment plants or new treatment plants.

There are three different categories of surface water source options, which were investigated for this version of the Water Security Program – dams (new or raised), weirs and off-stream storages.

Dams (in-stream storage)

A dam is an artificial barrier constructed across a river valley to form a storage reservoir. The surplus water is not allowed to flow over the dam, it flows through the spillways built into the dam. A dam is used for the purposes of water consumption, irrigation and flood mitigation.

Future supply dam options include raising existing dam infrastructure and construction of new dams.

Weirs

A weir is an impervious barrier constructed across a river to raise the water level on the upstream side. The water is raised up to the required height and the water then flows over the weir.

Off-stream storage

Off-stream storage is a dam-like structure built near a stream or watercourse, rather than in it. This can be used to divert and capture surface water during periods of high flow.

Where additional source water capacity is required, an assessment of the treatment capacity is also undertaken to consider whether additional treatment may be required. Often when new sources of surface water are introduced into the system, this is coupled with a need for additional water treatment capacity.

Typically stored surface water is treated at individual water treatment plants (WTPs) which are designed to a capacity 1.3 to 1.5 times greater than the average demand to account for demand peaks. Conventional water treatment plants can produce water that meets existing drinking water regulations, however if these regulations change, additional treatment processes may be required. Based on planning criteria (refer Appendix B), some of Seqwater's existing WTPs have potential for treatment capacity augmentation without augmentation of source water capacity.

In general, surface water options can be characterised as follows, noting that for any individual option, the specific site may have better or worse outcomes than those described.

Available yield –

- Allocations and licences granted by the Queensland Government govern the amount of water that can be extracted. Allocations are subject to changing regulation. As competition for resources increases, there will be increasing pressure on the existing water resources and consideration of how these are allocated.
- Hydrology plays an important role in the determination of a storage location and its size.
- Catchment characteristics affect the volume of runoff produced. Catchment areas with cleared land may generate different runoff proportion than areas that are heavily vegetated. Similarly, land that is characterised by sandy soil may have different runoff properties than that of a rocky catchment. Surface water options are particularly influenced by environment and catchment management. Additionally, the amount of water that can be extracted is climate dependent.

your say

"It's the most basic kind of water option. It has been tried and tested for centuries, and it doesn't require any further development."

Economic –

- Surface water sources are generally less costly to operate and maintain than climate-resilient water options (desalination and purified recycled water). This is because they can utilise gravity rather than relying solely on pumping, and because they are a civil structure that does not require frequent replacement of process and mechanical items.
- Treating surface water is generally lower in cost and uses less energy than treating other sources.
- Surface water sources, such as dams, can produce more solid waste. This is particularly evident during wet weather events when sediment loads can increase markedly. Solid waste production is generally a secondary consideration compared to energy intensity and operating costs.

Environment –

- New surface water sources can potentially impact existing water supplies and ecosystems. For example additional in-stream barriers can have a major impact on aquatic ecosystems, including fish movement and habitat for a range of species. Options such as fish ladders may resolve this issue.
- The large size of storages can potentially impact land and land values in the area where they are developed, if not carefully designed.
- As surface water transport and treatment generally uses less energy than other sources, the amount of greenhouse gases produced is generally lower. However the further away the storages from the bulk water supply system, the more pumping is required to move the water around.

your **say**

"Just think about the scale of loss involved to create a large storage area. There must be a huge [environmental] impact involved."

Resilience –

- Surface water options are designed to harvest in the wet years and supply dry ones. Climate variability remains the main issue with surface water options. Floods and droughts make surface water less resilient than other supply options such as sea water desalination.
- As the water source is derived from rainfall, a drought may result in reduced water quantity.
- Higher temperatures may result in increased evaporation rates, reducing stored surface water volumes.
- During floods, water quality can be impacted, particularly where catchments are degraded, making water more difficult to treat, reducing the volumes of treated water available for supply.
- Climate change is expected to increase frequency and severity of drought and flood conditions in South East Queensland which poses a risk to the resilience of surface water as a future option.
- Surface water sources are significantly impacted by activities and development in the catchment which can impact on both the quality of water and the available volumes of water.

People and place –

- Development of surface water infrastructure must consider potential impacts to residential or farm land, productive land and flood risk to downstream properties.
- Conversely, as population growth occurs and land downstream of surface water storages is developed, this may drive the need for investing in greater dam safety measures.

4.3.2 GROUNDWATER

Groundwater is sourced through bores and typically contains low levels of solid material, requiring less treatment than water obtained from other water sources. It can prove challenging to accurately predict the long-term sustainable yield of groundwater sources. The impact of long term extraction on groundwater-dependent ecosystems is also an important consideration. The main groundwater sources in South East Queensland are the underground water sources (aquifers) located on North Stradbroke Island and Bribie Island.

These and other smaller groundwater supplies were thoroughly investigated during the Millennium Drought for potential additional supply. The investigations found considerable constraints to developing these resources. For completeness in the development of the Water Security Program, all previous work undertaken has been revisited and formed part of the supply options assessment (refer Chapter 7 – Planning for the future).

Available yield –

- There are very few groundwater storages in our region and therefore only a small amount of groundwater that can be extracted for urban use.
- The amount of water that can be extracted and rules around its extraction is dependent on water allocations and licences as granted by the Queensland Government and thus subject to change with changing regulation.
- It is difficult to determine exactly how much groundwater is available at any given time.
- As competition for resources increases, there will be increasing pressure on the existing water resources and consideration of how these are allocated.

Economic –

- The sandy aquifers on North Stradbroke Island are known for their exceptional water quality, making it easier and cheaper to treat than seawater desalination or purified recycled water for drinking. However not all groundwater is of excellent quality or easy to extract. It varies by location, greatly influencing the cost to treat.

Environment –

- Groundwater extraction can impact on groundwater-dependent ecosystems which are often difficult to monitor.

your **say**

"Would they control the rate at which the water is extracted? It's hard to imagine that it would be refilled at the same rate."

Resilience –

- Climate has a significant influence on groundwater supply sources. Groundwater aquifers are recharged by rainfall, so wet years may result in an increase in groundwater supply, whilst droughts present a risk of drawdown or depletion of aquifer volumes. This may affect quantities available for supply.
- Climate change could result in increased frequency and severity of drought in South East Queensland which may directly influence the available volumes and quality of groundwater.

People and place –

- Groundwater extraction can only occur where aquifers exist and there is a sufficient supply.
- In South East Queensland, most aquifers are located in coastal areas where development is increasing over time. Site selection must therefore consider environmental, cultural and recreational areas in addition to urban development.

your **say**

"People have been using groundwater in remote areas for ages, and it's good quality water."

4.3.3 SEAWATER DESALINATION

Seawater is an abundant, climate-resilient source of water. Seawater desalination is the process of removing salt from seawater and is carried out using reverse osmosis membranes or distillation. Desalination is an energy-intensive treatment process but it reliably produces drinking water under most conditions.

Desalination plants can be either permanent facilities, such as the Gold Coast Desalination Plant, or temporary for use in response to drought. Temporary facilities tend to be smaller in size than permanent facilities.

Available yield –

- Seawater presents an unlimited supply source, with the amount of desalinated water produced only limited by the size of the plant.

Economic –

- Desalination is one of the more expensive supply options to construct and operate. Construction costs are generally high because the infrastructure is complex and specialised. Operating costs are high due to the high energy requirements to pump the water at high pressures, however these are decreasing with improvements in technology.
- Ongoing research and development in desalination membrane technologies are likely to produce desalination systems that require lower energy input in future.
- Most desalination plants constructed in the past decade include some form of energy recovery systems with the efficiency of these systems also improving as technology improves.
- Current desalination technology in Western Australia is able to utilise renewable energy in the form of wave energy to pump seawater at high pressures. This has the potential to reduce pumping costs.

your **say**

"Even when [desalination plants] are not being used, they cost us money for maintenance. Why are they built and not used?"

Environment –

- Desalination has the potential to create environmental impacts, such as disposal of highly saline or nutrient-laden by-products to fresh water or marine ecosystems, as well as high energy demands and the associated greenhouse gas emissions. In Australia the discharge of brine from seawater desalination is highly regulated with most discharges required to meet background salinity levels within a very short distance from the discharge location by using sophisticated diffuser systems. Extensive monitoring of the ecosystem impact of such discharges is also required and the chemical waste from such plants is not allowed to be discharged to ocean outfalls.

Resilience –

- Desalination is less influenced by climate than other supply options as the raw water source is not dependent on rainfall.
- Seawater presents a climate-resilient supply source, with consistent quality. The Gold Coast Desalination Plant, a reverse osmosis plant, provided emergency back-up supply to the water grid following the 2011 flood and 2013 weather event. Those events compromised production from some conventional water treatment plants supplying the bulk water supply system, and demonstrated the benefits of diverse and climate-resilient sources of supply and system interconnection.
- Desalination is likely to be able to adapt to changing technology as it has been subject to significant research over recent times. Lower energy membranes and improvements in energy recovery devices are examples of areas of research for which results can be readily incorporated into existing systems.
- Desalination plants are typically constructed on the coast so can be susceptible to sea level rise, high tides and storm surges. These risks can be mitigated through design.
- Innovations in desalination are resulting in the process becoming more energy efficient and less expensive, potentially enhancing desalination as a future supply source.

People and place –

- Seawater desalination plants are constructed on the coast so potential sites are often in sought-after locations which are becoming more developed. It may become more challenging to secure a site for desalination over the next 30 years as competition for land increases.

your **say**

"You don't have to pray for rain, you can control and manage it as you need it and plan ahead a bit more."

4.3.4 PURIFIED RECYCLED WATER FOR DRINKING

An effective way to get the most out of a water supply, or any resource, is to use the resource more than once. Purified recycled water for drinking involves a number of treatment processes which purify the water to meet stringent recycled water quality requirements.

Purified recycled water for drinking is dependent on the amount of feed water available, and requires more energy for treatment than surface water sources. However the treatment to produce purified recycled water is less energy intensive than the treatment for seawater desalination.

Recycling of water can also result in reduced nutrient discharge to receiving waterways (provided such nutrients are removed and disposed of in the treatment process) providing an additional environmental benefit compared to other water sources.

Purified recycled water for drinking schemes typically fall into two categories:

- indirect potable reuse (unplanned and planned)
- direct potable reuse.

INDIRECT POTABLE REUSE (IPR)

Indirect potable reuse (IPR) refers to schemes in which highly treated purified recycled water is supplied to an existing raw water supply, generally a storage dam or aquifer. Here it is blended with the raw water supply before treatment at a water treatment plant and then distributed through the water supply network. The process of IPR is outlined in Figure 4-9 Indirect potable reuse can be planned or unplanned.

Unplanned indirect potable reuse

Unplanned IPR already occurs in many places in the world, including Australia and South East Queensland. It generally occurs when a town or city discharges its treated wastewater into a river, stream or aquifer upstream of another town or city, which then extracts water from that same water source for its drinking water supplies. The treated wastewater in unplanned indirect recycling is not as highly treated as in planned schemes, however the volume of wastewater is typically small in comparison to the total drinking water supply volume.

While this occurs to a certain extent in some of the water supplies to South East Queensland, there are many examples in Europe and the United Kingdom where drinking water sources can contain significant proportions of 'previously used' water. For example the city of London is supplied with drinking water extracted from the Thames River downstream of towns such as Oxford. The Rhine River in Europe is the main water supply of many cities in Germany and the Netherlands and receives runoff and treated wastewater from a highly developed region all along its course.

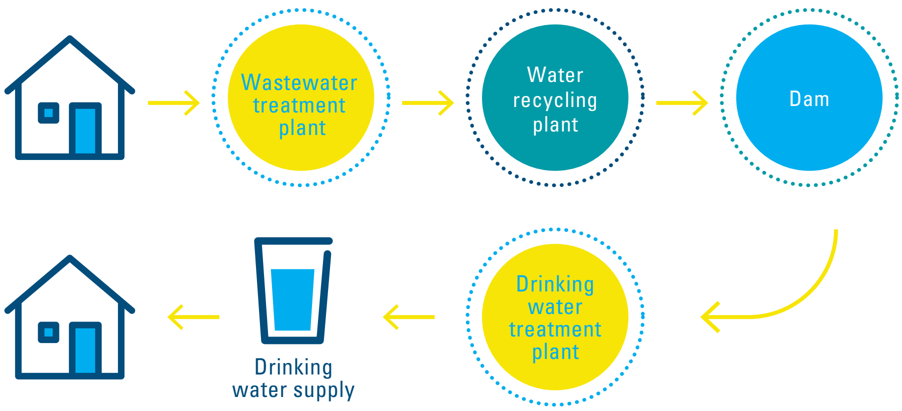


Figure 4-9 Indirect potable reuse schemes

Planned indirect potable reuse

Planned IPR, such as the Western Corridor Recycled Water Scheme, involves the intentional inclusion of purified recycled water for drinking into the community's supplies by mixing the highly treated purified recycled water with existing supply in raw water storages such as dams or aquifers. The blended water is then treated through a conventional water treatment plant and supplied as drinking water to the community. In planned IPR the purified recycled water is treated with advanced treatment processes following wastewater treatment, before being introduced to raw water storages.

Globally, IPR schemes have been implemented (or are currently planned) in a small, but rapidly growing number of communities.

Purified recycled water for drinking is more expensive to produce than treating surface water sources with conventional water treatment technologies, which results in reduced utilisation when water security is high and cheaper surface water sources are available. The higher cost and need for available storage in dams or aquifers renders IPR options most suitable for drought response rather than contributing to base supply.

DIRECT POTABLE REUSE

Direct potable reuse (DPR) refers to schemes in which purified recycled water for drinking is supplied either directly to a water treatment plant or directly into the water supply network. Currently DPR schemes are not allowed under Queensland's Public Health Regulation 2005.

Similar to IPR, DPR is used to augment drinking water supplies and so the purified recycled water undergoes highly advanced treatment using many treatment processes. The process of DPR is outlined in Figure 4-10. One benefit of supplying purified recycled water directly into the drinking water network is that schemes are not reliant on storages that are subject to evaporation and fluctuating capacity. Another benefit of DPR schemes is that they generally require less pumping than IPR schemes, as the water does not need to be transferred to raw water storages, which can be far away.

The Windhoek DPR scheme in Namibia has been operating since 1969, and now has a capacity of about 21 ML/day.

As surface and groundwater supplies have become stressed and less reliable, the need for DPR has increased in recent years. There are two full-scale DPR schemes in the USA, one in Big Spring, Texas, which has been operating since 2013; the other in Wichita Falls, Texas, which has been in operating since 2014.

A third DPR scheme in Cloudcroft, New Mexico, is scheduled for completion in 2018. Two more Texan communities are now planning for direct potable reuse. Most recently, a water treatment plant at Emalahleni, South Africa is being upgraded to 50 ML/day which will supplement further potable water supply to the community. In addition several South African municipalities have been conducting feasibility studies of water reuse options in water-scarce areas.

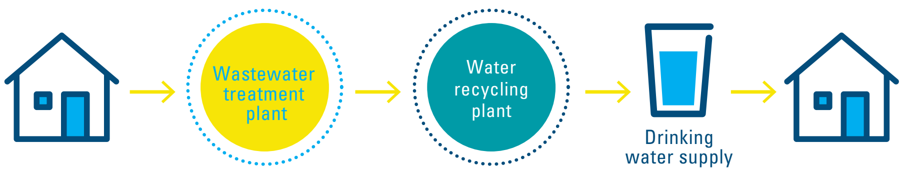


Figure 4-10 Direct potable reuse schemes

DPR schemes are in their relative infancy, with the exception of the Windhoek scheme in Namibia. As such, knowledge and experience about the long-term performance and reliability of such schemes is growing. Research and development into the technologies and significant investment in the reliable control of DPR schemes has progressed. In recent years DPR has become more prevalent in the USA to keep pace with their needs.

Given that a new supply source is not likely to be required until approximately 2040 (noting it may be earlier or later), it is possible that knowledge and long-term operational experience gained internationally may assist in addressing public risk concerns for DPR options. This may lead to a change to regulation which may allow DPR to be implemented by the time the next new source is required.

Available yield –

- Purified recycled water is relatively climate resilient, with some reduced availability during times of drought when use of water is restricted and the volume of water entering the sewerage system is consequently reduced.
- One of the most significant impacts on the availability of purified recycled water for drinking is regulation. Planned IPR is currently allowed under state legislation in Queensland and in Western Australia. Unplanned IPR occurs under current environmental legislation in all states and is not specifically disallowed under any other legislation. DPR is not allowed in any Australian State or Territory legislation. For DPR schemes to be implemented, a change in current policy would be required.

Economic –

- When compared to seawater desalination other climate resilient water supply options, purified recycled water schemes are cheaper to build. They do not require the large seawater intake tunnels that are required for desalination, which reduces construction costs.

- While the technology to produce purified recycled water often includes process steps which are similar to desalination, the salt content of wastewater is lower than that of seawater and this reduces the amount of energy required for treatment. Therefore, the energy use of the treatment process is much lower than seawater making purified recycled water much cheaper to produce.
- Depending on site location, purified recycled water may also have lower pumping requirements than desalinated seawater which would make operating costs cheaper.

Environment –

- Two key environmental considerations for purified recycled water are the treatment and discharge of the waste streams, and the high energy usage. To produce purified recycled water for drinking, advanced treatment is required which commonly includes desalination processes such as reverse osmosis which also produce waste streams.
- Purified recycled water may reduce the amount of treated wastewater discharged to the environment, including nutrients, however the concentration may increase which needs to be addressed in the treatment plant design, increasing the cost of treatment.

your **say**

"It's great as we are not wasting any water."

Resilience –

- Water quantity for purified recycled water is more resilient to climatic factors than other water supply options, as the source water is less dependent on rainfall.
- However, when water restrictions are imposed, people will use less water making less feed water available to use as water supply source.

- Water quality regulations are more stringent for purified recycled water use, as is the testing and monitoring requirements. As treatment and monitoring technologies improve, this will increase the efficiency and reduce costs of purified recycled water supply.
- Due to the number and types of treatment used to produce purified recycled water, it can be adaptive to new technology as it becomes available.

People and place –

- Historically, public perception of purified recycled water has not been favourable, however experience in Singapore and in the USA, showed that community perceptions changed over time with information.
- Education and community engagement is important for purified recycled water to be implemented as a future supply option in South East Queensland.

your **say**

"There is always the possibility that something can go wrong, it's a man-made process."

4.3.5 DECENTRALISED SCHEMES

Decentralised water supply schemes provide water for localised use, can reduce demand on the bulk water supply system and respond to the local context, providing distinct opportunities beyond what can be provided by extensions of the centralised scheme alone. Options include local collection of stormwater and rainwater, recycled water not for drinking and sewer mining for specific local uses. These schemes often provide other benefits, including environmental improvements, community well-being, visual amenity, improved system resilience, and/or local flood reduction.

Decentralised supply options require a sound regulatory framework and the commitment of various parties (e.g. state and local governments, property developers, and the bulk and retail water supply authorities) to be holistically planned, constructed appropriately and maintained over the long term.

The quality and use of water from decentralised schemes are regulated in Queensland through the *Water Supply (Safety and Reliability) Act 2008* and water quality specifications in the Public Health Regulation (2005). Usually these regulatory requirements make it uneconomical to provide water of drinking water quality on a localised scale even if the sources are rainwater or stormwater.

Stormwater harvesting

Stormwater harvesting is the diversion and treatment of stormwater runoff from urban catchments (such as stormwater drains) for local use.

Available yield –

- The volume and quality of the captured stormwater depends on catchment conditions, climate, soil type, the landscape, available storage and demand.

Economic –

- At this stage, stormwater harvesting is costly. The variability of quality and volume drives up the cost.

Environment –

- Stormwater harvesting can improve environmental impact of new developments. It can, help to manage the environmental impacts of increased runoff from increasing the area of impervious surfaces associated with developments (e.g. concrete driveways).

Resilience –

- Stormwater harvesting is not climate resilient. It is dependent on rainfall.

People and place –

- By capturing stormwater, there may be a reduction in localised flooding.

your **say**

"Putting in pipes for stormwater collection is expensive."

Rainwater harvesting

Rainwater harvesting is capturing rain in tanks, which off-sets demand for drinking water.

The quality of rainwater is better than stormwater, but there are currently no quality control measures in place. As a result, rainwater is generally not recommended for drinking.

Available yield –

- The harvesting of rainwater is limited by rainfall and the demand based on the end uses connected to the rainwater tank.
- It is also limited by the available storage capacity – the bigger the tank the more water can be captured when it does rain.

Economic –

- Generally rainwater harvesting is more costly than supply from the water grid.

Environment –

- Harvesting rainwater has localised environmental benefits and reduces need for treatment and transport of potable water.

Resilience –

- Rainwater is not a resilient supply because if there is no rain, there is no rainwater.

People and place –

- Rainwater harvesting gives people choice and greater awareness of how they manage their water use.
- It may reduce localised flooding if tanks have sufficient storage available in times of significant rainfall.

your **say**

"Many of these ideas already take place mostly in regional areas, they save a lot of water and make you really value the water you have."

Recycled water not for drinking (non-potable reuse)

Non-potable recycled water supply schemes are designed to supply recycled water for purposes other than drinking or 'primary contact use' such as showering or dishwashing. Recycled water not for drinking, or non-potable re-use, is usually used for industrial uses, toilet flushing, garden watering as well public open space irrigation or for agriculture. Such schemes require another distribution system to the community in addition to the drinking water and wastewater networks and are often referred to as 'third pipe' schemes. The type and degree of recycled water treatment of such schemes is matched to the quality required for the end use and does not necessarily meet drinking water requirements. However the water is required to be 'fit-for-purpose' so the quality of water from such schemes is usually much higher than what is normally produced from a wastewater treatment plant.

The intended use of the recycled water drives the level of treatment required and therefore the cost. As with any end use, it is important that recycled water quality meets the requirements of the purpose for which it is intended. Recycled water not for drinking is typically highly regulated as to quality and also control to avoid cross connection with drinking water supplies. This regulation combined with the expense of installing a separate third distribution system can result in high costs, especially when implemented in an existing urban development.

Non-potable reuse typically reduces the demand on drinking water supplies. Non-potable reuse schemes can also provide sustainable solutions for end water users during drought.

Available yield –

- The amount of water that can be supplied by recycled water not for drinking is limited to the amount produced through wastewater treatment. Given this is linked to the population of the region, the volume available will grow as the population increases.

Economic –

- Recycled water schemes supplied through third pipes are more costly than supply from the potable system due to the need to duplicate assets, the greater cost of the increased water quality monitoring required for such schemes and the smaller volumes produced.

Environment –

- Non-potable reuse can result in the reduction of nutrients discharged to waterways and the reduction in the need for fertilisers where nutrients are reused.

Resilience –

- Recycled water schemes tend to be resilient to climate change, but they are susceptible to regulatory changes.

People and place –

- Recycled water is an option for localised use such as supplying water and nutrients to sustain or improve local amenities and recreational areas. It can also be used for urban irrigation, horticulture, agriculture and industry.

Sewer mining

Sewer mining takes sewage directly from a sewer and treats it appropriately to make recycled water that is not for drinking. Sewer mining only treats the water to a quality suitable for its intended end use, for example irrigation or watering parks or golf courses.

South East Queensland currently does not have a regulatory framework for sewer mining however it was trialled at Brisbane's New Farm Park. The process is being used elsewhere in Australia. In Victoria, the Melbourne Cricket Ground (MCG) and Richmond Football Club use sewer mining to source water for irrigation.

Available yield –

- The amount of water that can be supplied by recycled water schemes is limited to the amount of wastewater transported through the network from which it is extracted for treatment. So as the population of the region grows, so too will the volume available..

Economic –

- Sewer mining schemes tend to be one of the highest cost sources due to the need for a completely new treatment process, the small amount supplied and water quality monitoring requirements. This may change with new, more efficient treatment technologies.
- While sewer mining can off-set demand for drinking water, increased use of this method may result in more concentrated and harder to treat sewage because the waste returned to the sewer is of a greater concentration.

Environment –

- Sewer mining can result in the reduction of nutrients discharged to waterways.

Resilience –

- Sewer mining is a climate-resilient resource and only impacted when water restrictions are in place which may restrict the volume of water entering the sewerage system.

People and place –

- Sewer mining is an option for localised treatment and reuse of water which is often used for supplying water and nutrients to sustain or improve local amenities and recreational areas.

4.3.6 UNCONVENTIONAL WATER SUPPLIES

Unconventional water supplies include options such as covering surface water storages to reduce evaporation, and cloud seeding. These options are generally less favourable because of their high cost, lack of proven effectiveness and/or the small volume of water they produce.

4.3.7 NON-STRUCTURAL OPTIONS

Non-structural options are those that can affect system performance (either with direct supplies or by reducing demand) by means other than physically extracting or producing water. Non-structural supply options include trading water between different sectors, water governance frameworks that apportion responsibility differently, recycled water policy, and policies on environmental flows versus consumptive allocations.

4.3.8 SUMMARY OF SUPPLY SOURCE OPTIONS AND TRADE-OFFS

Any supply option on its own, or in combination (e.g. a dam and a water treatment plant upgrade) responds differently to different influences and has costs and benefits. We call these trade-offs.

Seqwater has developed a set of criteria, called water considerations, to assess the trade-offs (refer Appendix C). For water supply options, we have assessed these trade-offs under the broad categories of available yield, economic, environment, resilience, and people and place impacts. These are based on general traits for an option.

Based on our assessment, some of the trade-offs for different options are described below in relation the assessment criteria. It is a general assessment and is based on the average performance of each type of supply source for long-term supply in South East Queensland. Water quality, inherent to the assessment of any option, was considered to make sure any option can meet drinking water quality guideline requirements. The results of the assessment may differ under site-specific or drought conditions. In particular site-specific impacts such as impact on cultural heritage, local environment and amenity may alter the outcome for any given option.

Surface water options generally cost less to operate and maintain due to less power consumption and longer weighted asset life than desalination processes (including advanced recycling plants that use desalination processes). Decentralised schemes on the other hand are generally less cost effective than surface water schemes due to the proportionally high initial construction cost, operation and maintenance costs and low yield.

In terms of available yield, seawater desalination is the most favourable option. This is because seawater as a supply source is almost unlimited. Conversely, there are only small volumes of groundwater available for drinking water supply in South East Queensland, and it is difficult to monitor how much is available at any given time. Groundwater recharge is dependent on rainfall.

Seawater desalination is also most favourable in terms of resilience. It is less influenced by climate than other supply option because the raw water source is not dependent on rainfall.

Decentralised schemes are considered the most favourable in terms of the environment, as they have minimal impact when compared with other supply options, such as surface water options like a dam or weir, which impact the natural watercourse.

4.3.9 SUMMARY OF SUPPLY TREATMENT OPTIONS AND TRADE-OFFS

Trade-offs must be made between water treatment options (for meeting treatment capacity requirements) based on consideration of treatment capacity, economic, environment, resilience and people and place impacts.

Considering costs, upgrading existing treatment plants is the most preferred option as it generally costs less than building a new facility on a new site. Existing water treatment plants use traditional treatment processes which are proven as cost effective. Operation and maintenance costs are low when compared to other options such as desalination which use a lot of energy.

Upgrading treatment plant alone will not meet demand requirement if the supply is constrained by the bulk supply network or the bulk water storage. The network must be capable of continuing supply during sustained peak demand. Given the relatively short duration of peak demands compared to the volumes stored in the bulk water storages, capacity augmentations to meet MDMM demand do not necessarily require additional source water capacity.

Transfer network capacity augmentations do not create any additional source water or treatment capacity, but can facilitate the transportation of water from a treatment plant with spare treatment capacity to a region with a deficit of treatment capacity during peak demand.

Augmentation options considered to meet MDMM requirements may include the bulk supply augmentation options considered for LOS requirements, as well as WTP capacity augmentations or transfer network capacity augmentations.

The cost and level of impact of treatment and transport augmentations are typically less than those for bulk supply source augmentations. The favourability of a particular type of treatment or transport option depends on the nature of the MDMM deficiency and issues related to the specific infrastructure required.

4.4 Potential new supply options

New supply options will be needed sometime in the future to secure water for South East Queensland. Previous planning considered a high level analysis of potential future supply options. In preparing this version of the Water Security Program, Seqwater further investigated the costs and benefits of potential options. Details about the assessments and the outcomes are contained in Appendix G.

Decentralised supply schemes were also further investigated. The assessment used assumptions aimed at understanding the maximum potential benefit in demand offset that decentralised schemes may provide.

The modelling assumed all new population growth in South East Queensland will be in greenfield development and that these developments will incorporate decentralised schemes to substitute demand for non-potable uses such as, outdoor watering and toilet flushing. More in-depth analysis of decentralised schemes on a case-by-case basis will be required to determine actual benefit.

Seqwater now has better information on how the potential supply options contribute to LOS yield and peak demand requirements.

Seqwater will continue to work with water service providers, government and the community to fully explore potential supply options.

4.4.1 POTENTIAL NEW SOURCE OPTIONS FOR LONG-TERM WATER SECURITY

Potential new source options for long-term water security include the following.

Harvesting water from the Mary River, and upgrading the Noosa WTP

The Queensland Government holds a strategic reserve for urban water supply in the Mary River Water Supply Scheme. This strategic reserve can be accessed for future water supply by harvesting water from the Mary River either to store in an off-stream storage or in the existing or raised Borumba Dam, then released and transported to an upgraded Noosa WTP.

This option, when combining the new source with the increased capacity of the Noosa WTP, can provide for both additional volumes and treatment capacity of the system.

Desalination plant in the northern and/or central sub-region, upgrade of Gold Coast Desalination Plant in the southern sub-region

A desalination plant in the northern and/or central region and/or an upgrade to the Gold Coast Desalination Plant can contribute additional volumes of water to meet growing demands and respond to drought, in addition to providing additional treatment capacity. They can thus contribute to a range of water security needs.

Connecting Wyaralong to the grid

The Queensland Government holds a strategic reserve for urban water supply of 37,000 ML in sub-catchment 3 of the Logan Water Supply Scheme. The key storage mechanism for this volume is Wyaralong Dam located on Teviot Brook. The dam, coupled with Cedar Grove Weir and Bromelton Off-stream Storage in the Logan River catchment can supply bulk raw water to a new water treatment plant (Wyaralong WTP) capable of producing treated water of 75 to 100 ML/day.

To supply treated water to the local community as well as the grid, construction of the new water treatment plant, in addition to pipelines and pump stations will be required.

The majority of the assets to support the dam have already been built (e.g. Cedar Grove Weir and Bromelton Off-stream Storage). However, construction of the WTP, pipelines and pump stations is still required.

If Wyaralong were connected to the grid, but only used to respond to drought, the availability of supply from the dam would certainly help to keep the Wyaralong WTP operational longer during drought thus allowing more time for other drought response actions to be taken. However, this option is climate-dependent and therefore not as resilient as other sources of supply. As such the volumes required may not be available in drought.

Decentralised schemes

Decentralised schemes are schemes which supply water of suitable quality for localised use. They can comprise any or all of the various options including rainwater tanks, stormwater harvesting, recycled water through third pipe schemes and sewer mining. They currently do not provide water for drinking, and are therefore considered to offset demand on the bulk water supply system through the provision of an alternative fit-for-purpose source of water. While their impact may be small when considered in isolation, the cumulative impact of decentralised schemes may provide more tangible benefits for water security.

4.4.2 POTENTIAL TREATMENT OPTIONS FOR LONG-TERM WATER SECURITY

Potential options to increase the capacity of the system to treat enough water for the region not identified as contributing to additional yield include the following.

Upgrading Mt Crosby WTP

This option involves upgrading the Mt Crosby WTP from the 850 ML/day to 950 ML/day. While the upgrade would increase the treatment capacity by 100 ML/day, it will not result in an increase to LOS yield of the system.

Upgrading Molendinar WTP

This option involves upgrading the Molendinar WTP to 100 ML/day. This would increase the treatment capacity of the system, but would not contribute any increase to the LOS yield of the system.

4.4.3 POTENTIAL NEW SOURCE OPTIONS FOR DROUGHT RESPONSE

Potential new source options for drought response were developed and assessed. Options not outlined in the sources for long-term water security (Section 4.4.1) are described below.

Temporary desalination

Temporary desalination involves the use of temporary desalination plant located either on land close to the sea or river, or located on a barge. The plant would be made up of modular units to provide capacity between 20 to 50 ML/day. A number of sites for the northern and central regions have been investigated as proof-of-concept for establishing the plant and its connection to the grid and water service providers' network.

Temporary desalination is climate resilient and can contribute significant yield as a number of plants can be developed at the same time to areas located close to where the demand is required. There are several factors that assist in siting a temporary desalination plant. These include availability of site, water source quality, power supply, ability to connect and storage capacity of the local water service provider's network.

When compared with permanent desalination, the temporary desalination may need to be located at less favourable sites with its intake and outfall extending a shorter distance into the sea or river due to its short-term nature and limited time for construction. Therefore, additional procedures may need to be employed to manage the raw water quality and brine discharge.

Construction and operation of a temporary desalination plant will cause disruptions to people and place, especially when the installation is close to residential areas. However, under the circumstances that a temporary desalination would be required, the greater concern would be running out of water.

Temporary desalination units are not readily available locally, especially for the larger units. They are expensive to build and operate, when compared with traditional sources of water. The additional expense is due to intake and outfall structures, imported membrane, high energy usage and more receiving water monitoring. However in the case of drought, this remains a very efficient and attractive option due to its climate-resilience and unlimited contribution to yield.

Lake Kurwongbah

Lake Kurwongbah is a lake located in north Brisbane. With the decommissioning of the Petrie WTP, there will be an available allocation of 7,000 ML which could be accessed from Lake Kurwongbah. There is a potential option to transfer water from Lake Kurwongbah to North Pine WTP.

This option involves bringing water from Kurwongbah Reservoir to North Pine Dam at 45 ML/day using a new pipeline and a new pump station.

This option is climate-dependent and the contribution to yield is insignificant, therefore it is not considered an efficient option for long-term supply. However, it may be used during drought to supplement local supply if water remains in the storage. It may also help to keep North Pine WTP operational longer, allowing more time for other drought response options to be implemented. Given its reliance on climate, it is a less favourable drought-response option than temporary desalination where the availability of water is more certain.

4.4.4 SUMMARY OF POTENTIAL NEW SUPPLY OPTIONS

As a result of our assessment, the following potential new supply options are considered in securing water for our region over the next 30 years. Each potential supply option may contribute additional volumes to the system as a new source, additional treatment capacity and/or drought response. Each of the specific options and how they can contribute to water security are outlined in Table 4-1.

Table 4-1 Potential new supply options

Option type	Sub-region	Options that meet the objectives	LOS	Additional treatment capacity	Responding to drought
Surface water	Northern	• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into the existing Borumba Dam • Upgrade the Noosa WTP	✓	✓	
		• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into a raised Borumba Dam • Upgrade the Noosa WTP	✓	✓	
		• Build a new weir on the Mary River in the vicinity of Coles Crossing • Raise Borumba Dam • Upgrade the Noosa WTP	✓	✓	
	Central	• Build Wyaralong WTP	✓	✓	
		• Connect Lake Kurwongbah to North Pine Dam			✓
WTP upgrade	Central	• Upgrade the Mt Crosby WTPs to 950 ML/day (no LOS yield increase)		✓	
	Southern	• Upgrade the Molendinar WTP to 190 ML/day (no LOS yield increase)		✓	
Desalination	Northern	• Build a northern desalination plant	✓	✓	✓
	Central	• Build a central desalination plant	✓	✓	✓
	Southern	• Upgrade the Gold Coast Desalination Plant (Stage 2) (additional 45 ML/day)	✓	✓	✓
	All	• Build temporary desalination plant(s)			✓
Decentralised Schemes	All	• Implement decentralised schemes where feasible	✓	✓	✓

4.5 Next steps

Seqwater will continue to update and review options for new water supplies and ensure new water sources can be delivered to maintain water security for the region. Actions will be adapted to support the requirements of this program and future versions of the Water Security Program and are likely to include the following.

- Where appropriate, steps will be taken to secure sites for new water supply assets, so that all water supply options remain available until they are ruled out.
- Ongoing option investigations, including on-site assessments, to ensure the options are fully understood and can be assessed through the options assessment framework, as the framework develops in future versions of the program.
- Review and update option information to take into account changes in technology, cost assessments and the impacts of the influences outlined in Chapter 2.
- Provide the community with information about the advantages and disadvantages of potential new supply options. Facilitate an understanding of the issues associated with the existing supply arrangements.

05 System **operation**

05 System operation

5.1 Operating strategy for the water grid

System operation is one of the three levers that influence system performance of the bulk water supply system, along with supply and demand (Figure 5-1). The ability to operate the system in different ways to influence performance is greatest for integrated networks.

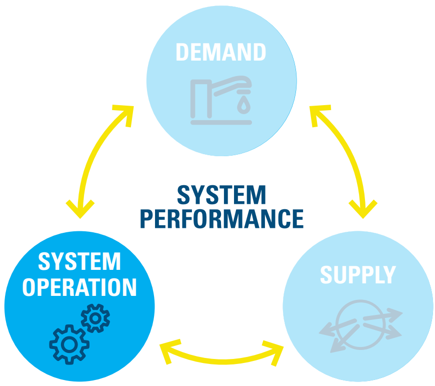


Figure 5-1 System performance – system operation

The integrated nature of South East Queensland's water grid provides flexibility. It allows us to maximise system output, mitigate the impacts of drought and manage emergent issues that would normally result in loss of supply for standard single water supply source schemes (e.g. power outages, floods, temporary raw water quality incidents).

System operation for our region's water grid is guided by the principles of cost effectiveness and water security. The water grid is operated to balance these often competing principles. Accordingly, least-cost operation becomes the main focus during times of plentiful supply, when dam storage levels are high.

As storages draw down, changes to system operation occur progressively to maintain water security, which generally results in elevated operational costs. Such operational changes aim to delay the need for supply augmentations.

These principles – cost effectiveness and water security – ultimately guide the development of operational rules (i.e. triggers) that control the treatment and transport of water across the water grid. The development and implementation of these rules occur within a system operational planning framework. This framework includes the following elements:

- development of operational rules
- asset operation and maintenance strategies
- long-term operational planning
- medium-term operational planning.

The following sections provide an overview of the processes used to develop operating rules, asset operation and maintenance strategies as well as operational planning.

5.2 Development of operating rules

5.2.1 OVERVIEW OF FACTORS AND TRIGGERS

To meet water security objectives the operation of the water grid is guided by a number of rules built on trigger levels aligned to key bulk water storage levels and system constraints. Triggers elicit a change in how our system is operated for existing assets. System operation may also be modified in response to short-term events such as variations in demand, raw water quality issues, system failures or emergencies. Operating rules are based on a number of factors as outlined in Table 5-1.

Table 5-1 Factors that contribute to operating rules

Factor	Contribution to development of operating rules
Cost of production	Each water source and its treatment has different cost profiles for water production. Operating rules aim to maximise the production of least-cost sources when storages are full and then progressively maximise the use of other sources as storages begin to empty.
Key Bulk Water Storage levels	Consideration is given to the current and projected storage levels as a measure of the volume of water available.
Demand	Demand influences how quickly volumes of the key bulk water storages may reduce and thus influence operating rules over time.
Storage inflows	Inflows influence how quickly key bulk water storages will either increase or reduce in volume.
System constraints	The bulk network exhibits maximum and minimum flow constraints. The maximum flow constraint is dictated by hydraulic capacity. Minimum flow constraints are related to water quality. Water quality also potentially limits how far water can be transferred from the source with or without secondary disinfection. Consideration is also given to temporary changes due to maintenance, water quality preferences and ability to delay future infrastructure.
Level of service	Operating rules must be designed to meet Level of Service Objectives (refer Appendix A).
Infrastructure performance standards	Planning criteria (refer Appendix B) are also considered as these standards impose constraints on how the system can be operated.

Operating rules for system operation have been related to regional and sub-regional triggers. Regional triggers are focused on the need to satisfy longer term LOS objectives for the entire region, and are related to the key bulk water storages. While they also contribute to meeting the LOS objectives, sub-regional triggers are primarily used to mitigate the impacts of declining water storages, at a sub-regional level. The processes used to derive the various triggers considered as part of the system operational planning framework are outlined in Appendix H.

5.2.2 REGIONAL OPERATIONAL TRIGGERS

Regional triggers are focused on the need to satisfy longer term LOS objectives. These are developed with the use of the Regional Stochastic Model, which simulates the operation of the storages in the water grid under the influence of a large number of potential rainfall and evaporation variations.

These rainfall variants include cases that are worse than historical droughts experienced in South East Queensland, but are possible should particular climatic conditions occur. Based on this model, assessments are made to establish operational triggers for the Western Corridor Recycled Water Scheme and the Gold Coast Desalination Plant for responding to drought.

Table 5-2 provides an overview of the current regional triggers based on key bulk water storage levels for existing drought response infrastructure. These triggers have been adopted based on assessment to determine the optimal range for operation in conjunction with other drought response measures while meeting the LOS objectives. An overview of the process used in the development and assessment of regional triggers is provided in Appendix H. The assessment undertaken to derive these triggers in conjunction with drought response planning is outlined in Chapter 6 – Planning for resilience.

5.2.3 SUB-REGIONAL OPERATIONAL TRIGGERS

South East Queensland is a very large geographic area so climatic conditions and water security can be markedly different across the region. The distance water can be transferred across the region can be limited by water quality impacts and the amount of water that can be transferred through the network.

Sub-regional triggers (based on the sub-regions of the water grid) are developed to respond to declining water security of a small proportion of the region. Rainfall, and the occurrence of drought, is not necessarily evenly distributed across the region at any point in time. Water security may be threatened within one sub-region without being threatened throughout the entire region. The main objective of sub-regional triggers is to mitigate the impacts of declining water storages at a sub-regional level. They are developed and reviewed by Seqwater each year to reflect the current storage levels, short term operational constraints and climate outlook.

Sub-regional triggers provide a level of operational control and allow an adaptive approach to managing limitations of water transfer within the network. Sub-regional triggers also influence how the interconnector pipelines will operate and generally have a 10-year outlook. Appendix H provides an overview of the sub-regional trigger development process, including the triggers implemented for the northern sub-region as an example.

Table 5-2 Regional triggers – recommissioning and operational triggers

Trigger	Key Bulk Water Storage Level	
	WCRWS	GCDP
Recommissioning	60%	-
Operational	-	60%

5.3 Asset operation and management strategies

5.3.1 ASSET MODES OF OPERATION

The mode of operation of assets directly influences the operation and maintenance costs of the bulk water supply system. For an asset to achieve optimal value over the longer term it is important to establish an acceptable mode of operation that considers both water security and cost effectiveness.

The following modes of operation are considered by Seqwater across our asset portfolio:

- operational
- hot standby
- care and maintenance (cold standby)
- decommission/retire.

To determine a mode of operation, Seqwater considers water security and cost effectiveness along with reliability and resilience factors. In general, the most cost effective assets are used in an operational mode to minimise costs and the more expensive and less efficient ones are used in hot standby and care and maintenance as well as decommissioning/retire. A description of each of these modes is provided in Figure 5-2.

Mode 1 – Operational

Asset is used day-to-day to supply required demand.

Mode 2 – Hot standby

Asset can be made available at short notice and is usually used as a contingency measure. The notification period to elevate to operational mode is asset specific.

Mode 3 – Care and maintenance (cold standby)

Asset is able to have a longer notice period before being required. This mode optimises maintenance costs when the asset is not required.

Mode 4 – Decommission/retire

Asset is no longer required for water security or other reasons and a more cost-effective alternative is available, a decision is made to retire or decommission it.

Diminishing operational cost

Figure 5-2 Mode of operation – cost profile and description

The decision on the mode of operation is based on financial and non-financial assessments such as risk and time to reach operational triggers. Examples of where this process has been applied are outlined below.

- Mt Crosby water treatment plants – Base load operational assets required to achieve day-to-day supply needs for the region.
- Gold Coast Desalination Plant – Hot standby with a notification period of 72 hours for 100% production capability. The main reason for this mode of operation is system reliability and short notification resilience. The reliability need has been demonstrated during flood events which required the operation of the plant to supplement the region's drinking water supply.
- Ewen Maddock and Banksia Beach water treatment plants – Care and maintenance mode of operation with a six-month notification period is applied to these assets. Both treatment plants are designated as drought response measures at a sub-regional level, allowing for longer notification periods.
- Western Corridor Recycled Water Scheme – Care and maintenance mode of operation is adopted with a 24-month notification period. The Western Corridor Recycled Water Scheme forms a regional drought response measure and therefore a longer notification period is currently adopted.
- Petrie water treatment plant – Currently operational but in coming years it will be decommissioned. The decision to decommission was based on comparison of the estimated cost to continue operating the plant (including significant renewals work which would be required in the near future) with the cost of decommissioning the plant and associated network reconfigurations to provide an alternative supply. The impact on water security, system reliability and other risk factors were also considered. Decommissioning the plant was determined to be the most cost effective option.

The decision to decommission or retire an asset is ultimately based on a number of considerations, outlined further in Appendix H. Seqwater considers the mode of operation for an asset as part of its ongoing business operations.

The notification period for the different modes of operation is an important consideration when scheduling renewal and maintenance work. This work needs to be accommodated within the agreed notification period so the assets will be available if required. This approach allows for reduced operational cost under various modes of operation.

5.3.2 PRINCIPLES FOR MAINTENANCE AND RENEWALS

Seqwater's goal is to achieve effective asset utilisation, reliability and availability while operating the bulk water network in accordance with standards of service, at an acceptable operating cost and with the appropriate levels of investment to responsibly manage risk.

The condition of built assets deteriorate over time and the development of proactive, integrated and transparent condition management strategies informs the development of future renewals, maintenance and condition monitoring programs.

Seqwater's asset management strategies vary depending on the mode of operation of the asset. For operational assets, investment in maintenance and renewals is less discretionary, given the more immediate risks involved. However added prudency is required for assets in hot standby or care and maintenance modes. Meeting LOS objectives is reliant on drought-response assets being returned to operation within defined restart periods. Ongoing maintenance and renewals are required to allow the facility to be restarted within the defined period. Over time, the required investment in maintenance and renewals to achieve the restart period will increase as the condition of the built asset deteriorates.

Planning to optimise the whole-of-life investment strategy is undertaken using a Strategic Asset Management program. Maintenance strategies are reviewed periodically for continuous improvement. Our reviews include asset capability assessment, investigation of breakdowns and failures, asset performance analysis and best practice management.

The development of asset renewals, refurbishment and replacement projects is underpinned by a rigorous process to demonstrate investment prudency and efficiency.

Seqwater's investment program of work is informed by:

- the asset management strategy for different classes of assets (which reviews how they are managed over their asset life)
- asset capability assessment (ratings, service standards and constraints)
- asset condition inspection
- asset performance analysis
- maintenance records
- risk assessments
- ongoing emergent works
- minor works improvement and enhancement opportunities.

An asset in operational mode is required to be available for use at any time to supply required demand and therefore maintained to maximise operational use. Planned shutdowns are typically less than four weeks per year. Asset maintenance, renewal and replacement is performed in accordance with the maintenance strategy defined by the class of asset.

Assets that are in hot standby and care and maintenance modes of operation are out of service for a significant time – sometimes years in the case of those assets in care and maintenance mode. These assets have a defined restart period. Maintenance and renewals of these assets is focused on preserving the condition of significant infrastructure on site and a detailed and costed recommissioning program of works to transition these assets into an operational mode within the defined restart period.

Maintenance for decommissioned assets is focused on continuity of public safety and minimisation of impacts on adjacent infrastructure or third-party assets. Assets from decommissioned sites may also be removed and placed in storage for use elsewhere.

5.3.3 AVAILABILITY OF CLIMATE-RESILIENT WATER

Seqwater's climate-resilient water assets, the Gold Coast Desalination Plant and the Western Corridor Recycled Water Scheme, are both relatively large sources of water which play an important role in securing the region's water supply. While purified recycled water and seawater are very resilient sources of water, they have higher operational costs than surface water sources. When rainfall is adequate to keep key bulk water storages full and the associated treatment plants are available, climate-resilient water is used sparingly. This maximises cost effectiveness. Purified recycled water and desalinated seawater play a crucial role in times of drought. Desalination also plays an important role during flood and when major water treatment plants are not available such as periods of extended planned maintenance. Both of Seqwater's climate-resilient water assets are maintained in a state that is not fully operational so it is necessary that both can be returned to full operation within appropriate timeframes. Issues relating to the restart of each of the assets are discussed separately overleaf.

your say

South East Queenslanders want a resilient water supply. The consideration for water planning that the community rated as being most important was:

"Provides a reliable water supply in all climate and weather conditions, including droughts and floods."
(87% of community forum participants gave an importance rating 8-10/10).

5.3.3.1 Gold Coast Desalination Plant

The Gold Coast Desalination Plant currently operates in hot standby, as defined in Section 5.3.1. The desalination plant supplements supply during drought and provides a responsive contingency supply in the event of emergencies or planned maintenance. For contingency supply purposes, the plant has a defined restart period that enables it to return to 33% production within 24 hours and up to 100% production within 72 hours for short-term operation. For longer term operation (greater than several weeks), a notice period of eight weeks is required to allow for securing increased chemical supplies and scheduling of any required maintenance. The ability of the plant to achieve these restart periods, and its value as a contingency supply has been demonstrated in previous flood events which forced temporary shut-down of other major water treatment plants.

To achieve the defined restart periods, cost must be balanced with readiness. The maintenance regime aims to minimise cost in times of limited operation and ensure the restart period is not compromised by down-time for asset replacements. The main difference between the maintenance regime of a fully operational plant and a plant that is in hot standby (like the Gold Coast Desalination Plant) is the approach to the replacement of major components as they near the end of their useful life. In relation to the Gold Coast Desalination Plant, the components which have the greatest cost impact and potential to cause operational down-time are the reverse osmosis membranes. The quantity and quality of water produced by the membranes reduces as the condition of the membranes deteriorates. Monitoring of the quantity and quality of water produced allows replacement of membranes to be scheduled based on membrane performance targets.

The maintenance program is subject to continuous review as part of the maintenance process. The program will also be reviewed in more detail in preparation for a change of operating mode.

5.3.3.2 Western Corridor Recycled Water Scheme

The Western Corridor Recycled Water Scheme (WCRWS) is currently in care and maintenance mode of operation as defined in Section 5.3.1. When placed in this mode of operation it was anticipated that the scheme would not be required to operate in the immediate future. It was expected that it would be returned to operation as required during drought conditions. Seqwater currently has a maintenance program and a restart strategy for the scheme that considers actions, costs, risks (and mitigation measures).

Placement of the scheme in this mode of operation has involved taking actions to maintain all major components in a temporarily inoperable state except for one treatment train at the Luggage Point Advanced WTP, which remains operational. Essential maintenance to ensure the safety of each site continues, however non-essential maintenance is minimised and components with short asset life, such as reverse osmosis membranes, have been removed.

The intention of care and maintenance mode is to maintain the scheme so that it can be returned to full production within a two year period. Restart of the scheme will require significant investment. Components which have been removed will need to be replaced. There may also be a requirement to replace components which have deteriorated or have become obsolete due to technology changes. Planning to maintain the scheme so that it can be restarted in two years involves not only the maintenance of physical components, but also regulatory requirements, licenses and approvals.

Seqwater maintains several levels of planning and operational processes to ensure the restart period can be achieved when required. Our planning seeks a balance between the need to defer capital expenditure on renewals, the likelihood of reaching the recommissioning trigger and minimising the restart period. The restart strategy is reviewed as a minimum in line with reviews of the Water Security Program.

Based on the available information and preliminary estimates of the recommissioning tasks, Seqwater has determined that two years is an appropriate restart period to adopt for water security planning. The single longest duration task is the water quality validation period to obtain approval to supply the water to Wivenhoe Dam, estimated at 100 days. This task also has the highest risk of exceeding the planned duration if one or more of the components perform below acceptable levels. It may be possible, through further, more detailed assessment of the program of required recommissioning tasks, to reduce the recommissioning period through challenging constraints on certain tasks. This assessment is due to be completed in 2018. However based on the level of planning to date, it is considered unlikely that a significant reduction in the recommissioning period will be achievable. Any opportunities for reduction of the recommissioning period will be considered in due course.

It should be noted that this two year recommissioning timeframe is only valid if the scheme is restarted within the next five years. Beyond that, additional component replacements will likely be required. This would increase the cost of recommissioning and could potentially increase the restart period required. Periodic condition assessment and status reviews will identify items which could trigger a review of the restart period, or the need for renewals to allow the currently defined restart period to remain achievable.

Given the two year duration of the restart process, there is a possibility that storage-filling rainfall could occur prior to the WCRWS returning to full operation. Therefore, it is desirable to defer the major capital expenditure items as late as possible in the two year period to reduce the probability of renewing items that may not be needed if the water security situation changes. The major restart expenditure items are labour, defect items and membrane procurement. Labour is needed immediately following the direction to restart and cannot be deferred. Similarly, most defect items would be needed immediately, although some specific tasks could be deferred. In some instances the procurement of membranes may be deferred by between four and nine months without impacting the restart schedule, however this would need to be considered in relation to the availability of the membranes and the likelihood of timely delivery. This may, therefore provide an opportunity to set hold points for capital expenditure within the restart period, which will need to be defined through further, more detailed planning of the restart process.

The WCRWS maintenance program is subject to continuous review as part of the maintenance process. The program will also be reviewed in more detail in preparation for a change of operating mode.

5.4 Operational planning

5.4.1 LONG-TERM OPERATIONAL PLANNING

In developing this Water Security Program, long-term operational planning for the water grid has been undertaken. Seqwater examined how the likely range of broad scale system operating modes affected performance against LOS objectives and performance of potential future bulk supply augmentations over time. Based on this high-level assessment, Seqwater is developing a 30-year operational plan which will refine the planning undertaken to date to a greater level of detail. The plan will incorporate the outcomes of this Water Security Program, operational cost considerations, network constraints, storage inflows, operating rules and future demand.

There are many benefits to developing a 30-year operational plan. Notably, the plan will:

- compare infrastructure options based on operational cost
- identify various operational modes to achieve supply of water at least cost
- enable understanding of the operational modes for the network under fair weather and drought conditions to allow for network infrastructure planning that considers the need to operate the network in a certain manner and maintain adequate capacity into the future
- assist with understanding network constraints that can be addressed to further improve operational performance.

A key aspect of the 30-year operational plan is the consideration of the following two inflow sets as part of the modelling. These inflows are derived from the stochastic inflow set and include the following:

- Fair weather – the fair weather inflow represents a case with regional dam storages at elevated levels (i.e. high water security). Under this situation the bulk supply system operation is reflective of least-cost considerations. To mimic this outcome, the stochastic inflow set has been reviewed and an inflow sequence representing the 50th percentile has been chosen.
- Drought – to gain an understanding of how the bulk supply system responds during drought, a design drought inflow sequence has been derived from the stochastic inflow set (refer Appendix J). This sequence can be used to test how the system performs against a range of drought severities, including that required by the LOS objectives, by varying the duration and severity of drought.

The process for developing the long-term operational plan is outlined in Appendix H.

Previous long-term system operation planning has demonstrated that the way the system operates in fair weather will change in future compared to current operation, largely due to population growth increasing demand. System operation will also change significantly between fair weather and drought conditions. The comparison between current, and planned future operation during fair weather is summarised in Table 5-3.

Table 5-3 Change to asset modes of operation over time

Asset	Current mode of operation	Future mode of operation
Noosa WTP	Operational – production typically minimised, using NPI2 to supplement supply to Noosa.	Operational – production increased to supply most of Noosa demand with minimum from NPI2 as regional demand increases.
Image Flat WTP	Operational – production to meet local demand balanced with supply from NPI2.	Operational – production increased to supply most of local demand with minimum from NPI2 as regional demand increases.
NPI2 (Noosa - Eudlo)	Predominantly northerly flow direction to supplement Image Flat and Noosa supply except when Landers Shute production is decreased for water security.	Predominantly northerly flow direction to supplement Image Flat and Noosa supply except when Landers Shute production is decreased for water security. If a future bulk supply augmentation in the region eventuates, this would change the NPI2 operation.
Landers Shute WTP	Operational – production maximised when source water availability is good, otherwise in accordance with sub-regional triggers.	Operational – production maximised when source water availability is good. More Landers Shute water will be used locally in future as demand increases.
Ewen Maddock WTP	In care and maintenance mode of operation – can be used for drought response.	Mode of operation moved to hot standby by early 2020's and full operation to meet local demand by early 2030's.
NPI (North Pine - Eudlo)	Predominantly southerly flow direction at minimum flow except in drought response or emergency.	Predominantly northerly flow direction from early 2020's, magnitude increasing over time and for peak demands. Southern section reconfigured for Petrie WTP decommission in next few years and expected to reach limit of capacity in peak demand by mid 2030's.
Banksia Beach WTP	In care and maintenance mode of operation – can be used for drought response in accordance with sub-regional triggers.	In care and maintenance mode of operation – can be used for drought response in accordance with sub-regional triggers.
Petrie WTP	Operational – production to meet local demand.	Decommissioned in near future.
North Pine WTP	Operational – production maximised when source water availability is good, otherwise in accordance with sub-regional triggers.	Operational – production maximised when source water availability is good. Over time volume sent to Sunshine Coast increases and volume sent to Brisbane decreases. WTP upgrade in 2023 for increased system capacity to meet peak demand.
Central Brisbane network spine	Transfers a balance of Mt Crosby and North Pine water into Brisbane. In response to northern sub-regional triggers in drought, flow direction is predominantly north with most water supplied by Mt Crosby.	Transfers a balance of Mt Crosby and North Pine water into Brisbane, but increasing proportion from Mt Crosby over time. In response to northern sub-regional triggers in drought, flow direction is predominantly north with most water supplied by Mt Crosby.
Enoggera WTP	In care and maintenance operational mode – can be used for drought response.	In care and maintenance operational mode – can be used for drought response.
Mt Crosby WTP	Operational – production to meet regional demand.	Operational – production to meet regional demand. WTP upgrade in 2029 for increased system capacity to meet peak demand.
WCRWS	In care and maintenance operational mode – can be used for drought response.	In hot standby mode – available for drought response.
EPI	Predominantly easterly flow direction at minimum flow except in drought response or emergency.	Predominantly easterly flow direction at minimum flow except in peak demand, drought response or emergency.
Capalaba WTP	Operational – production typically minimised.	Operational – increased production as local Redland demand increases.
North Stradbroke Island WTP	Operational – production to provide primary supply for local Redland demand.	Operational – production to provide primary supply for local Redland demand, which will increase over time.
SRWP	Predominantly southerly flow direction at minimum flow except in drought response or emergency.	Predominantly southerly flow direction at increasing rate as demand in Gold Coast, Logan and Ipswich increases and Beaudesert is connected to the Grid.
Molendinar WTP	Operational – production to meet Gold Coast demand balanced with minimum flow from SRWP	Operational – production maximised when source water availability is good.
Mudgeeraba WTP	Operational – production to meet local demand.	Operational – production maximised when source water availability is good.
Gold Coast Desalination Plant	In hot standby operational mode – available for drought response or emergency.	Required to operate to meet peak demand by early 2020s, and normal summer demand by early 2030s. Required to operate to full capacity for peak demand by late 2030s.

5.4.2 MEDIUM-TERM OPERATIONAL PLANNING

Since the construction of the water grid, the balance of water security versus cost effectiveness has generally led to a cost-minimisation mode of operation. When water security is high, the system can be operated to minimise costs. In this mode, production volumes from water treatment plants with the lowest cost production are maximised.

As storage levels decrease, focus will shift towards water security drivers, to avoid adverse effects of drought and potentially delay future augmentations. Trigger levels are developed for particular storages and once reached, that source will be supplemented with the next least-cost option for supply.

These concepts are captured as part of the medium-term operational strategy for the water grid. The strategy aims to facilitate the following:

- develop, review and monitor triggers that maintain water security, quality, reliability and cost considerations
- mitigate risks to water supply security
- delay and offset the need to invest in capital infrastructure solutions
- provide operational protocols so drought response measures are implemented when required.

Medium-term operational planning includes sub-regional triggers. This level of planning also looks at the current and future mode of operation for assets and their notification period to determine relevant pre-operational triggers, which are additional to their operational triggers (i.e. when the asset is physically required to operate). This is critical to making specific drought response infrastructure available when required.

A medium-term operational plan, which spans 10 years is produced annually and is reviewed twice a year. The plan is developed every year to capture changes to the availability and performance of existing assets, such as temporary dam lowering or assets which are not available due to significant maintenance.

5.5 Operating strategy options for water security

System operation plays a role in achieving the LOS objectives and securing the continuity of water supply for the region under a range of climatic conditions. The influence of system operation on water security is limited by the sustainability and capacity of the water sources available. It does not offer the ability to create more source water, which will inevitably be required in future. However, system operation does offer the ability to make the most of what we do have and can greatly influence the ongoing cost of operation.

Optimal system operation could be considered to be a balance between competing drivers of water security and cost effectiveness.

- Water security – desire to maximise the water security of the region.
- Cost effectiveness– desire to minimise the cost of supplying water to end water users (considering both operational costs and capital costs associated with modifications to the system to allow it to achieve Seqwater's objectives).

The influence of each of these competing drivers is constrained by the requirement to meet Seqwater's other major objectives relating to the water supply system, including our ability to:

- supply peak demand
- maintain adequate water quality
- maintain adequate reliability and resilience of the system
- meet all regulatory requirements, including safety and environmental management.

For a particular system operation strategy to be viable, it needs to meet the minimum required standards relevant to each of these objectives in accordance with the planning criteria. The influence of these objectives may be translated as an operational cost or capital cost.

The optimal balance between the competing drivers will vary depending on future climatic conditions and demand. Operational or capital costs incurred to respond to future drought are not certain, and can only be measured in terms of probability. For example, it would be possible to adopt an operating strategy that minimises operating costs in the short term, but there is some probability that there will be high capital costs to respond to drought if it occurs. Conversely, an operating strategy with higher operating costs could be adopted that reduces the capital cost, or the probability of incurring that capital cost, if drought occurs. The system operating strategy requires consideration of the probability of events occurring as part of the balance between the competing drivers of water security and cost effectiveness.

Operating the system to maximise water security can increase operational costs through more frequent operation of the more expensive sources of water. Using our climate-resilient water sources all of the time would give some increase in water security but the additional operational costs would most likely be more than the potential saving to be gained from deferring contingent infrastructure or implementing water restrictions. In some cases, existing transfer capacity also limits how much of the demand in the less resilient areas can actually be supplied by the climate-resilient sources. This limits the ability to increase water security in particular areas without investment in additional transfer capacity or climate-resilient sources being located in those particular sub-regions.

Minimising operational costs provides an obvious short term benefit. However, the approach to achieving operational cost savings may reduce water security in the long term. It may also require additional capital cost in the medium term to modify the transfer network to operate differently in a drought situation. If water was continually extracted from the less expensive sources at a rate that is greater than that which is sustainable during dry periods, these sources would eventually be depleted, limiting the amount of water available during drought. Such a scenario would result in an overall reduction in water security and place greater reliance on increased transfer capacity. That would require capital investment or potentially additional climate-resilient contingent supply to respond to drought. Transition from least-cost operation to more expensive operating modes that protect depleting storages, needs to be appropriately timed. Desire to minimise operating costs has to be balanced against the probability of sufficient rainfall to replenish the storage.

Operating the system to minimise capital expenditure on system upgrades in the short to medium term would limit available treatment and transfer capacity. Placing greater reliance on a particular source to defer the need to spend capital on a water quality facility may result in additional capital cost if that source is consequently depleted earlier than expected. Greater transfer capacity would be required to compensate for the inability to use that depleted source.

The optimal system operation strategy will always be some balance between cost and water security. Defining what is optimal is not straightforward. What is defined as optimal is dependent on the probability of a particular sequence of climatic events occurring over time and the demand on the system. The optimal approach will also change over time depending on conditions so the system operation strategy needs to be flexible enough to transition between approaches as conditions change.

The current operating strategy has been developed based on water balance modelling to trial different approaches and compare the probabilistic whole-of-life system cost over a 30 year period. This assessment has been undertaken within the long term and medium term operational planning frameworks. Assessment of the influence of the constraining objectives generally requires planning at a greater level of detail than water balance level planning. Therefore, there is an iterative approach between defining water balance level approaches, assessing the performance of the objectives at a greater level of detail, and then feeding that back to modify the water balance level planning. Seqwater continues to refine the system operating strategy and its influence on water security and other objectives as part of ongoing planning functions.

5.6 Next steps

Seqwater's next steps to implement the system operation outcomes of this program will include:

- monitoring the system performance, including the key inputs, to ensure the regional triggers and modes of operation remain appropriate to meet the objectives of the Program
- review of the restart plans for assets that are in care and maintenance mode to ensure the plans include appropriate detail to achieve the restart requirements and remain fit-for-purpose over time.

Over the longer term, Seqwater intends to further develop its system operation plans as follows.

- Development of the resilience objectives as described in Chapter 6 – Planning for resilience and other appropriate objectives.
- Development and enhancement of tools and models that will be required to support assessment of operating modes and predict how these operating modes will impact Water Security Program objectives.
- Further development of sub-regional triggers.

06 Planning for **resilience**

06 Planning for **resilience**

6.1 Climate of extremes

South East Queensland is subject to weather extremes. In recent years we have experienced the Millennium Drought and the 2011 and 2013 floods. During these times, our communities played an important role by reducing their water use, and our water supply was maintained.

This experience of climatic extremes highlighted the need for robust planning. Our work to better understand how shocks and trends influence the performance of our water supply system to strengthen the resilience of our region.

'Urban resilience is the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt and grow no matter what kinds of chronic stresses and acute shocks they experience.' – 100 Resilient Cities (a Rockefeller Foundation program)

Our water grid, including the introduction of two climate-resilient sources of supply, has been instrumental in improving system resilience.

'Improving the individual systems that make up a city will increase the resilience of the city overall. Resilient systems withstand, respond to, and adapt more readily to shocks and stresses to emerge stronger after tough times, and live better in good times.' – 100 Resilient Cities program.

In future we are likely to experience greater climate extremes. Seqwater has planned to manage floods, which can occur with little warning, as well as slow moving droughts of increasing severity. While the likelihood of experiencing severe floods and droughts is low, we know it is possible. And, with the uncertain impact of climate change in the future, it is critical that when we plan for extreme events we consider the trade-offs.

For example, if we reduce the level of water stored in our dams to minimise the risks of flood, we will increase the risk of entering drought sooner, because we have less water available. The Water Security Program seeks to balance these trade-offs to provide the best outcomes for our communities.

6.2 Resilience

Clean, safe drinking water is critical to a healthy and prosperous region. Seqwater, in partnership with the water service providers, works to supply water in all conditions, including severe droughts and floods.

The Rockefeller Foundation's 100 Resilient Cities program is dedicated to helping cities become more resilient to the growing physical, social and economic challenges of the 21st century. The program sets out seven principles to create a resilient city.

- Reflective – using past experiences to inform future decisions.
- Resourceful – recognising alternative ways to use resources.
- Inclusive – prioritise broad consultation to create a sense of shared ownership in decision making.
- Integrated – bring together a range of distinct systems and institutions.
- Robust – well-conceived, constructed and managed systems.
- Redundant – spare capacity purposely created to accommodate disruption.
- Flexible – willingness and ability to adopt alternative strategies in response to changing circumstances.

Seqwater intends to further apply these principles in planning for resilience of the bulk water supply system.

Water supply is only one of the many systems that support a resilient city. Seqwater will work with our communities, water service providers and government to create a more resilient region, manage shocks and stresses, and operate more effectively in all conditions.

your **say**

Year 7 students from Aspley State High School envision a water future that uses innovation to help alleviate water supply issues during drought.

As part of the 2016 World Science Festival, the students participated in Brisbane City Council's Green Heart Schools Future BNE Challenge. The challenge, supported by Seqwater, saw 400 Year 7 students participate in visioning-solution engagement about their water future. Students were asked to develop a creative solution for water security in the year 2100.

The Aspley State High School team designed the technologically-advanced 'Rain Warrior' spaceship to deliver water to the homes of people affected by drought. Their solution condenses and filters water from the air and fills up home tanks. The 'Rain Warrior' also collects unclean household water and filters it to deliver to areas in drought.

The Aspley students won the Innovation category of the competition.
View the students' submission at yourseqwater.com.au.

6.3 Planning for flood

A flood occurs when water inundates land that is normally dry. The dominant cause of floods in South East Queensland is heavy rainfall, leading to swollen streams and rivers and inundation of floodplains. Flooding can also be caused by tsunamis, large tides and storm surges as well as breaches in natural and manmade barriers, such as dams and levees. Floods are usually a natural process, but human activity affects flooding. Floods occur at irregular intervals and vary in size, area of extent, and duration. Floods cause a shock to the water supply system.

6.3.1 THE IMPACT OF FLOODS ON WATER SECURITY

Floods can impact water security in a number of ways. Impacts can be acute, during the actual flood, and enduring, causing cumulative impacts on water security over many flood events.

Flood events can cause the following impacts on our water supply system:

- catchment damage due to flood waters mobilising sediments and pollutants
- disruption of water treatment plants, reducing capability to treat sufficient quantities of water until the flood passes and source water quality improves
- restricted access to water treatment plants, interrupting operations
- interruptions to electricity supplies and communications services
- damage to water supply infrastructure such as pipelines and pump stations.

Following a flood, the quality of water sourced from a catchment may take some time to recover and may not return to pre-flood conditions. Much of the mobilised sediment may be deposited in water storages such as dams and weirs, reducing the volume of water that can be stored. Over time, this reduction in storage capacity may impact negatively on the system's yield and regional water security.

Floods can affect catchments by causing significant erosion and damage to water courses. The extent of the damage is influenced by the health of the catchment. Catchments that are modified by human activity with reduced vegetation are more vulnerable to degradation by floods. Erosive damage may endure beyond the flood event and, due to land use practices in the catchment, may not stabilise without intervention. This destabilisation can become a permanent feature of a catchment that contributes to poor water quality during normal operations or during small floods into the future.

Reduced water quality will influence the cost of treatment and subsequent flood events can exacerbate this situation.

Floods directly impact communities. Water supply infrastructure, such as dams and stormwater systems, can mitigate the impact of small to moderate floods (depending on how the infrastructure is designed and operated) but has limited ability to mitigate large to extreme flood events. Increasing the flood mitigation benefits that can be achieved by existing water infrastructure can have a negative impact on water security.

THE FLOODS OF 2011 AND 2013

The January 2011 flood was the largest experienced at Wivenhoe, Somerset and North Pine dams since 1974 and had major impacts on South East Queensland communities. The above-average rainfall preceding the flood event meant catchments were saturated. Heavy rains resulted in run-off from the catchment carrying significant sediment loads into the Brisbane and Pine river systems. The resultant highly turbid water reduced the capacity of the Mt Crosby water treatment plants and the North Pine WTP to treat water both during and immediately after the event. In addition, the Mt Crosby East Bank WTP raw water pump station was damaged by floodwater, further affecting treatment capability.

Heavy rainfall and gale force winds generated by ex-Tropical Cyclone Oswald characterised the January 2013 flood. The storm caused widespread damage to water supply infrastructure and persistent loss of power and telecommunications.

Catchment conditions in 2013 were much drier than in 2011. A combination of rainfall and a highly degraded Lockyer Creek catchment produced very poor raw water conditions in the Brisbane River. This was exacerbated by the closure of Wivenhoe Dam's gates for flood mitigation, which reduced diluting flows from the Upper Brisbane River. The Mt Crosby water treatment plants has to be temporarily shut down and production rates at several other water treatment plants were also restricted due to a combination of deteriorating raw water quality and localised power outages.

When there were short-term supply disruptions during these events, Seqwater (and its predecessor organisations) in collaboration with the water service providers, continued to supply water to South East Queensland by utilising the interconnected water grid and Gold Coast Desalination Plant and seeking the community's assistance in reducing demand.

6.3.2 THE RISK OF FLOODS IN SOUTH EAST QUEENSLAND

Flood records in South East Queensland go back to the early 1800s and early European settlement. Since then, 11 major floods have been recorded at the Brisbane River Port Office gauge and many other major floods have occurred throughout the region. This is a relatively short period of recorded flood data. Analysis of the region's climate and hydrology shows there is potential for significantly larger floods to occur in the future. Climate change is also expected to influence the frequency and severity of major floods.

Seqwater works closely with the Queensland Government and other agencies to understand flood risks so that flood management planning is well informed.

6.3.3 INTEGRATED PLANNING TO MANAGE FLOOD RISKS

Integrated planning to manage flood risks seeks to balance water security (including the risk of drought), dam safety, flood inundation impacts downstream of dams, and economic outcomes. Ultimately, trade-offs must be made between flood mitigation and water security while considering the structural safety of the dams and environmental impacts.

6.3.3.1 Catchment improvement

Seqwater invests in water supply catchments to stabilise erosion and improve catchment resilience against future floods. Stabilising erosion reduces the amount of sediment entering waterways and ending up at water treatment plants.

6.3.3.2 Dam optimisation studies

The primary purpose of all of Seqwater's dams is to store water. Somerset and Wivenhoe dams were also designed to help manage floods (through the provision of temporary flood storage compartments above their drinking water storage capacity). Figure 6-1 illustrates the flood storage compartment of Wivenhoe Dam.

While North Pine Dam does not have additional flood storage capacity, it can mitigate floodwater flows through controlled gate releases to reduce the rate of outflow from the dam.

Following the 2011 flood event, the Queensland Floods Commission of Inquiry reviewed flood events across Queensland. The Commission's final report, released in 2012 (QFCI, 2012), made recommendations across a broad range of issues, including dam management.

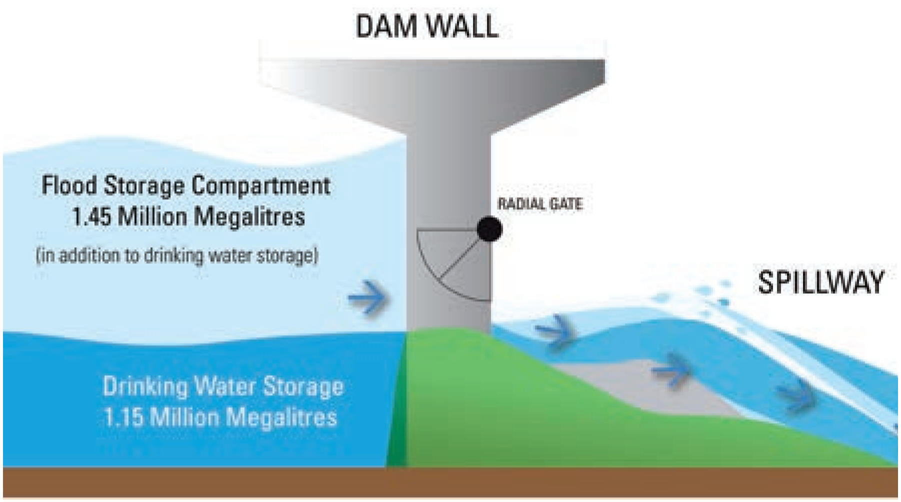


Figure 6-1 Flood storage compartment of Wivenhoe Dam

To address recommendations on the operation of Somerset, Wivenhoe and North Pine dams, the Wivenhoe and Somerset Dam Optimisation Study (WSDOS) and the North Pine Dam Optimisation Study (NPDOS) were undertaken by the Department of Energy and Water Supply with other partners, including Seqwater.

WSDOS investigations extended beyond alternative flood operation modes for Somerset and Wivenhoe dams and considered potential alternative water supply operations. Options included various reductions of Wivenhoe Dam's full supply level to provide additional temporary flood storage and the impact of these reductions on water security. Similarly, NPDOS included a range of alternative operational options for North Pine Dam (such as reductions in full supply level) with a view to balancing the use of existing infrastructure for the dual purposes of flood mitigation and water supply.

These studies included an integrated assessment of operational options. Consideration was given to the trade-off between increasing or reducing flood mitigation measures, water supply security and the extent of disruption to downstream communities from bridge and road inundation and closures. Operational options also considered dam safety so this could be managed.

WSDOS led to pre-feasibility investigations into potential flood storage infrastructure that could provide increased flood mitigation benefits for properties downstream of Wivenhoe Dam in the major population centres of the Brisbane and Bremer river catchments. The study resulted in new flood operation rules that provide improved urban flood mitigation and increased flexibility during the transition between flood mitigation and dam safety strategies.

Based on the assessment of a wide range of flood events, NPDOS recommended that North Pine Dam be lowered to 90% of its full supply level for up to 20 years (i.e. semi-permanent), delivering small improvements in flood mitigation and dam safety, and providing a better balance of short- term benefits without a long-term risk to water supply security.

A key consideration of both WSDOS and NPDOS was to ensure dam safety was not compromised.

6.3.3.3 Prefeasibility investigation into flood storage infrastructure

Continued work is required to further optimise the balance between water security and flood mitigation while managing dam safety. Seqwater has begun a prefeasibility investigation into flood storage infrastructure in the Brisbane River catchment. The investigation is considering options to augment Somerset and Wivenhoe dams to meet required dam safety flood capacity as well as options to augment or operate the dams differently to enhance flood mitigation while minimising water security and community impacts. This research is being carried out within the context of Seqwater's Dam Improvement Program, which includes future upgrades at both Wivenhoe and Somerset dams.

The prefeasibility investigation will include:

- temporary operational changes that could be implemented to improve flood mitigation capacity without reducing water security (such changes may be in place for approximately 10 years)
- the most appropriate upgrades of Wivenhoe and Somerset dams to meet Queensland and Australian guidelines for flood capacity
- analysis of opportunities to create additional temporary flood storage and modify dam infrastructure to provide greater flood mitigation.

These three aspects of the investigation must be undertaken concurrently due to the interdependency of the outcomes. The results will be incorporated in future versions of the Water Security Program.

6.3.3.4 Infrastructure and development

Flood risk can also be influenced by planning for new infrastructure and development. Consideration of where new development occurs can reduce the community's exposure to flooding risks in the future. New infrastructure might also influence the response of flood water in a local area. Appropriate planning by responsible agencies is required to ensure optimised performance of infrastructure and drainage.

An example of a trade-off between development and water security is the impact of development downstream of large dams. An increasing population in the floodplain downstream of a large dam increases exposure to flood and dam safety risks because more people are potentially impacted. As a responsible dam owner, Seqwater must manage these increasing risks, which in turn may lead to decisions that reduce water security or increase the cost of supplying water to communities. Development and local drainage risks are often outside Seqwater's area of direct influence so Seqwater must work with other planning authorities to manage these risks.

6.3.4 FLOOD PLANNING

Floods can occur at any time, although they are more common in the wet season.

To prepare for a potential flood, Seqwater conducts pre-summer risk assessments of all its assets to identify issues of resilience, reliability and capacity constraints so that appropriate control mechanisms can be put in place.

A key aspect of responding to floods in the context of water security planning is managing potential risks to water supply and their consequences. Seqwater and the water service providers have improved our flood responses based on learnings from recent events. Actions can take the form of a demand, supply or system operation response or a combination of these depending on the severity of impact, as described below.

6.3.4.1 Demand response

It is important to keep our communities well informed about using water responsibly when treated water production is reduced or disrupted. Managing demand will slow the consumption of treated water stored in suburban reservoirs and reduce the likelihood of them emptying. Demand responses range from general media messaging asking consumers to conserve water, to water service providers exercising water restriction emergency powers under the *Water Supply (Safety and Reliability) Act 2008*. The timing for implementing these responses will depend on the severity of the event and is guided by agreed media and communication protocols.

6.3.4.2 Supply response

As floods can cause short-term water supply disruptions by impacting infrastructure, the resilience of critical infrastructure must be continually reviewed. This includes review of the ability of dams to pass major flood events and the ability of the water supply system to treat and transport sufficient quantities of water at an acceptable quality during and after major flood events.

6.3.4.3 System operation response

The value of the interconnected water grid is highlighted in times of flood, when a system operation response can maintain supply to the region. While flood impacts to water supply infrastructure pose short-term supply risks, the water grid helps us to respond to such extremes.

Seqwater's operational preparedness is achieved through:

- increasing treated water storage in the central sub-region to address any vulnerability caused by events which may impact on supply from the Mt Crosby water treatment plants
- maintaining the Gold Coast Desalination Plant in hot standby mode so it is ready to provide back-up supplies at short notice
- maintaining a thorough understanding of system performance through real-time modelling and distributing the available bulk water produced at the time to satisfy demand – this involves timely reversal of flows in interconnectors
- undertaking joint training and emergency response exercises, which enable staff to experience emergency management scenarios
- having short-term water supply disruption plans in place for each off-grid community.

Seqwater also operates a 24-hour control centre to monitor the bulk water supply system, as well as a flood operations centre, and works with the Bureau of Meteorology to enable timely responses to emerging issues and help minimise downstream impacts from dam operations.

In response to the 2011 floods, the Queensland Government amended the *Water Supply (Safety and Reliability) Act 2008* to include provisions for the Minister to declare temporary alterations to the full supply levels of dams that have an approved flood mitigation manual. This provides one mechanism for preparedness before a predicted wet season, increasing the temporary flood storage capacity of Wivenhoe and North Pine dams through planned releases to maintain the supply at predetermined levels that sit below normal full supply level.

6.3.5 ONGOING WORK

Future flood events have the potential to cause severe and widespread impacts. Seqwater will continue to work cooperatively with our communities, water service providers and other government agencies to continuously evaluate and improve responses

Seqwater will also continue to provide input and feedback on any future South East Queensland flood mitigation planning, including appropriate consideration of the implications on water security.

6.4 Planning for drought

A drought is an extended period of time with low or no rainfall that can result in a water supply shortage – stress on the water supply system.

In South East Queensland there are regular periods of low rainfall. The water grid provides resilience to respond to this rainfall shortage. However, the more extended and severe the drought, the more significant the shock on the water supply system. Such a shock must be managed by changing the way the system operates, reducing demand on the system, and introducing new supply options.

The Millennium Drought demonstrated the consequences of prolonged drought. Many lessons were learned, including:

- the need to have a detailed action plan in place
- the importance of acting quickly in accordance with the plan
- the importance of being prepared for a drought worse than any on the historical record
- the importance of being adaptable as the drought progresses and engaging with communities.

Seqwater has a well-planned drought response that we are ready to implement should storage volumes reach trigger levels (Section 6.4.5). Once triggered, we will work with the water service providers to adapt our response as the drought progresses and keep communities informed.

The drought response detailed in this Water Security Program balances cost, water security and community outcomes, and recognises the lessons learned from the Millennium Drought. It utilises current Seqwater infrastructure and the principles of optimally applying the system operation, supply and demand levers to:

- provide a long term, least cost to the community solution
- delay construction of contingent infrastructure.

The drought response approach presented below encompasses all communities drawing drinking water supplies from the key bulk water storages. This includes the water grid-connected communities, and the off-grid communities of Kilcoy, Esk, Lowood and Somerset. All other off-grid communities have a site-specific drought response plan (refer Appendix N).

Licenced irrigators who use water from Seqwater dams are not subject to this drought response approach. Irrigation is managed under the announced allocation formula in the Department of Natural Resources and Mines Resource Operations Plan, which is independent of this drought response plan.

This version 2 drought response approach differs from the version 1 approach. It is based on more detailed modelling and data, and a greater understanding of the impact of drought response on the bulk water supply system. By responding earlier, Seqwater is able to defer contingent water supply infrastructure and reduce the likelihood of reaching severe water restriction triggers.

The significant progress of the drought response approach between versions of the Water Security Program is outlined in Table 6-1.

Table 6-1 Progress from version 1 to version 2 drought response plan

Version 1	Version 2
• Carried over the drought response triggers from the Queensland Water Commission approach, which was developed after the Millennium Drought. • Commenced a consultative approach with the water service providers. • Introduced the concept of the three levers – supply, demand and system operation and their combined use in response to drought, however did not fully cost all of the options.	• Application of the design drought to drought response planning (refer Appendix J). • Continued consultation with water service providers and developed a more collaborative approach. • Updated and included additional information (e.g. operating costs and societal impacts). • Considered probabilistic cost impacts. • Revised triggers based on robust modelling.

During the next five years, Seqwater will continue to work collaboratively with the water service providers and our communities to refine and improve our drought response.

6.4.1 THE IMPACT OF DROUGHT ON WATER SECURITY

Droughts can impact water security in a number of ways from catchment to tap. Droughts can result in short-term impacts on communities and enduring impacts, if not managed well.

Drought events can cause the following impacts on our water supply system:

- reduction of available supply from surface and groundwater sources, resulting in reduced water security
- increasing requirement on communities to reduce water use
- catchment impacts due to reduced rainfall which affects biodiversity and soil structure and thus increases the risk of mobilisation of sediment if heavy rainfall occurs after the drought
- increased likelihood of water quality impacts in surface water storages due to algal growth.

6.4.2 THE RISK OF DROUGHT IN SOUTH EAST QUEENSLAND

Rainfall and temperature records for South East Queensland go back to the early 1890s. Since that time two major droughts have been recorded – the Federation Drought (circa 1899–1902), and the Millennium Drought (2001–2009).

Climate history obtained from ice core records shows greater natural climate variability. These records show there have been eight droughts in the past 1,000 years which lasted more than five years, and one mega-drought which lasted almost 40 years. Climate change is expected to alter rainfall and temperature patterns in the region and therefore the frequency and severity of droughts.

It is not possible to accurately predict drought, so it is possible for South East Queensland to move into drought at any time. Seqwater works closely with the Queensland Government and other agencies to understand climatic risks so that drought planning can be properly informed. Further detail on drought risk is provided below and in Appendix J.

6.4.3 INTEGRATED PLANNING TO MANAGE DROUGHT RISKS

In developing a drought response approach it is necessary to consider the best water security and cost outcomes for our communities, while complying with regulated requirements and considering water service provider business requirements.

6.4.3.1 Seqwater regulated requirements

Seqwater is required to develop a drought response approach and meet the LOS objectives for drought response. The LOS objectives stipulate requirements for the duration, severity and frequency of water restrictions (refer Appendix A). In addition, the Department of Energy and Water Supply guideline requirements establish key criteria to consider in the development of a drought response approach. Compliance with the LOS objectives is summarised in Table 6.2.

In addition, Seqwater must set triggers for the:

- drought response level (drought response actions commence) – this level is 60% KBWS.
- safe minimum storage level (trigger for taking more severe action in response to drought to minimise the risk of storages reaching minimum operating levels) – this level is 25% KBWS.
- EMSV restrictions level (trigger for reducing total consumption to 100 L/p/d) – this level is 5% KBWS.

It is important to note that public communication about drought response will occur before the drought response level is reached. Communication about water efficiency will increase at 70% to provide enough time to build engagement momentum before the drought response level. Justification of the drought response trigger levels can be found in Appendix I.

Table 6-2 LOS compliance of current operating strategy and the drought response

LOS objective		Current operating strategy and drought response
LOS yield		440,000 ML/annum[1]
Criteria	**Complying value criteria statistic**	**Value achieved**
Key bulk water storages reaching 50% (Medium level restrictions trigger)	Less than once in every 10 years on average	Once in every 11 years on average
Key bulk water storages reaching 5% (Essential minimum supply volume trigger)	Less than once in every 10,000 years on average	Did not occur
Brisbane storages reaching minimum operating level	Less than once in every 10,000 years on average	Did not occur
Baroon Pocket Dam reaching minimum operating level	Less than once in every 10,000 years on average	Once in every 12,333 years on average
Gold Coast storages reaching minimum operating level	Less than once in every 10,000 years on average	Once in every 110,987 years on average
Average duration of medium level restrictions[2]	Less than or equal to 1 year on average	10 months on average

1. For drought response an LOS of 440,000 ML/annum has been determined based on the current operation of the system.
2. Average time KBWS remain below 50%.

6.4.3.2 Drought response principles

Water security, cost and community outcomes have been considered in developing this drought response. Seqwater is also committed to:

- collaborating with water service providers, our partners in implementing drought demand management.
- avoiding the EMSV demand restriction trigger due to the significant community impact. EMSV is the volume of water that must be supplied under extreme water restrictions when storage levels are at very low levels. The EMSV is 100 litres per person per day, combined residential and non-residential demand, which is extremely low and should be avoided where possible. The EMSV requirements are detailed in Appendix A.
- cost-effectively optimising Seqwater infrastructure to manage supply before imposing water restrictions on our communities or building new water supplies.
- keeping the community informed and providing a stepped drought response, with a community communication journey from voluntary to mandatory drought response demand management measures.
- meeting regulated requirements.

Seqwater recognises the significant impact of water restrictions on South East Queenslanders, especially more severe water restrictions, and will cost effectively optimise assets and implement voluntary demand management before introducing severe water restrictions.

6.4.4 DROUGHT PLANNING

Our drought response aims to optimally apply the system operation, demand and supply levers. All actions for each lever have been costed and can be compared to determine the most effective drought response solutions based on current knowledge.

6.4.4.1 Demand response

The demand options to respond to drought are detailed in Chapter 3 – Demand, and have been developed with the water service providers. Demand options including rebates, retrofits, voluntary programs and water restrictions were selected due to their:

- potential water savings
- effectiveness during the Millennium Drought
- consistency with drought response approaches within Australia and throughout the world
- ability to implement
- economic impact (including potential social impacts).

The drought demand management options have been staged in the drought response to delay the more severe and costly options. This staged approach enables an effective community drought awareness and education journey. Each stage begins with communication about the commencement of drought, with messaging increasing as the drought continues, including suggested voluntary water-efficiency actions. Voluntary options will be implemented before mandatory water restrictions. A range of voluntary options continue to apply when mandatory water restrictions are in place. Refer to Chapter 3 – Demand, for further detail.

Upon reaching 50% KBWS, medium level water restrictions will commence together with voluntary rebate or retrofit programs. At this time the GCDP will already be operational and the WCRWS is planned to be almost recommissioned, if not already operational. As the drought becomes more severe, water restrictions will also increase in severity. Before severe water restrictions are imposed, the WCRWS is planned to be operational. Each stage of the demand drought response has a targeted demand reduction for residential consumers. This target is a regional average, recognising that some areas will achieve reductions less than the target and others will achieve greater savings. This average allows for the differing climatic conditions, soil types, industries and water uses throughout the region.

Water restriction schedules for each water restriction level will be developed with the water service providers. The regulation makes some stipulations about restrictions, such as a requirement that medium level water restrictions do not include water restrictions for non-residential customers, except for general outdoor water use, such as garden irrigation and outdoor cleaning. This requirement will be consistent for residential and non-residential customers. Where outdoor water use is part of business production (e.g. nurseries) restrictions will not apply.

6.4.4.2 Supply response

Supply options for drought response are detailed in Chapter 4 – Supply. Due to the optimisation of the system operation and demand levers, the drought response for this version of the Water Security Program only requires a contingency supply operational at the EMSV restriction trigger. The selected supply response to meet EMSV supply before 2026 is temporary desalination. The site(s) and appropriate sizing will be further considered and determined at the time of drought, based on where the water is required, demand, climatic conditions and other factors. This determination will be well in advance of the contingency construction trigger.

The desalination plant or plants will be temporary as the next bulk water supply is not required for some time. Temporary desalination will provide a climate-resilient solution, with a construction time of up to two years.

As the probability of reaching the contingency construction trigger is very low, a contingent water supply is not likely to be required within the next five years. Over a longer period, modelling shows contingent drought response infrastructure is required due to increased total demand. To be prudent, a contingent infrastructure construction trigger has been included in this drought response approach.

The planning for contingent infrastructure will commence at 60% KBWS once the GCDP is operational and the WCRWS recommissioning has commenced.

At this time, consideration will be given to further investigations into the effectiveness of using other decommissioned water supply assets or assets not connected to the water grid and the need to bring forward planned base case augmentations. These assets will be available at appropriate triggers to cost-effectively defer the need for temporary contingent infrastructure and avoid reaching the EMSV restriction trigger.

Due to the low probability of reaching the regional EMSV restriction trigger, it is possible that after construction has commenced, significant rainfall will occur resulting in drought exit before the temporary desalination plant is commissioned. A drought exit trigger of at least 60% KBWS would be required before construction ceasing. Any lower drought exit trigger may result in a return to the drought contingent infrastructure trigger within a short time. The financial implications of ceasing and re-starting construction could be significant.

6.4.4.3 System operation response

System operation options to respond to drought are based on current Seqwater infrastructure and are outlined in Chapter 5 – System operation. The key system operation options are to change the modes of operation of the GCDP and WCRWS. By maximising the yield from these existing climate-resilient water assets, the need for new supply assets and severe water restrictions can be minimised.

The GCDP operates in hot standby mode and can be fully operational within 72 hours for short-term operation and eight weeks for longer term operation.

The WCRWS has been placed in care and maintenance mode and will require almost two years of recommissioning and water quality testing before it can be fully operational. Seqwater is refining a recommissioning plan, including possible events and timing for when recommissioning may be suspended. The timing of any suspension of recommissioning is limited due to the significant early financial commitment required.

A target WCRWS operation trigger has been used for modelling purposes, but if the scheme is ready (including regulatory approvals) before reaching this trigger it would become operational. The mode of operation will be reviewed once the WCRWS is recommissioned, with consideration of the KBWS level and drought situation at the time.

Drought response modelling has shown that the WCRWS is a key drought response asset. As total water demand grows over time, a higher trigger to commence operation will be required to maintain water security and compliance with the LOS objectives. The increased frequency of use means there is unlikely to be any financial benefit gained from decommissioning the WCRWS between droughts. Decommissioning would be of benefit only where the WCRWS would not be operational for a long period of time. Once recommissioned, the WCRWS will remain in hot standby mode of operation. Ongoing maintenance of the WCRWS will be continually optimised.

A range of other system operation options will be used, including the Northern Pipeline Interconnector, Southern Regional Water Pipeline and Eastern Pipeline Interconnector. Refer to Chapter 5 – System Operation for more detail.

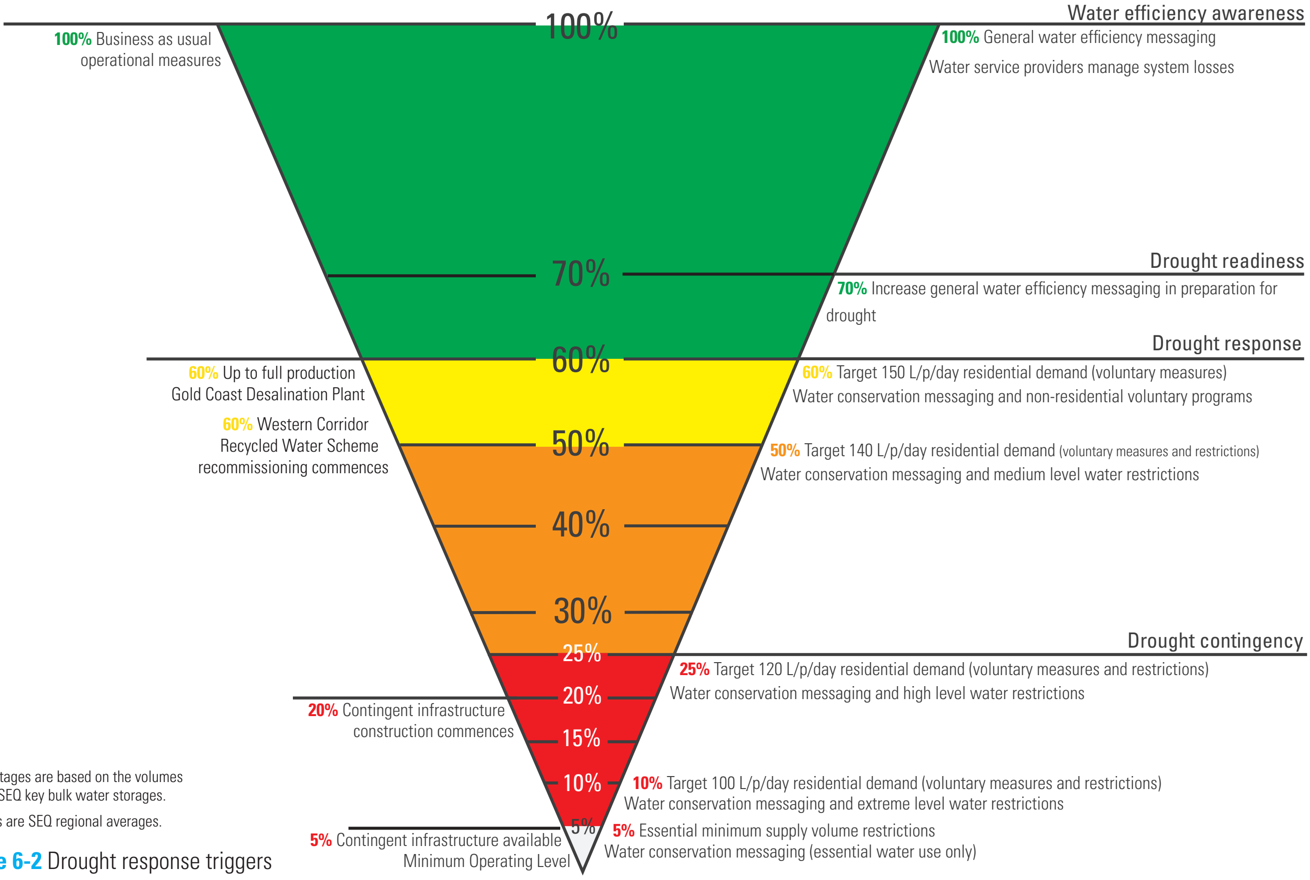
In the event of a severe drought, Seqwater will also consider bringing online other system operation options currently in care and maintenance mode, along with possible future planned upgrades, where they cost-effectively provide significant climate-resilient water supplies. These options will be considered and investigated in early drought planning between 60–50% KBWS.

6.4.5 DROUGHT RESPONSE TRIGGERS

Our drought response approach is adaptive to allow actions and triggers to adjust to demand, climate, severity of drought and other external factors. This flexibility is critical to a resilient region. Nevertheless, triggers should not be significantly delayed or the benefit of the actions will be diminished. In a severe drought, delays could result in a serious risk to water security. Some actions may be brought forward if the drought is more severe than the supporting modelling has anticipated.

The drought response triggers detailed in Figure 6-2 are the result of extensive modelling (refer Appendix I). We aim to optimally use existing infrastructure before introducing water restrictions, consistent with the principles in Section 6.4.3.2. Triggers are based on the percentage capacity of the KBWS.

Table 6-3 lists the actions that will be taken at each KBWS trigger level. The detail of the actions can be found in their respective chapters.



Notes:

1. Percentages are based on the volumes of the SEQ key bulk water storages.
2. Targets are SEQ regional averages.

Figure 6-2 Drought response triggers

Table 6-3 Key drought actions at each KBWS trigger level

KBWS % capacity	Key system operation action	Key demand management action	Key supply action
60%	GCDP fully operational WCRWS recommissioning commences	Drought communication Target 150 L/p/d	
50%		Drought communication Medium level water restrictions Voluntary residential demand management programs Voluntary non-residential programs	
40%	WCRWS operational target#	Drought communication	
25%		Drought communication High level water restrictions	
20%		Drought communication Possibility of extreme level water restrictions	Contingent infrastructure construction commences
10%		Drought communication Emergency level water restrictions	
5%		EMSV restricted demand	Contingent infrastructure operational target#

 # where the asset is ready (including regulatory approvals) it may be operated earlier than the operational target

Table 6-4 highlights the drought demand management actions at each trigger level. The detail of the water restriction schedules will be determined with the water service providers.

Table 6-4 Drought demand management measures at each KBWS trigger

KBWS trigger level	Drought demand management actions
100-60%	Continuing business as usual measures including: • residential indoor and outdoor water efficiency information • system loss programs • metering
60-50%	Pre-drought messaging Increased residential indoor and outdoor water efficiency program Non-residential voluntary measures Non-residential voluntary programs for specific user groups
50-25%	Drought messaging target 140 L/p/day Medium level water restrictions (target 140 L/p/day residential demand) Rebate or retrofit program on water efficient devices
25-10%	Drought response messaging target 120 L/p/day High level water restrictions (target 120 L/p/day residential demand) Where required the following can be implemented in the lower percentages of this band: • Demand response messaging target 115 L/p/day • Extreme level water restrictions (target 115 L/p/day residential demand)
10-5%	Drought response messaging target 100 L/p/day (emergency response) Emergency level water restrictions (target 100 L/p/day residential demand)
5% (EMSV)	Required to supply 100 L/p/day (combined residential and non-residential demand)

6.4.5.1 Drought response drawdowns

During the Millennium Drought, water storage levels fell below 20%. When this drought response plan was tested against Millennium Drought inflows, the KBWS did not fall below 40%. This difference can be attributed to the operation of the water grid, including the use of the WCRWS and the GCDP.

The drought response approach was also tested against design drought inflows, with a starting point of June 2015, when the KBWS levels were at 97% – a comparable starting point to the Millennium Drought.

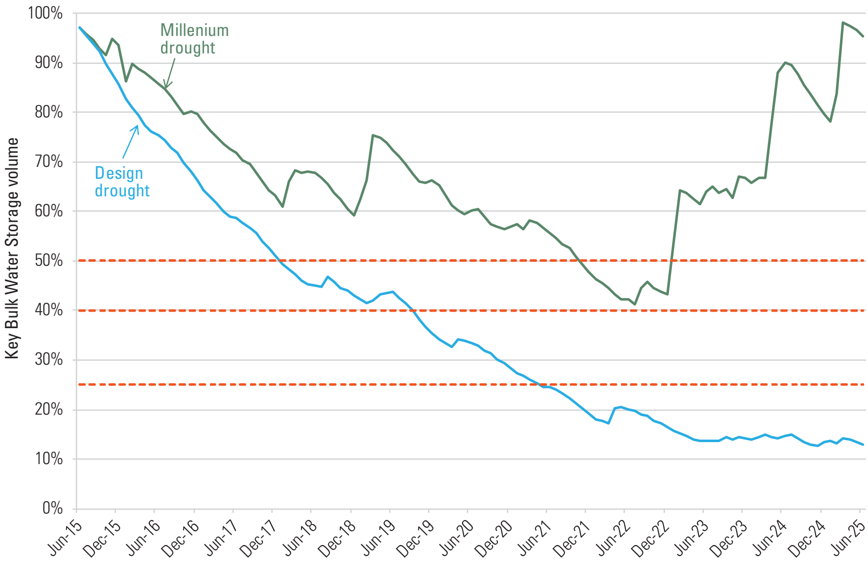


Figure 6-3 Comparison of Millennium Drought and design drought drawdowns using the version 2 drought response approach

The design drought was developed based on data from our historic record to define a potential drought worse than the Millennium Drought (refer Appendix J). Figure 6-3 simulates the drawdown of the two scenarios using the version 2 Water Security Program drought response. For the much more severe and longer lasting design drought inflows, the planned drought response measures would prevent the KBWS dropping below 10%.

6.4.5.2 Drought exit triggers

Drought exit triggers have not been prescribed. South East Queensland will exit drought adaptively for the drought situation at the time. Drought exit will not be the same trigger as drought entry and it will be a stepped exit. At the time of each potential stepped drought exit, consideration needs to be given to the climatic conditions, demand, probability of again reaching the drought response entry trigger, drought response action and other relevant matters. For example, it may be relatively simple and cost-effective to cease some system operation options and operate them again within a few weeks or months. Options such as rebate and retrofit programs, and water restrictions require longer lead times for ceasing and restarting.

Drought exit will be clearly communicated to the community at each stepped drought exit event.

6.4.6 DROUGHT RISK

The level of risk associated with drought occurring over the next five, 10 and 20 years has been assessed based on the existing water supply system and its current operational strategy.

The level of risk posed by an event depends on the:

- likelihood of the event occurring and
- consequences of the event occurring.

Detail on drought risk modelling and probabilities, regional and sub-regional, is provided in Appendix J. The consequences and impacts of reaching the KBWS trigger levels are considered below and summarised in Table 6-5.

- At 60% – minimal as there is a slight increase in operational costs, and there are no community impacts from demand management measures as these measures are voluntary and significant supplies remain in the storages.
- At 50% – small as medium level restrictions are introduced that only affect outdoor watering and there are still significant supplies in the storages.
- At 40% – moderate as there are no additional community impacts but there would be some concerns for water security.
- At 25% – high as high level demand management measures are likely to have more significant impacts on daily life and there are potential risks to water security.
- At 20% – very high as while there are no changes to demand management measures, water security concerns are higher and cost impacts from implementing contingent infrastructure will be high, noting these costs will ultimately be borne by customers.

The drought risk assessment presented in Table 6-5 is based on a 10-year timeframe, consistent with the drought response approach. Factors such as increased demand, LOS objective reviews and recommissioning of the WCRWS, are likely to trigger updates to this drought response plan within 10 years.

Monitoring of storage levels against drought inflows illustrates that even though the cumulative probability of reaching drought response triggers may be low, preparations need to be in place because a drought can occur at any time.

Table 6-5 Drought risk assessment as at 5 January 2017

KBWS trigger	Probability of occurring over the next 10 years	Likelihood of occurring over the next 10 years	Consequences	Risk
60%	35%	High	None	Low
50%	10%	Medium	Small	Low
40%	2%	Low	Moderate	Low
25%	<0.1%	Extremely low	High	Very low
20%	<0.1%	Extremely low	Very high	Very low

6.4.7 ONGOING WORK

6.4.7.1 Review of triggers

Our drought response must remain effective and adaptable, so drought response triggers will be reviewed:

- every 12 months through Seqwater's operational planning process to maintain water supply security, including consideration of current infrastructure capability and demand
- at least every five years, as part of the Water Security Program, this review may include a reassessment of triggers including the modelling assumptions.

The methodology used to determine the drought response will be used to undertake these reviews however Seqwater may update the methodology for future versions of the water security program.

In addition a review will occur if, for example:

- the WCRWS is recommissioned
- the LOS objectives are revised
- demand changes by +/- 10%
- regulated requirements change
- a drought has occurred
- there is change to the operating full supply level of a KBWS or a +/- 10% permanent change to the production capacity of a grid-connected water treatment plant

Triggers will be revised if:

- a review indicates triggers are not sufficient to maintain water supply security (for example if LOS objectives are not met)
- regulatory change alters the availability of options
- economic impact changes to the extent that the efficient ordering of options changes
- there is strong community feedback to change the triggers.

6.4.7.2 Preparing for drought

Seqwater is prepared for drought. Our drought response is developed and we are working with the water service providers to develop detailed implementation plans.

We will monitor KBWS levels and water demand to be ready to take drought response actions when required and we have systems in place enabling operations to be prepared for a potential drought response. When we are approaching a drought response trigger, we will collaborate with the water service providers and communicate the relevant actions to be taken to the Queensland Government and our communities.

6.4.7.3 Future drought response approach

Future drought response approaches may differ from this drought response. Our drought response must be reviewed regularly (Section 6.4.7.1) to maintain its effectiveness for water security and cost.

Seqwater will work collaboratively with the region's water service providers on future drought response approaches. It has already been agreed that the future drought response approach should achieve long term best value to our communities and that the approach will be developed by:

- optimising the use of existing water supply assets
- considering customer and community desire for, and impacts of, demand management
- construction of contingent and future water supply infrastructure when economically prudent
- recognising that water quality is essential and as important as water quantity
- providing an adaptive approach that can respond to changing conditions.

We will also work with the water service providers to engage our communities about future drought response approaches, including the detail of the water restrictions.

6.5 Next steps

In this version of the Water Security Program, Seqwater has considered flood and drought as the acute shocks and chronic stresses that will impact the resilience of the South East Queensland water supply system. Seqwater's next steps are as follows.

- Long-term planning work with water service providers, stakeholders and the community to:
  - implement the drought response approach
  - further develop and adapt the drought response approach for future versions of the Program.
- Optimise the balance between water security and flood mitigation while appropriately managing dam safety.

07 Planning for **the future**

07 Planning for the future

7.1 Integrated planning

Integrated planning considers all water security objectives in parallel to identify how Seqwater can achieve the best outcomes for our communities. Traditionally, bulk water supply planning has considered the LOS, treatment and transport objectives in isolation and developed options to respond to each of these separately. In the past, solutions also focused predominantly on cost and not community values and preferences. The integrated planning approach means all of these objectives are considered in parallel, enabling optimisation of the long-term plan for water security.

The integrated planning approach is consistent with leading practice for water utilities and crucial to adaptive planning. By considering the critical infrastructure investment drivers and system operating strategies in parallel, options that can contribute holistically to the existing and future system are better identified.

Integrated planning is a structured process where the following questions are considered.

1. How do we best meet our long-term water security requirements and achieve the LOS objectives, including during drought conditions?
2. When consumption is very high, e.g. during peak demand periods daily and seasonally, what is the most efficient way to treat water to the expected high quality and to store and transport this water to where it is needed?
3. How do we develop a solution that best reflects the needs and values of our communities?

The answer to these individual questions may be different when the questions are considered together. For example, the system may be able to provide water for long-term growth but peaks in demand may be experienced in areas where the infrastructure is at capacity, constraining the ability to supply enough treated water. Conversely, a solution may achieve long-term water security objectives and peak demand objectives, but may not reflect community views and values.

The optimum solution, when the questions are considered together, will be one that provides the best overall system performance (fine-tuning demand, supply and system operation) and aligns with community needs and values.

The drivers of long-term water security planning introduced in the first Water Security Program were:

- achieving the LOS objectives (refer Appendix A) to sustain the water supply system, including during times of drought
- being able to treat, store and transport enough water to provide water 'on demand' during very high consumption periods, usually during the hotter, drier summer months (refer Appendix B).

Version 1 of the Water Security Program identified that there are many supply options which can efficiently achieve optimal system performance when considering LOS objectives and peak demand concurrently.

This Water Security Program has enhanced the integrated planning approach by introducing the consideration of community views and values in relation to the economic, environmental, resilience and social (people and place) performance of options.

This integrated planning approach is underpinned by a modelling framework (Appendix K), and is developed and tested through a systematic options assessment framework.

The options assessment framework used to develop this version of the Water Security Program applies a combination of cost effectiveness analysis and multi-criteria decision analysis (MCDA) in developing investment strategies for long-term water security.

The Program considered the economic impacts on the community for the assessment of drought response demand management options only (refer Chapter 3 – Demand).

Future versions of the Water Security Program will extend this framework to integrate other water security objectives, such as short-term system reliability, dam safety, catchment management, water quality and liveability objectives.

7.2 The assessment approach

Integrated planning using an adaptive approach considers the broad range of option types and determines their ability to provide water security under different conditions.

The Water Security Program is required to identify an appropriate balance of demand, supply and operational options that achieve the greatest value for our communities. Options are assessed against their contribution towards meeting the LOS objectives and planning criteria – both mandatory requirements in developing the Program. Options are also assessed against broader considerations, including economic, environmental, resilience and social (people and place) impacts.

Seqwater has undertaken extensive whole-of-system modelling and analysis, underpinned by a flexible and adaptive options assessment framework (Section 7.3), to determine how the system responds to various combinations of supply and demand options, and operational strategies under a range of conditions. Based on the information gained through this assessment, the trade-offs of investment pathways can be better understood.

WHAT IS A TRADE-OFF?

A trade-off refers to the benefits and costs associated with a single option or a particular combination of water security options.

It is unlikely that any one option or combination of options will achieve outstanding performance against all areas, including the ability to respond to drought, economic, environmental, people and place, and system resilience factors. Some options will perform better in drought but not so well economically, while others may be lower in cost but have a higher social impact.

Some of these trade-offs are site-specific and subject to future detailed investigations. Others require community input to understand how to make decisions about trade-offs that align with community values. Seqwater has sought community views to better understand the values and how to rank these trade-offs. We will continue the conversation with our communities as options and community values evolve over time.

7.3 The options assessment framework

The options assessment framework describes the assessment process. It demonstrates how Seqwater can achieve the primary LOS and treatment capacity objectives over the next 30 years, and considers how a range of supply, demand, system operations options may contribute to meeting those objectives. The framework also incorporates community values and views in the selection of options.

The options assessment framework in this version of the Program is based on the Institute for Sustainable Futures framework (2011). This framework particularly sought to incorporate community views and values about water considerations relating to the economic, environment, resilience and people and place performance of options (refer Appendix C) and the performance of the system.

The options assessment framework provides a systematic way of defining, analysing and recording the:

- water security objectives, boundaries and key performance criteria to be assessed
- system characterisation
- system influences
- scenario selection
- option identification and characterisation
- investment strategies
- investment pathway development and assessment
- assessment of shock influences.

7.3.1 OBJECTIVES, BOUNDARIES AND KEY PERFORMANCE CRITERIA

The objectives, boundaries and key performance criteria for the Water Security Program (Table 7-1) are consistent with regulated obligations, Seqwater's organisational vision, and industry and stakeholder values.

This Water Security Program aims to meet regulated LOS objectives and operational performance objectives (i.e. supply water to meet peak demand needs). There is also the consideration of costs and benefits to find a solution that best meets community views and values. Community engagement has provided information to guide selection of options (specifically in refining and weighting of criteria), rather than specifying outcomes in this Water Security Program.

Table 7-1 Defining objectives, boundaries and criteria

Inputs	Tools and processes	Outputs	Outcomes
LOS objectives	Provided by DEWS	Planning objectives	Planning objectives consistent with regulated requirement
Water security program for south east Queensland – Guidelines for development Version 3	SEQ water service provider engagement	Defined system boundary	Planning boundary defined – options assessment tailored to system boundary, with constraints identified
Planning criteria	SEQ water service provider engagement	Peak demand planning objectives for treatment capacity	Planning objectives incorporate ability to treat enough water in periods of peak demand
Community feedback	*Water for life* community engagement	Views and values	Planning incorporates community views and values

Stakeholders and communities may have additional objectives which can be incorporated into future versions of the Water Security Program, including liveability objectives encompassing flood mitigation, recreation, reliability, water quality, aesthetic objectives and demand requirements.

7.3.2 SYSTEM CHARACTERISATION

This Water Security Program is largely focused on the bulk water supply system, the population served, and the region's water demand. It does not incorporate the reticulation networks of the water service providers, nor the wastewater system.

The supply system is characterised by the bulk water supply assets (physical and natural) and water resources owned and operated by Seqwater (Table 7-2).

Demand forecasts are based on the medium demand forecast unless otherwise stated.

7.3.3 SCENARIO SELECTION

To test the robustness of an option or investment pathway, future scenarios are developed based on combinations of identified trends. The scenarios provide insights into a plausible future, but are not used to provide a deterministic prediction of the future. The scenarios provide information about the ability of an option or pathway to adapt to changing trends, and may provide an indication of triggers for review.

This Water Security Program includes scenarios that capture changes in inflows due to climate change and dam lowering (theoretical lowering of Wivenhoe and Somerset dams based on possible dam safety lowering requirements which are greater than currently in place), and changes to demand forecasts. The scenarios have been limited to these predominant influences, particularly due to the timeframe for delivery of this version of the Program.

Climate change is considered in relation to changes to inflows but not its impacts on demand and catchment conditions. These impacts may be considered in future versions. Energy price trends have been captured but other trends have not been incorporated into quantitative assessments due to timeframe and data constraints.

7.3.4 OPTION IDENTIFICATION AND CHARACTERISATION

Options that contribute to meeting Program objectives need to be identified and characterised. This can be done in several ways. An 'all options on the table' approach was adopted for the Water Security Program.

Each option captures implementation (capital cost), operational and maintenance costs incurred by Seqwater. Qualitative impacts on economic, environment, resilience and people and place are also captured. The costs and benefits to the water service providers have not been holistically captured in version 2, but may be incorporated in future versions to optimise community outcomes.

Assessment of the impact of influences on the options is an element of the options characterisation process. The impact of influences that can be characterised at a category level, and the outcomes of the assessment are as per Table 7-3.

Table 7-2 System characterisation

Inputs	Tools and processes	Outputs	Outcomes
System characteristics	• GIS • RSM • RAT • DSS	Supply system characterised and reflected in models	System characterised in accordance with boundary for planning and reflected in modelling tools
Population growth projections, population density, population distribution and water consumption data	• Water service provider meetings • Demand Forecast Model	Demand forecasts	Consistent and agreed demand forecast to be used for planning

Table 7-3 Characterisation of option categories based on the impact of influences

Influences	Low inflows/ increased evaporation			Energy price shock			Increase in peak demand days			Change in catchment conditions			Technology change		
Option Categories	yield	opex	capex	yield	opex	capex	yield	opex	capex	yield	opex	capex	yield	opex	capex
Demand management	+				+		+						+	+	
Surface water	--				-				-	-	-	-			
Desalination					--				-					+	+
Purified recycled water					-				-					+	+
Groundwater					-										
Rainwater tanks	-														
Stormwater harvesting	-				-					-	-			+	+
Sewer mining					-									+	+
Decentralised recycled water					-									+	+

+ = small positive impact, ++ = large positive impact, - = small negative impact, -- = large negative impact

Option identification and characterisation processes (Table 7-4) for this Program built upon the work undertaken for version 1. Gaps in information for options were identified and further investigations undertaken. In some cases, this involved a review of potential siting considerations to gain an improved and refined knowledge of the option and its associated impact.

Table 7-4 Version 2 options identification and characterisation

Inputs	Tools and processes	Outputs	Outcomes
• Options information • Potential options from version 1 • Assessment criteria	• GIS assessment • Options refinement (further investigation and influence assessment) • Multi-criteria decision analysis • Short-listing workshop	Characterised short-listed options (combination of qualitative and quantitative assessment) to address the shortfalls in objectives	Clearly defined and characterised options to address shortfalls in objectives with impacts of trend influences assessed

Other influences that are unique to options need to be considered and assessed. Such influences may include regulatory change that inhibits or makes an option available. It may also include community attitudes that change over time.

7.3.5 INVESTMENT STRATEGIES

As outlined in version 1 of the Water Security Program, no single option can meet the water security needs of the region over the 2016-2046 planning period. Water security can be achieved by delivering a combination of options. Investment strategies can define how combinations of options are developed. The strategies are tested against future scenarios to determine how they deliver against the objectives of the Program under a range of conditions. This may also identify triggers for review of an investment strategy.

An investment strategy defines:

- triggers for new options to be brought online (e.g. sub-region shortfalls)
- predecessors for new options (e.g. implement demand management options to defer infrastructure first, then build new infrastructure)
- constraints for new options (e.g. timing for new developments in the case of decentralised schemes).

This Water Security Program outlines investment strategies to:

- demonstrate that the LOS objectives can be met by drawing from the portfolio of options available
- highlight how different investment strategies can result in different trade-offs that should be tested against the overarching objectives
- identify the trigger(s) for deciding on an investment strategy and likely timing for implementing the investment strategy over the 30-year horizon.

This Program does not represent the full spectrum of investment strategies or indicate a preferred strategy. As there is significant time before the next system augmentation is required, the level of uncertainty remains high. There is a risk that solutions that appear optimal now, will not be optimal when the augmentation is required.

Options assessment workshops with the water service providers for version 1 identified the following themes, which have been used to derive investment strategies for this second version of the Program.

- Centralised – economies of scale are maximised. Incorporates the whole region and encompasses potential for collaboration.
- Decentralised – provides sustainable localised outcomes, prolongs need for any new centralised major assets.

Each investment strategy includes a portfolio of options from which to select.

The approach to developing investment strategies will be revisited in version 3 of the Program and will need to align with the assessment methodology selected.

7.3.6 INVESTMENT PATHWAY DEVELOPMENT AND ASSESSMENT

An investment pathway is developed by applying the investment strategy to the portfolio of options relevant to that strategy. Once the pathway is developed, its ability to deliver on objectives is analysed. This includes assessing the pathway's performance under a range of scenarios to test its adaptability and robustness.

This Program has incorporated cost effectiveness analysis to select efficient options, followed by multi-criteria decision analysis (MCDA) in both the development and assessment of pathways. This method was used so that both the qualitative and quantitative information available could be analysed. Costs and benefits are not all monetised. The use of MCDA allows for incorporation of community views and values (Section 7.5) in the application and weighting of criteria used for assessment.

Two investment strategies were developed to demonstrate that LOS objectives can be achieved, highlight how different investment strategies will result in different trade-offs and identify when triggers for decisions and implementation of options are required. The two pathways are outlined below.

Investment strategy 1 – Centralised

Portfolio of options for this strategy:

- regional demand management
- surface water
- centralised purified recycled water for drinking
- groundwater (note no options have been identified for inclusion in this version of the Program)
- desalination.

The investment pathway for the centralised strategy is as follows.

1. Invest in next MCDA preferred option so that it is available before and where water security objective can no longer be met by the existing system (LOS objectives or peak demand objectives).
2. Continue selection of options until all objectives are satisfied for the period 2016-2046.

Constraints for new options:

Direct potable reuse (DPR) options cannot be considered within the centralised purified recycled water category of options while DPR is not allowed by regulation. Therefore DPR has not been considered within this Program.

Investment strategy 2 – Decentralised (prolong next major augmentation)

The portfolio of options for this strategy includes:

- decentralised schemes
- regional demand management
- desalination
- groundwater (note no options have been identified for inclusion in this version of the Program)
- surface water
- centralised purified recycled water for drinking.

The investment pathway for decentralised strategy is as follows.

1. Decentralised options implemented opportunistically (generally in line with new greenfield and brownfield developments).
2. Demand management options to defer infrastructure implemented regionally before centralised infrastructure solution.
3. Next MCDA preferred centralised supply option selected such that it is available before and where water security objectives can no longer be met by the existing system.

4. Continue selecting options following this method until all objectives are satisfied for the period 2016-2046, noting that demand management options to defer infrastructure can only be implemented once in the period (i.e. once they are implemented, the same measures cannot be implemented again).

Constraints for new options:

- Direct potable reuse (DPR) options cannot be considered within the centralised recycled water category of options unless regulation is changed.
- Decentralised schemes are reliant on timing of new developments. There are other barriers that would also need to be resolved as noted in Section 4.3.5.

7.3.7 SHOCK INFLUENCES

Shock influences are step changes that can occur at any time.

These may include floods (which can change the amount of water that can be stored in dams due to event-based sedimentation) or bushfires (which can reduce inflows into dam storages). They may also include the introduction of disruptive technologies, changes to pricing regimes, changes to institutional arrangements, energy price shocks, and macro shocks such as the Global Financial Crisis.

This Program qualitatively analysed system shocks, with the exception of energy price shocks. Energy price shocks were assessed through sensitivity analysis.

7.4 Investment pathway formation methodology

The investment pathway formation methodology was designed with the constraints of time, information availability and current Seqwater modelling capability in mind.

Figure 7.1 shows the high-level investment pathway formation methodology process developed for this Water Security Program. For details, refer to Appendix M.

7.5 Community views and values

To plan for a sustainable water future that meets the needs of all South East Queenslanders, Seqwater needs community input. Following the release of the first version of the Water Security Program in July 2015, Seqwater commenced a community engagement program – *Water for life*. The engagement was developed in line with the International Association for Public Participation's framework for public participation.

The iterative nature of the Water Security Program provides an opportunity to engage our communities over the long term to help determine the right water future for South East Queensland. As such, a phased approach to community engagement has been adopted.

The first phase of engagement was in 2015 and explored the community's values towards water and water planning. The second phase, undertaken in 2016, further explored those values, the concept of liveabilty and the categories of future water options.

Future phases of engagement will involve drought response planning and eventually the selection of a water security investment strategy.

Water for life engagement has involved community forums and quantitative online surveys, supported by an engagement website. Seqwater has sought to gain a broad understanding of community views. Both the engagement and survey research used statistically valid samples that were demographically representative.

Figure 7-1 Option assessment methodology process high-level overview

An overview of community engagement undertaken to date is shown in Figure 7-2.

8	COMMUNITY FORUMS
548	FORUM PARTICIPANTS IN FOUR REGIONS
296	VOLUNTEER COMMUNITY REPRESENTATIVES
2	SEQ SURVEYS
2863	SURVEY RESPONDENTS
4300	VISITORS TO YOURSEQWATER.COM.AU
11	NEIGHBOURHOOD SESSIONS
115	VISITORS TO NEIGHBOURHOOD SESSIONS

Figure 7-2 Overview of water for life community engagement

Face-to-face events were supported by online engagement, feedback opportunities, education events, neighborhood sessions, engagement at small-scale community events and large-scale public events such as the Royal Queensland Show (Ekka).

All views and feedback gathered through the engagement process – whether it be an email, forum participation or survey response – was considered as part of the water security planning process.

It is important to monitor community views and values over time. Seqwater is committed to continuing to engage with our communities to ensure future versions of the Water Security Program reflect current views.

Given the 30-year planning horizon of the Water Security Program, it is critical the region's youth are engaged about their vision for our water future. Seqwater worked with Brisbane City Council to gather the ideas of 400 students as part of the 2016 World Science Festival.

The Green Heart Schools Future BNE Challenge was a visioning-solution exercise, which saw students develop solutions for water security in the year 2100. This engagement showed the vision our region's youth have for their water future – one where technology, innovation and creative solutions are embraced to provide water security.

7.5.1 COMMUNITY FORUMS

Seqwater hosted a total of eight community forums – two in the North (Sunshine Coast), two in the South (Gold Coast), two in the West (Scenic Rim) and two in the East (Greater Brisbane). The forums were conducted under research-like conditions and participants were recruited to be representative of the region's demographics.

Forum participants explored complex issues related to water security through a mix of table discussions, presentations and films, as well as feedback and voting sessions.

This engagement approach, with participants seated at round tables each with its own independent researcher/facilitator, enabled meaningful discussion between community members and provided the depth of insight required to inform South East Queensland's 30-year water plan. The independent researcher/facilitator captured all discussion, which was later analysed to generate insights.

Each forum was four hours in duration, so participants had the opportunity to gain information, ask questions and fully explore the factors surrounding the delivery of bulk water to South East Queensland. Participants explored the risks and influences that need to be managed and the many options available.

A total of 548 South East Queenslanders attended the 2015 and 2016 *Water for life* community forums. Of these forum participants, 296 volunteered to be *Water for life* community representatives, demonstrating a high level of interest and engagement in designing our region's water future. Seqwater will continue to seek the views of this unique group of community representatives as the planning for version 3 of the Program progresses.

7.5.2 QUANTITATIVE SURVEY

Seqwater conducted two online surveys to gauge the views of South East Queenslanders about liveability attributes, their values toward water and opinions about future water security options. A total of 2863 residents were surveyed.

While the forums provided rich, qualitative information, it was important for Seqwater to understand views of a larger sample of the community. The results of the quantitative surveys represent a snap shot of community opinion without the provision of information, explanation or context.

7.5.3 COMMUNITY VALUES IN RELATION TO WATER

Community engagement during 2015 and 2016 focused on understanding the community's values in relation to water. This engagement told us that South East Queenslanders want a secure water supply – one that is sustainable and reliable. They expect clean and safe drinking water at an affordable price.

7.5.3.1 Water quality

Seqwater's *Water for life* engagement confirmed our communities value water quality and safety. Of the people consulted in 2015 during the first round of consultation, 9 out of 10 people considered water quality to be important or very important to water planning.

your **say**

"We need reassurance that it is clean and pure."

From catchment to tap, Seqwater's priority is water quality and all drinking water is sourced, treated, stored and transported in line with the Australian Drinking Water Guidelines. In the context of the Water Security Program water quality is considered a non-negotiable criteria. Water quality is the first consideration for any future water options. If quality cannot be achieved, then the option is not viable.

7.5.4 COMMUNITY EDUCATION

The community believes education about water is important. During the first round of consultation, more than 8 in 10 people thought that community education was important or very important. Many forum participants in 2015 and 2016 felt that water savings achieved during the Millennium Drought were not unreasonable and believed water-saving education should continue. There were concerns that, since the drought ended, water saving messages had fallen away. Participants believed that without intervention 'bad habits' would return and that consumption levels would rise over time. There was support for more education of adults as well as children. Education was thought to be required about the water cycle, water management and water conservation measures.

your **say**

"Very few people know where water actually comes from, more education is needed."

7.5.4.1 Water considerations

In assessing water security options, Seqwater uses criteria we call water considerations to inform the options assessment framework.

The engagement program sought to understand whether these criteria align with community views and values and whether the criteria will ultimately help achieve the community's vision for the future liveability of the region.

Seqwater has taken an iterative approach to developing the water considerations. Work on their development will be ongoing over the long term to ensure they remain in step with community expectations.

Values and considerations were discussed with the community in 2015 and then refined for consultation during the second round of engagement held in 2016. Forum participants and survey respondents were asked to assign value to a number of statements, which relate to aspects of liveability. The water considerations are outlined in Appendix C.

Categories of water considerations

The water considerations presented to the community for feedback were divided into four categories – economic, environment, resilience, and people and place. Forum participants and survey respondents were asked to rate the importance of each of the categories.

Through both formats of engagement, environment factors rated the highest and economic factors rated the lowest. The proportional importance of each category is shown in Figures 7-3 and 7-4.

Figure 7-3 2016 survey – Proportional importance of each category of water considerations

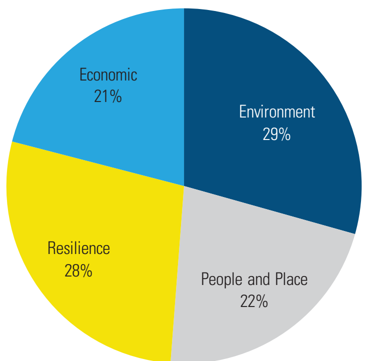


Figure 7-4 2016 community engagement forum – Proportional importance of each category of water considerations

Seqwater's engagement activities show the environment is an important factor when deciding on future water options. Planning and infrastructure needs to take the environment into account to a greater extent than other consideration categories. Based on this engagement research, the most important environmental factors to be considered are the protection of the land and soil and the biodiversity of natural waterways.

Views on water considerations

The community was asked to provide feedback on 16 water considerations and to rank them in order of importance. The same water consideration was ranked highest by both the forum and the survey respondents – 'Provides a reliable water supply in all climate and weather conditions including droughts and floods.'

With that similarity aside, the top-of-mind results received from the survey are different from the rankings of forum participants, who had the opportunity to discuss the considerations with each other, ask questions, digest information and consider their response. The ranking of the most important water considerations from the survey and community forums is outlined below in Figures 7-5 and 7-6.

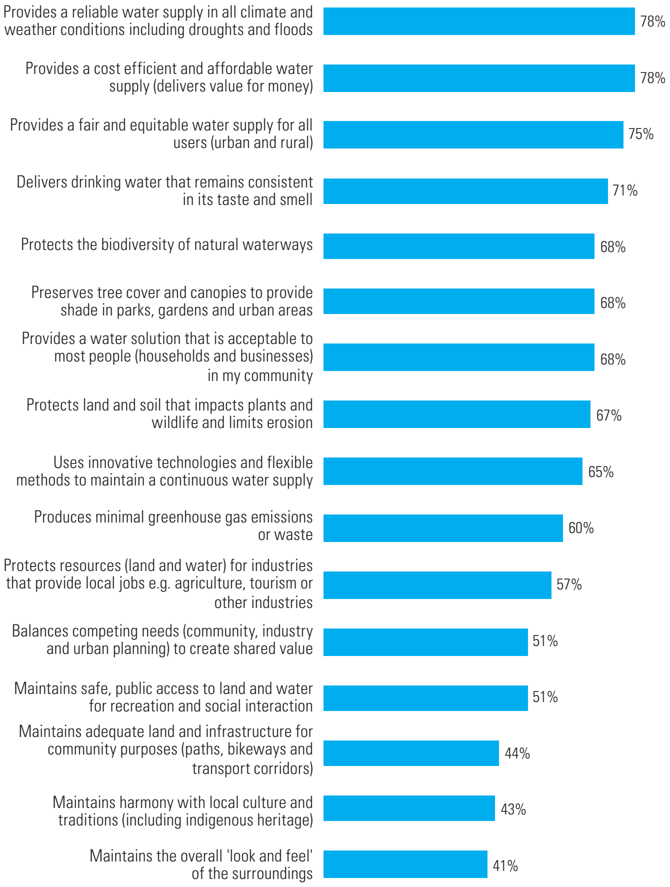


Figure 7-5 2016 Survey – Most important water considerations (% rating 8-10)

Figure 7-6 2016 Community Engagement Forum – Most important water considerations (% rating 8-10)

From these results it can be assumed that more information about the decision-making process, including the considerations themselves, makes a difference to community priorities.

7.5.5 WATER OPTIONS

Seqwater is committed to enabling healthy communities and a prosperous region. We are planning so that South East Queensland has enough water to make our region a place where people will want to live. As part of the community engagement program, feedback has been gathered about the range of future water security options available. No single option alone will fulfil our water needs over the period 2016-2046. A portfolio of options will be required. So it is important to understand the community's views on each option, at this point in time – particularly in terms of how the community perceives each option may contribute toward, or detract from, the liveability of the region.

Discussion at the community forums revealed information and education about the water cycle and water management has a sizeable influence on public opinion about water security options.

The second round of community engagement, undertaken in June 2016, asked the community for feedback on six water option categories:

- surface water
- groundwater
- seawater desalination
- purified recycled water for drinking
- decentralised schemes
  – rainwater harvesting
  – stormwater harvesting
  – recycled water (not for drinking)
  – sewer mining (not for drinking)
- demand management.

Survey respondents were asked how strongly they agreed or disagreed with the future adoption of each of the water options in South East Queensland. The response is outlined in Figure 7-7. Rainwater harvesting was seen as the most favourable water option and sewer mining the least favourable option.

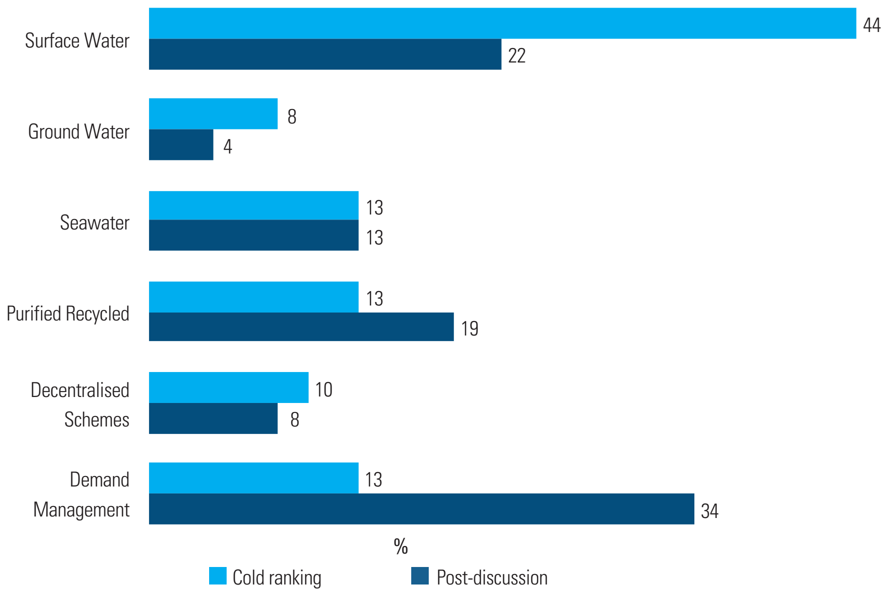


Figure 7-8 2016 Community forums – Most preferred water options before and after discussion.

Q1: Please rank the following water options in order of preference for future water planning.

Q2. Now after all this information and your table discussions, please rank the following water options in order of preference for future water planning.

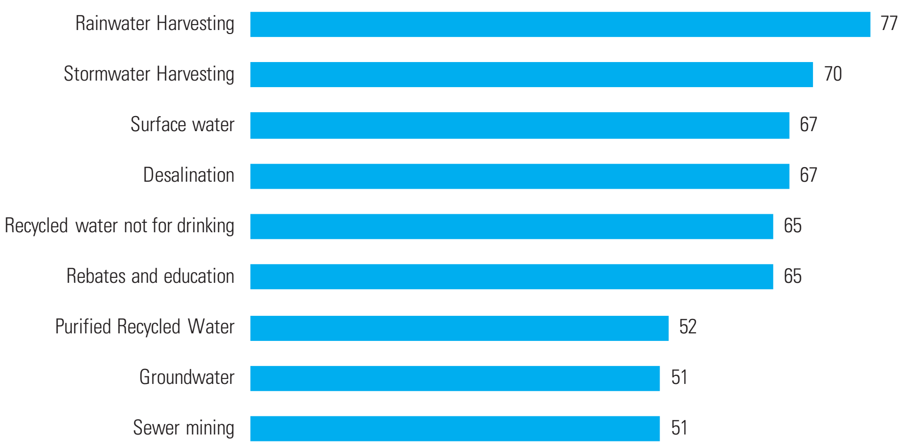


Figure 7-7 2016 Survey – Water security options (% rating 8-10)

Q: How strongly do you agree or disagree with the future adoption of each of the following water options in South East Queensland on a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree.

7.5.5.1 Importance of information

While survey respondents were given limited information about each water option, community forum participants were given information about the water options and the decision-making process, including trade-offs involved in making choices. They were given an opportunity to ask questions of experts and time to discuss the options with each other in light of earlier discussions about liveability and the water considerations.

Forum participants were asked to rate the options before and after the table discussions and their ratings changed significantly. The rating of the water options before and after table discussions is summarised in Figure 7-8. Before the discussion, surface water was the most preferred water option. After discussion, demand management became the preferred.

Table discussion revealed knowledge gaps about the water security options available, with some participants having little understanding of the option. This was particularly true of some decentralised schemes. Information and discussion on future options shifts attitudes, highlighting the need for ongoing communication, education and engagement.

7.6 Ongoing community engagement

It is understood that the needs and expectations for liveability will change over time, and will differ between communities. Seqwater will continue working within the framework of the International Association for Public Participation to engage our communities in planning future versions of the Water Security Program and in decision-making processes. The Water Security Program must be adaptable to change, including being able to respond to and reflect community views and values as they evolve. For this reason it is the intent of Seqwater to further integrate community engagement into future options assessment frameworks, as outlined in Chapter 10.

7.7 Existing system – future needs

Demand for water is projected to range from 415,000 ML per year to 650,000 ML per year, with the medium projection for demand currently assessed to be 525,000 ML per year in 2046 (Chapter 3 – Demand). Peak demands are also forecast to range from 1465 ML/day to 2320 ML/day in 2046.

The LOS yield of the existing system is approximately 440,000 ML per year. With some minor planned augmentations and subsequent optimisation of system operation, this increases the LOS yield to 495,000 ML per year. This means that augmentations to increase the volume of water the system can supply will be required once demand exceeds 495,000 ML/annum.

The optimisation of system operations includes a change to operating trigger for the WCRWS. If this change cannot be made the increased LOS yield will be limited to 485,000 ML/annum.

The peak daily capacity of the bulk water supply system is estimated to be 1,347 ML/day (after the Petrie WTP is decommissioned) (Section 4.2.3.1).

7.8 Base case for planning

To establish a model to plan for our future, it is necessary to make some assumptions about the starting point for planning – a planned base case. There are a range of actions that will be undertaken regardless of our future water supply planning, these are included in the planned base case. These actions are very cost-effective and generally required for the efficient operation of the water grid.

Table 7.5 details the assumptions of options that have been implemented for each of the levers of demand, supply and system operation as part of the base case. The future planning options considered are in addition to the base case.

Table 7-5 Base case actions

Base case demand	Base case supply	Base case system operation
• Medium demand forecast • Existing Seqwater and water service provider demand management programs: – General water efficiency community messaging – System loss demand management programs – Non-residential voluntary demand management programs	• North Pine WTP upgrade to 250 ML/day • North Pine WTP pump station reconfiguration • Mt Crosby WTP upgrade to 850 ML/day • Sparke's Hill to Aspley pump station upgrade • NPI to Landers Shute upgrade (Paynters Creek Connection) • Southern NPI augmentation (North Pine to Narangba) – 7km DN500	• System operation in alignment with the principles outlined in Chapter 5 including operation of the WCRWS at a higher trigger. • Asset operating modes as per current status unless required to meet system performance as part of the planning process • Drought response triggers adopted as outlined in Chapter 6 as well as a higher WCRWS trigger • Connectivity of bulk supply to water service provider network as per existing system connections

7.8.1 BASE CASE DEMAND

As outlined in Section 3.5, Seqwater and the water service providers are already undertaking business as usual demand management programs such as system loss management and unaccounted (or non-revenue) water programs. For the residential sector, business as usual measures include water efficiency programs for garden and outdoor use and indoor water efficiencies. These are currently in place but better consistency across the region could be achieved.

Non-residential voluntary business as usual programs may include online audits and targeted programs in collaboration with peak industry bodies. These programs are new, and will be developed further with the water service providers and relevant peak industry bodies. Similar programs occur in other Australian states.

7.8.2 BASE CASE SUPPLY

Two highly efficient system reconfigurations were identified in version 1 of the Water Security Program to increase the LOS yield and are described below.

- The construction of a new off-take from the Northern Pipeline Interconnector around Paynters Creek will supplement supply into the Maroochy water supply zones.
- Reconfiguration of the Aspley Pump Station through additional pipework will provide additional capability to transport bulk water in a northerly flow direction from the Mt Crosby WTP.

Future planned infrastructure upgrades and network modifications have also been considered in this version.

The following upgrades are to meet peak demand only:

- North Pine WTP upgrade to 250 ML/day to be completed by 2023
- Mt Crosby WTP upgrade to 850 ML/day to be completed by 2029.

The following upgrades will meet the LOS objective requirements only:

- Sparkes Hill to Aspley Pump Station upgrade to be completed by 2033
- NPI to Landers Shute upgrade (Paynters Creek connection) to be completed by 2033.

The remaining supply planned base case inclusions meet peak demands and LOS requirements:

- North Pine WTP pump station reconfiguration to be completed by 2023
- Southern NPI augmentation – North Pine to Narangba 7km, to be completed by 2035.

Given the efficiency of these options, they have been included in all future assessments under a 'planned base case'. They improve the ability of the water grid to transport water from the central sub-region into the northern sub-region and increase the LOS yield of the system to around 495,000 ML/annum and increase the capacity to treat water. These minor system augmentations therefore delay the construction of a new major supply source, under the medium demand scenario, until approximately 2040, assuming no other changes to system performance occur in that time and the normal full supply levels for Wivenhoe and Somerset dams have been restored.

All modelling undertaken as part of the options assessment includes all of these infrastructure upgrades.

7.8.3 BASE CASE SYSTEM OPERATION

Future water supply planning inherently involves planning for how the system will be operated. The basis for this planning exercise is the current principles for operating the system, along with information gained from previous planning.

Assets which are not currently in operational mode are considered to be operating at capacity over time and assessed as such. This means the mode of operation will change and the system will be operating at capacity before a new augmentation is required. This includes changes to the operation of the WCRWS so that it is available for operation at a higher trigger.

7.8.4 THE PLANNED BASE CASE

The inclusion of the planned base case options and use of all assets to achieve their operating capacity delays the need for a new augmentation to meet LOS objectives by at least five years based on medium demand by increasing the LOS yield of the system to 495,000 ML/annum (Figure 7-9 below).

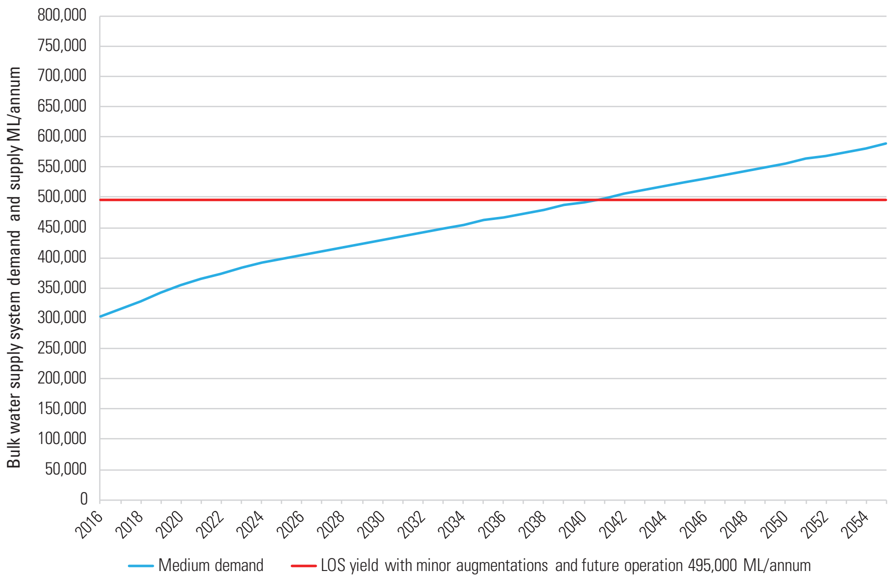


Figure 7-9 Medium demand and LOS yield for planned base case

LOS yield schedules bulk water supply system augmentations at the time when supply matches demand. In contrast, the system must have capacity to supply surplus treated water when compared with demand.

The bulk water supply system includes the large diameter bulk water transport mains known as the regional interconnectors. These interconnectors are capable of moving water in either direction between the major population areas (Section 4.2.4.1). Each has a daily minimum transport volume to maintain drinking water quality.

Since treatment plant capacity, minimum transport volume, and the precise location of demand are not always perfectly matched, there needs to be adequate operational flexibility to deliver the required system performance. Additional capacity beyond meeting average day and peak seasonal volumes is therefore required.

Treatment plant infrastructure is designed to meet peak demands as compared to average day demands. This means water is available to meet the greater demand seen in the hotter months when consumption is above average.

The existing bulk water supply system has surplus yield to meet LOS objectives in the short term but does not have the same level of surplus capacity to treat water to meet peak demand. To address this shortfall, Seqwater is already planning upgrades to existing WTPs from around 2022. These upgrades are coupled with planned closures of some older facilities that would otherwise require significant investment to refurbish and connect them to the grid (e.g. Petrie WTP).

As part of the planned base case developed for version 1 of the Water Security Program, two cost-effective augmentations at existing major WTPs were identified for inclusion in all future assessments:

- capacity upgrade at the North Pine WTP to 250 ML/day (over 24 hours) in 2022
- capacity upgrade at the Mt Crosby WTP to 850 ML/day (over 24 hours) in 2027.

The additional WTP upgrades and system reconfigurations below are assumed to be implemented as a part of the planned base case to meet peak demand objectives.

- North Pine WTP upgrade to 250 ML/day to be completed by 2023
- Mt Crosby WTP upgrade to 850 ML/day to be completed by 2029
- North Pine WTP pump station reconfiguration to be completed by 2023
- Southern NPI augmentation – North Pine to Narangba) – 7km, to be completed by 2035.

The above WTP augmentations and network upgrades increase treated water throughput and will also reduce ongoing water quality risk under a range of raw water conditions. Figure 7-10 shows how these two treated water augmentations push the timing of the next system expansion to around 2035.

By including the planned base case infrastructure, the medium demand forecasts are able to be met for at least the first 19 years of the 30-year planning horizon of the Water Security Program, with treatment capacity driving the first system augmentation in around 2035.

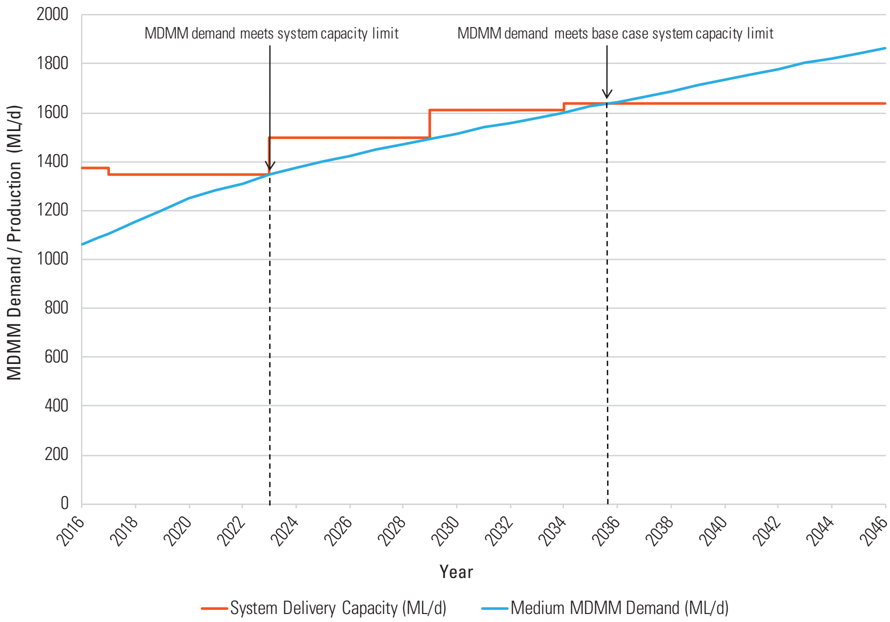


Figure 7-10 Peak demands and treated water capacity for the planned base case

7.9 Options for long-term planning to balance yield with demand

Any option on its own or as part of a combination (e.g. a dam and a water treatment plant upgrade), responds differently to different influences and has a set of costs and benefits. We call these trade-offs.

The focus of this Water Security Program is selecting and assessing efficient supply and demand options and combinations to meet demand projections while using a common approach to system operations.

The efficient supply options and demand management options carried forward were assessed to understand how they can best contribute to the integrated plan for the grid, based on how they influence system performance – both as individual options and in combination – in accordance with the rules of an investment strategy.

Once a new option has been implemented, whether it is a supply, demand or operational response, the system performance is altered and a new status quo is established. Subsequent new options then need to be assessed on the basis of how they improve the new status quo for system performance in line with the rules of the investment strategy.

This means that timing and sequencing of different options has a significant effect on system performance creating a situation where an option may not be efficient at one point in time but becomes more efficient in the future. Similarly, an option may not appear to be efficient in isolation but becomes so when considered as part of a broader program of works.

The integrated planning process undertaken for the Water Security Program has been systematically structured to determine not only those options which are inherently the most efficient and that best meet community expectations, but at what stage in the future is the best time to implement them. The planning process also determines which combinations of options are complementary to overall system performance.

Under the integrated planning process, the investment strategy combined with the next driver of system augmentation (LOS or treatment capacity) determines the list of potential options to be considered. If the next driver for augmenting the system is related to LOS, an initial assessment is undertaken of the existing system and the potential future options required to meet LOS objectives. Some (but not all) options that improve the LOS yield of the system also increase treated water capacity. This list of potential options is then reviewed against the needs of the system to treat and transport water during the peak consumption periods. Invariably, if the next system augmentation is driven by treated water capability, additional infrastructure will be required to meet this objective. As for the LOS objectives, some (but not all) options that improve treated water capacity will also increase the LOS yield of system.

The LOS yield of the system is based on the capacity of the existing assets, the ability to meet LOS objectives and the demands placed on the system. The demand used for planning is the medium demand forecast unless otherwise stated.

As a result, options for long-term planning to balance yield with demand must either:

- contribute to the LOS yield of the system, or
- reduce the demand on the system.

A new treatment plant, when considered in isolation, does not achieve either of these objectives, unless there is available water that cannot be supplied due to treatment plant constraints (i.e. there is more water available from a storage than the treatment plant can treat).

The option categories for long-term planning to balance yield with demand are:

- surface water
- groundwater
- desalinated seawater
- purified recycled water for drinking
- decentralised schemes
- non-structural options including demand management
- unconventional supplies.

7.10 Options for long-term planning to balance treatment capacity

The treatment and transfer capacity of the system are not perfectly matched to peak demand so there needs to be adequate operational flexibility to deliver the required system performance. Additional capacity beyond meeting average day and peak seasonal volumes is therefore required.

Options to contribute to the system's capacity to treat and supply enough water to meet peak demand must:

- increase the capacity of the system to treat water to drinking water quality requirements to meet peak demands, and/or
- reduce peak demands.

For this version of the Water Security Program, we have evaluated options that can increase the capacity of the system to supply treated water to meet peak demand. We note that demand management options and decentralised options may reduce peak demand, however further investigations are required to quantify the impact of these options in reducing peak demand.

Options assessed for their contribution to the treatment capacity of the system are:

- upgrades to existing water treatment plants
- new water treatment plants
- desalination plants
- purified recycled water for drinking treatment plants.

7.11 Illustrative investment pathways

Two alternative investment strategies for developing investment pathways were considered.

- Investment strategy 1: Centralised (economies of scale are maximised, by incorporating the whole region and encompasses potential for collaboration)
- Investment strategy 2: Decentralised (provides sustainable localised outcomes, prolong need for any new centralised major assets)

These investment strategy rules were used to consider what demand/supply options were assessed when developing the investment pathways.

A number of supply and demand options were considered when creating the possible investment pathways. These options were broken down into seven different option categories.

Table 7-6 below provides the full list of options available for consideration for each of the illustrative investment strategies.

The following sections provide an overview of the investment pathway development process for the two alternative investment strategies. Both investment pathways are developed using the Planned Base Case.

7.11.1 INVESTMENT STRATEGY 1 – CENTRALISED

Under the centralised investment strategy, by applying the medium demand to the planned base case, the first system augmentation was found to be driven by treatment capacity (peak demand) that would be required in 2035 in the central sub-region of South East Queensland.

Based on the investment strategy rules and augmentation driver, a list of potential options was determined and assessed. A preferred option was then selected based on the weighted score. Scores for individual options for each consideration were assessed by subject matter experts against a qualitative scoring matrix.

Table 7-6 Demand and supply option list

Option category	Sub-region	Options	Investment strategy 1	Investment strategy 2
Surface water	Northern	• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into the existing Borumba Dam • Upgrade the Noosa WTP	✓	✓
		• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into a raised Borumba Dam • Upgrade the Noosa WTP	✓	✓
		• Build a new weir on the Mary River in the vicinity of Coles Crossing • Raise the wall of the existing Borumba Dam to increase its storage capacity • Upgrade the Noosa WTP	✓	✓
	Central	• Build Wyaralong WTP	✓	✓
WTP upgrade	Central	• Upgrade the Mt Crosby WTPs to 950 ML/day (no LOS yield increase)	✓	✓
	Southern	• Upgrade the Molendinar WTP to 190 ML/day (no LOS yield increase)	✓	✓
Desalination	Northern	• Build a northern desalination plant	✓	✓
	Central	• Build a central desalination plant	✓	✓
	Southern	• Upgrade the Gold Coast Desalination Plant (Stage 2) (45 ML/day)	✓	✓
Decentralised Schemes	All	• Implement decentralised schemes where feasible		✓
Demand Management		• Implement new regional permanent demand management options	✓	✓

Weightings based on community feedback were then applied to the scores, with the highest scoring option selected as the preferred option to meet the specific need (LOS or MDMM objective). The matrix and the scores should be reviewed with further input from the community before a decision on an investment strategy is made.

Demand management options to defer infrastructure were not considered for any augmentations driven by peak demand. This is because the impact of regional demand management on treatment capacity drivers requires further investigation.

The selected option is incorporated into the investment pathway at the year when it is required, 2035.The next driver for augmentation was determined through simulation of the system with the new option in place.

The next augmentation was found to be driven by LOS objectives in the northern region. This driver requires an augmentation in 2040 based on the medium demand forecast. Again, based on the investment strategy rules and investment driver, a list of potential options was determined and assessed. The next preferred option was then selected based on the weighted score and added to the investment pathway at year 2040. This augmentation trigger assumes the planned base case including a higher WCRWS trigger than outlined in Chapter 6. If this change to the WCRWS trigger cannot be made, the impact will be to bring forward the northern region LOS augmentation timing by approximately one year and may have similar impacts on subsequent augmentations.

Demand management options to defer infrastructure were included in the assessment to address the LOS driver, however the benefit of cost saving achieved through deferral of infrastructure build/upgrade was shown to be less favourable when all four community weighted criteria were considered. As a result, demand management options to defer infrastructure were not included as an optimum solution for resolving the LOS driver at this point.

The third need for investment was found to be driven by treatment capacity (peak demand) needs that occur in 2042 in the southern sub-region of South East Queensland. The assessment process repeats and a preferred option was selected based on the weighted score. The selected option is then added to the investment pathway in 2042.

The final augmentation was found to be driven by treatment capacity (peak demand) needs that occur in 2043 in the southern sub-region. The assessment process repeats and a preferred option was selected based on the weighted score and appended to the investment pathway.

After the last peak demand augmentation in 2043, the investment pathway developed is able to meet both LOS and peak demand requirements to the end of the 30-year planning horizon. At this point the investment pathway construction is completed. Figure 7-11 below shows the completed pathway LOS supply/demand balance characteristic.

It should be noted that this investment pathway has not been optimised. Further efficiencies may be gained once the impact of demand management to reduce peak demand is better understood and this may result in a different investment pathway.

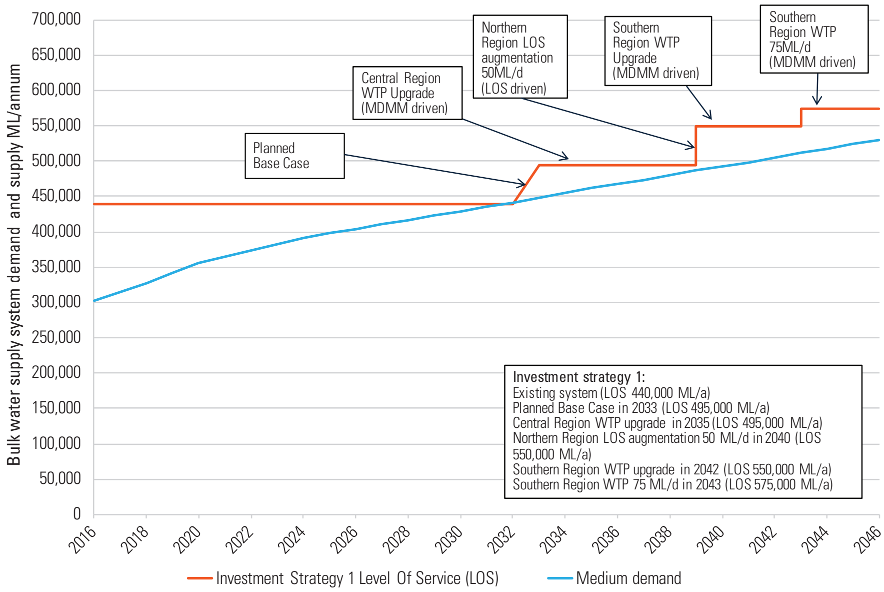


Figure 7-11 Investment strategy 1 (centralised) pathway LOS supply/demand balance

7.11.2 INVESTMENT STRATEGY 2 – DECENTRALISED

While this strategy is labelled decentralised, the intent of this investment strategy is to defer centralised infrastructure investment.

Decentralised schemes are most efficient when incorporated in new developments. Retrofitting decentralised schemes into existing developments is feasible, however the cost of doing so is much higher than incorporating them into the initial development. The investment in decentralised schemes tends to be triggered by growth in development areas as opposed to the need for a system augmentation.

The decentralised investment strategy rules prescribe the preference for investment in decentralised schemes investment if there is any growth and new development as opposed to the need for future water system augmentation.

For modelling purposes, decentralised schemes were modelled based on their ability to reduce demand for drinking water as opposed to their contribution to total water supply. They were included upfront based on timing of new growth areas. Then an investment pathway was developed based on this new reduced demand scenario rather than the medium demand used in the centralised investment strategy.

Under the decentralised investment strategy, the first augmentation driver was found to be treatment capacity (peak demand) that would occur in approximately 2036 in the southern sub-region of South East Queensland.

Based on the investment strategy rules and augmentation driver, a list of potential options was determined and assessed, a preferred option was then selected based on the weighted score.

Under investment strategy 1 (centralised) the second augmentation driver is LOS failure.

Under investment strategy 2 (decentralised) demand is lowered by the implementation of decentralised schemes and the driver for the second augmentation is treatment capacity (peak demand) in the central sub-region that would occur in 2040. Again, based on the investment strategy rules and augmentation driver, a list of potential options was determined and assessed. The next preferred option was then selected based on the weighted score and added to the investment pathway in 2040.

The next driver for investment was found to be caused by LOS that would occur in 2042. The investment strategy dictates that options to defer centralised infrastructure should be considered before centralised infrastructure options. Therefore demand management options to defer infrastructure were the only solutions considered in this step of the pathway development. The demand management options were then added to the investment pathway in 2042.

The estimated timing of this trigger assumes the planned base case has been implemented, including a higher trigger for the WCRWS. If this change to the WCRWS trigger cannot be made the impact will be to bring forward the demand management options by approximately one year and similar impacts may occur for subsequent augmentations.

The final investment driver was found to be caused by LOS that would occur in 2044 in the northern sub-region. The assessment process repeats and a preferred option was selected based on the weighted score and appended to the investment pathway.

After the last LOS augmentation in 2044, the investment pathway developed is able to meet both LOS and peak demand requirements to the end of the 30-year planning horizon. At this point, the investment pathway construction was completed.

Figure 7-12 below shows the completed pathway LOS supply/demand balance characteristics.

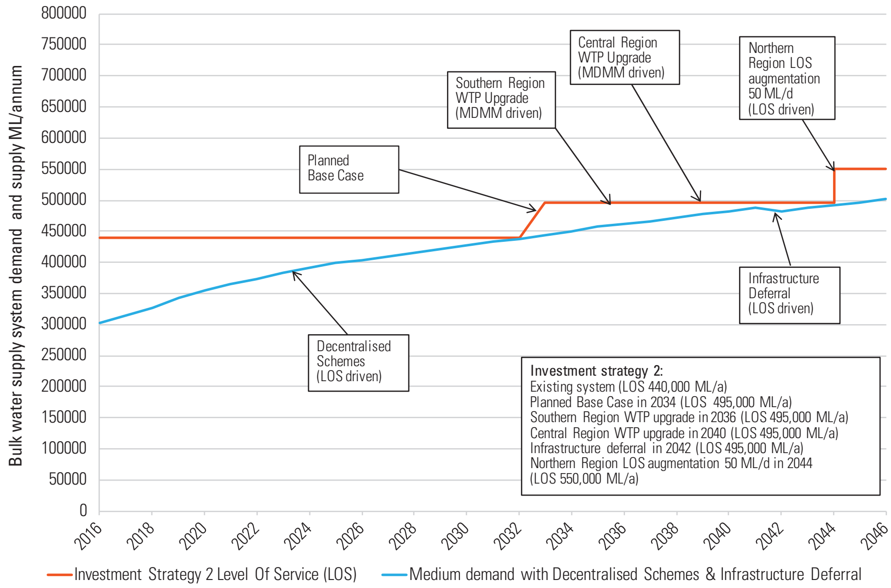


Figure 7-12 Investment strategy 2 (decentralised) pathway LOS supply/demand balance

7.11.3 SCENARIO ANALYSIS

Scenario analyses were undertaken on each of the pathways to identify how they perform under different conditions and identify triggers for implementation and review (Table 7-7). For this Program, the scenarios only tested impact on LOS objectives and not treatment objectives.

Table 7-7 Scenario analysis outcomes

Scenario	Earliest LOS augmentation* (for either Investment Strategy)	After implementation of Investment strategy 1		After implementation of Investment strategy 2	
		Year the LOS yield requires augmenting	Years differential to base scenario	Year the LOS yield requires augmenting	Years differential to base scenerio
Base scenario	2040	2054	-	2054	-
Low demand	2055	>2056	At least + 2 years	>2056	At least + 2 years
High demand	2032	2039	-15	2038	-16
Climate change	2033	2044	-10	2045	-9
High demand and climate change	2029	2034	-20	2032	-22
Somerset and Wivenhoe temporary lowering	2040	2045	-9	2045	-9

** The earliest LOS augmentation date after the planned base case has been implemented*

The scenario analysis demonstrated that, based on this high level examination, investment strategy 2 was slightly more resilient to climate change impacts by 2046, whereas investment strategy 1 was slightly better in responding to demand. This outcome may change when further analysis is undertaken to determine the impacts on treatment capacity investment.

7.11.4 PATHWAY TRADE-OFFS

There are multiple variations of supply, demand and system operations options that can be implemented to achieve the region's water security objectives. When combined by applying the investment strategy rules, these options form an investment pathway.

Each pathway has different characteristics and performs differently in relation to economic, people and place, resilience and environment considerations.

The performance of each pathway is described in relation to each of these considerations.

7.11.4.1 Economic performance

The economic performance of the investment pathways was limited to consideration of cost for this version of the Water Security Program, noting that future versions intend to transition to total economic value rather than an assessment of total cost.

In this version, once the investment strategy pathways were formed, the total expected cost of that investment pathway over the 20 year assessment period 2026–2046 is calculated. The purpose of costing these investment pathways is to compare the cost of one pathway with another.

The costing assessment is fit for purpose only and is designed to highlight the cost difference between investment pathway options only. The total cost generated by this assessment should not be used as an actual total cost as other costs that are unchanging across the investment pathways might not be included.

Total expected cost shown in Table 7-8 shows that investment strategy 2 is likely to cost twice as much as investment strategy 1.

Table 7-8 Options assessment total expected cost modelling results

Investment strategy no.	Approximate total pathway expenditure($million) (over 20 year assessment period)		
	Expected Cost	99th Percentile	1st Percentile
1	$2,000	$3,000	$1,750
2	$4,500	$5,500	$4,000

7.11.4.2 Resilience

The resilience of each investment pathway can be considered in relation to how each pathway performs under different scenarios and its ability to respond to different system shocks.

One shock is extreme drought, where Seqwater is required to be able to supply an essential minimum supply volume to meet essential minimum demand.

The assessment of each pathway considers the contingent infrastructure needed to meet this requirement of the LOS objectives and can attribute a cost to increasing the resilience of the pathway to extreme drought.

There were no contingency costs included in the total cost assessment. The methodology adopted for the costing of contingency for each of the investment strategies was a calculation of the essential minimum supply volume deficit over the assessment period. Figures 7-13 and 7-14 illustrate this measure for the two investment strategy pathways considered.

Investment strategy contingency costing is presented in Table 7-9. For cost comparison purposes only, contingency gap is assumed to be met by construction of temporary desalination plants of sizes 20 ML/day and/or 25 ML/day. Higher cost for 25 ML/day is due to site conditions assumed in the proof of concept option only, noting the 20 ML/day facility is based on a temporary land-based facility and the 25 ML/day facility is based on a barge mounted facility, which includes the cost of the barge and berthing facilities. Beside the potential build cost of temporary infrastructure to meet the contingency gap, it is necessary to also consider the probability of reaching the 20% contingency build trigger under each investment strategy pathway.

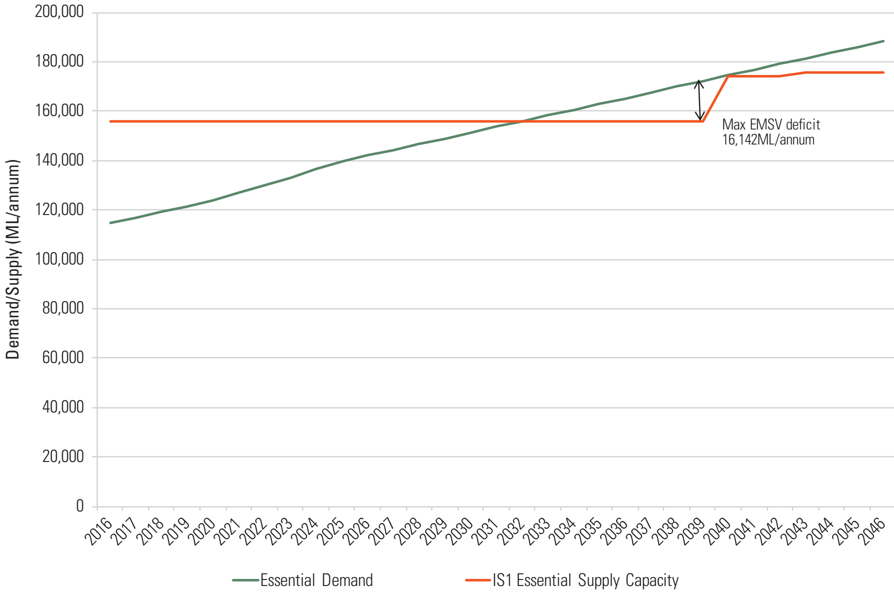


Figure 7-13 Investment strategy 1 (centralised) pathway – essential minimum supply demand and supply

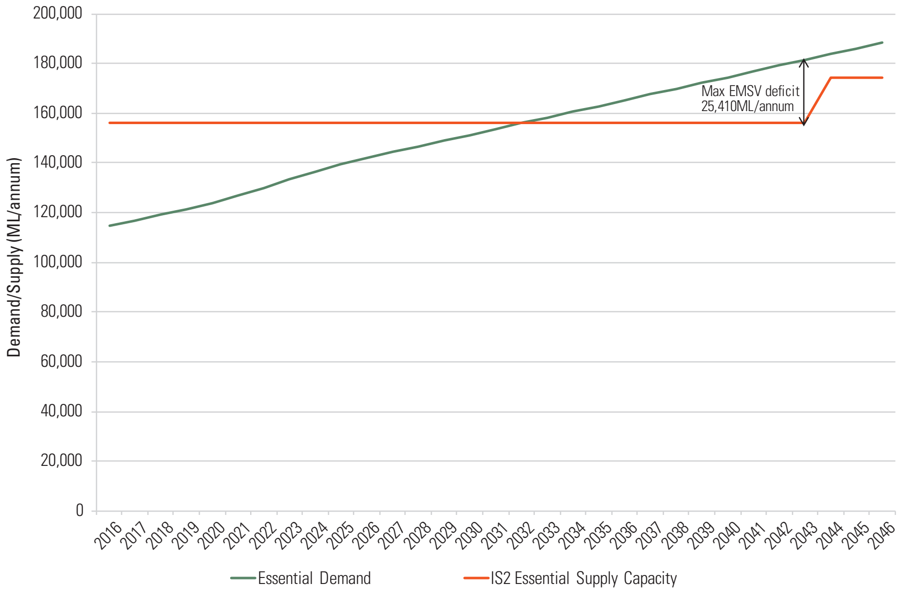


Figure 7-14 Investment strategy 2 (decentralised) pathway – essential minimum supply demand and supply

Table 7-9 Investment strategy contingency costing

Investment strategy no.	Contingency option required	CAPEX	Total CAPEX
1	20 ML/day Temporary Desalination	$55M	$215M
	25 ML/day Temporary Desalination	$160M	
2	20 ML/day Temporary Desalination	$55M	$375M
	25 ML/day Temporary Desalination	$160M	
	25 ML/day Temporary Desalination	$160M	

Table 7-10 below presents the probability of reaching the 20% contingency construction trigger within 10 years and 20 years for each of the investment pathways. The results show that there is a much higher probability of triggering contingency infrastructure under the pathway of investment strategy 2 (decentralised), than under the pathway of investment strategy 1 (centralised).

Table 7-10 Probability of triggering the construction of contingency infrastructure

Investment strategy no.	Probability of reaching contingency construction trigger (20%) within:	
	10 years	20 years
1	0.03%	0.18%
2	0.23%	1.33%

This outcome implies investment strategy 1 is more resilient to extreme droughts. It should be noted however, that the contribution of decentralised schemes to the EMSV requires further investigation and will be dependent on individual scheme characteristics and the type of alternative supply used.

Resilience can also be considered from the perspective of diversity of supplies and social resilience, which would potentially render investment strategy 2 more favourable.

7.11.4.3 People and place

The comparison of each pathway on people and place can only be undertaken once specific sites are determined. The adoption of decentralised schemes can often contribute to a positive benefit on people and place which may result in a more favourable outcome for investment strategy 2.

7.11.4.4 Environmental considerations

Investment strategy 2 is likely to have a better environmental outcome than strategy 1 due to the positive environmental contribution from decentralised schemes and reduction in demand. The deferral of the need to augment the yield of the system may also reduce the energy required for treatment and transport over the longer term and thus reduce greenhouse gas emissions when compared to investment strategy 1.

As a result of this high-level analysis, it can be considered that, while both investment pathways meet water security objectives, investment strategy 1 provides a lower cost solution which has greater drought resilience, whereas investment strategy 2 provides a solution with greater benefits to the environment and people and place.

7.12 Adaptive planning

The Water Security Program must be adaptable to change, including being able to respond to and reflect community views and values as they evolve. It must also be adaptable to structural and non-structural changes, such water technology, consumption behaviour, political and economic drivers and environmental changes.

The Water Security Program is underpinned by an adaptive planning approach that allows it to respond to future changes. Adaptive planning captures future issues that will influence system performance by acknowledging that there are currently multiple pathways to achieve the water security objectives over the next 30 years.

Each of these pathways represents different investment strategies, with different portfolios of options from which to select, different characteristics and suitability to possible future conditions and alternative choices for shaping water security for our region. Options are implemented in the order prescribed by the investment pathway.

The region must have a plan to achieve water security objectives over the long term. As part of this Program, triggers for action have been identified and appropriate actions taken to enable an optimal long-term outcome (e.g. securing land for potential future water sources). The Program recognises shifts in trends and conditions for review, and is ready to adapt to change that is difficult to predict.

To develop this adaptive Program, Seqwater tested the performance of two investment pathways against possible future scenarios of:

- high demand
- low demand
- climate impact
- high demand and climate impact
- permanent lowering of Wivenhoe and Somerset dams to 70% and 80% full supply volume respectively.

Full details of the scenario assessment are in Appendix I.

The most adverse scenario tested combined high demand and climate change impacts. For the investment strategies tested, the outcome meant the next supply augmentation would need to be brought forward to 2032 compared to the base case scenario. The outcomes of this scenario analysis enable Seqwater to understand parameters that require close monitoring and will inform decisions on what scenarios should be tested in the future.

These parameters are:

- demand
- inflows
- climate change (changes to rainfall, evaporation and temperature)
- permanent changes to dam storage levels.

Over the 30-year planning period of this Water Security Program, there will be many changes to forecast trends, including potential changes to expectations and preferences of the community. This reinforces the benefit of options that can be staged and therefore adapted to changes in influences on water security. As a result, the influences, which impact on system performance, must be monitored. Major changes to these influences would trigger a review of the solutions for future water security.

7.12.1 TRIGGERS FOR ACTION

The options assessment framework will be reviewed with the development of each updated Water Security Program. Seqwater will use the options assessment framework in place at the time the decision is required, to select the investment pathway. The framework will be informed by community preferences current at that time.

The trigger for implementing water security options beyond the planned base case has been derived using the current options assessment framework and is based on the longest timeframe required for planning and construction of the options which may resolve the objective being met (either water treatment or yield).

In the case of the illustrative investment pathways included in this Program, the first driver for augmentation is treatment capacity. At this stage, the decision point is likely to be 2027 based on medium demand projections. This timeframe has been selected based on the longest period to implement all available options in time to meet water security needs and consideration of the risks. The year 2027 has been selected based on an eight year planning, approvals and delivery timeframe.

Table 7-11 outlines the key triggers for action that have been identified in this Water Security Program. These triggers are based on current planning forecasts, and are subject to change.

Table 7-11 Key triggers for action

Timeframe	Action	Prerequisite actions
Within five years	Develop a strategy to secure land to remain adaptable for future water supply augmentations where there is a risk that option will become unavailable due to lack of suitable sites	Detailed site investigations and site risk assessment
Within five years	Update Water Security Program drought response to reflect community preferences and integrate drought response into long-term water security assessments	Community input
Ongoing	Monitor trends in consumption, population, climate variability, technology, policies and standards, and continue to implement business as usual demand management measures	Proactively seek outcomes to improve system performance in these areas
Ongoing	Monitor supply demand balance and treatment capacity and peak demand balance, commence construction of an augmentation from up to four years (depending on construction timeframes) prior to the need for the augmentation	Detailed planning and assessment of specific augmentations (site and technology specific) completed
Every five years	Adapt Water Security Program to reflect changes in community feedback and trends. This may change dates and/or actions outlined	Fast-track if material changes to trends are identified
2027[1] (based on medium demand profile)	Implement preferred investment pathway	Investment strategy decided Options available under legislation

1. This trigger assumes the option with the longest implementation time is selected for the first system augmentation. It includes an allowance for securing land, gaining planning and environmental approvals, implementation (including design construction and commissioning) and a time allowance for surface water options to receive inflows.

7.12.2 TRIGGERS FOR REVIEW

The influences on water security are vast and numerous. Any of these influences alone, or in combination, may impact on system performance, the preferred water security investment strategy and the implementation of the Water Security Program.

The Water Security Program will be reviewed if any of the following conditions are realised:

- site-specific assessments identify issues with the efficient supply options
- prolonged drought occurs, bringing forward the need for investment in climate-resilient sources
- climate change results in reduced rainfall (and thus water availability) and/or increasingly intense rainfall events which may impact on water quality, reducing the ability of the system to treat and supply surface water
- innovations in desalination and purified recycled water treatment significantly reduce the cost of these options while maintaining or increasing their reliability improving their performance compared to other sources of water
- drinking water quality requirements change significantly, which may impact on treatment requirements and thus costs of surface water supplies to a greater degree than climate resilient supplies
- change in demand forecast of +/- 10% for any reason, including:
  - demand growth distribution changes significantly such that a different sub-region of SEQ has a greater degree of vulnerability
  - demand behaviours change, affecting sub-regional performance against water security objectives to differing degrees
- policy or climate variability reduces the surface water allocations available over time
- an increased prevalence of decentralised solutions and/or integrated regional planning alters the distribution and degree of growth in demand
- changing availability of land and/or incompatible investment in neighbouring land
- government policy removes an option from consideration.

There are limited potential new surface water sources remaining in South East Queensland. There will be another drought and, as the population grows, there will be a need for additional climate-resilient water sources to respond to drought. The northern sub-region is currently the most vulnerable and will require an augmentation in the next 30-year period under any of the conditions assessed.

The availability of suitable land to accommodate any future augmentations is becoming increasingly limited. Seqwater will therefore progress site investigations with the aim of securing land for possible future augmentations to remain adaptable and responsive to future water security needs.

Preservation of sites and obtaining approvals as early as possible will enable flexibility to respond to changing conditions and influences. It will also enable sites to be secured for future water supply needs beyond the 30-year horizon.

7.13 Next steps

Seqwater aspires to meet the United Nations definition of water security (Section 1.2).The broader goals of this definition require Seqwater to widen the frame of the Water Security Program beyond the strict provision of the bulk water service. To continue to progress toward meeting the United Nations definition of water security, the options assessment framework for the next Water Security Program will likely:

- incorporate liveability into the objectives
- expand the boundary of assessment (catchment–to-tap as opposed to a bulk water supply system focus in isolation).
- transition towards evaluating the total economic value of options as opposed to solely financial impact

The framework for future versions of the program will build upon version 2 and will use a fit-for-purpose method of assessment. It will be based on a potentially revised scope, objectives and boundaries. The tools and models used will depend on the assessment approach adopted.

Future Water Security Programs may extend beyond the bulk water supply system boundary to catchments, the retail distribution network and wastewater systems. The scope may capture additional considerations such as water quality, system reliability, flood mitigation and stormwater management.

Future versions are likely to consider a broader range of trends in the development of scenarios. The system shortfall for the existing system under each plausible future scenario can then be determined. This would provide an indication of the number and type of additional system augmentations required by the option or investment pathway under investigation.

In progressing toward the United Nations definition of water security, future versions of the Program are expected to transition to an options assessment framework that considers the total economic value of water, including the contribution toward resilience, the effect on people and place, and the impact on the environment. The components which inform the economic value of water are demonstrated in Figure 7-15 as per Turville et al. (June 2014).

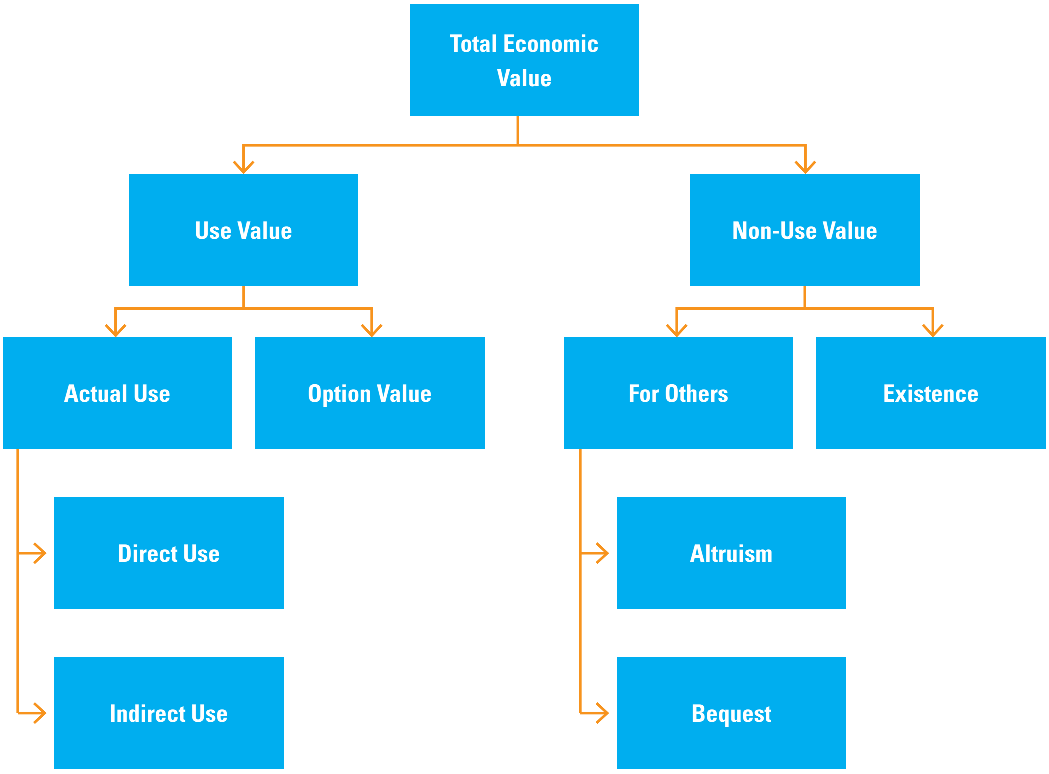


Figure 7-15 Total economic value of water

Given the broad reaching implications of adopting a total economic value approach, Seqwater propose key principles for a staged and gated options assessment process, consistent with the Queensland Government's *Project Assessment Framework* and other institutional and legislative requirements. The gated process will consider:

a) applicable institutional and legislative arrangements – e.g. the role of Building Queensland in driving consideration of the economic value and social impact evaluation of proposals to the Queensland Government

b) legislative requirements – e.g. the requirement for Environmental Impact Statements to include cost benefit analysis.

Assessment methodology

The following tenets guide how the options assessment framework may develop.

1. Anchoring to least financial cost outcomes (Financial Analysis). With analysis to be incremental, in the first instance framed to the bulk water supply system with incremental approaches for incorporation of upstream / downstream financial costs including financial costs to end water users.
2. Broader Economic Analysis applied incrementally to least financial cost outcomes to end water users. Divergence from least cost financial outcomes would need to be justified through broader tools such as Cost Benefit Analysis / MCDA, in conjunction with quantified community preferences.

The key strategic premise of the future options assessment framework is that options will be screened and ranked with regard to price impact on end water users. This will provide a strong feedback mechanism to inform end water users of the financial impact of water supply planning decisions and will help to develop a mandate from end water users over the medium term. The price lens will incrementally build, so end water users can identify the pricing impacts of diverging from least cost supply planning (financial costs) to incorporate broader outcomes (economic).

It is important to note that in the broader policy and regulatory context, if the preferred solution is greater cost than the least cost solution, then a further assessment will be required, considering matters such as how the additional costs are to be funded (e.g. through water prices or an alternative recovery mechanism such as a government funded community service obligation).

A conceptual illustration of the potential future options assessment framework is provided in Figure 7-16 below.

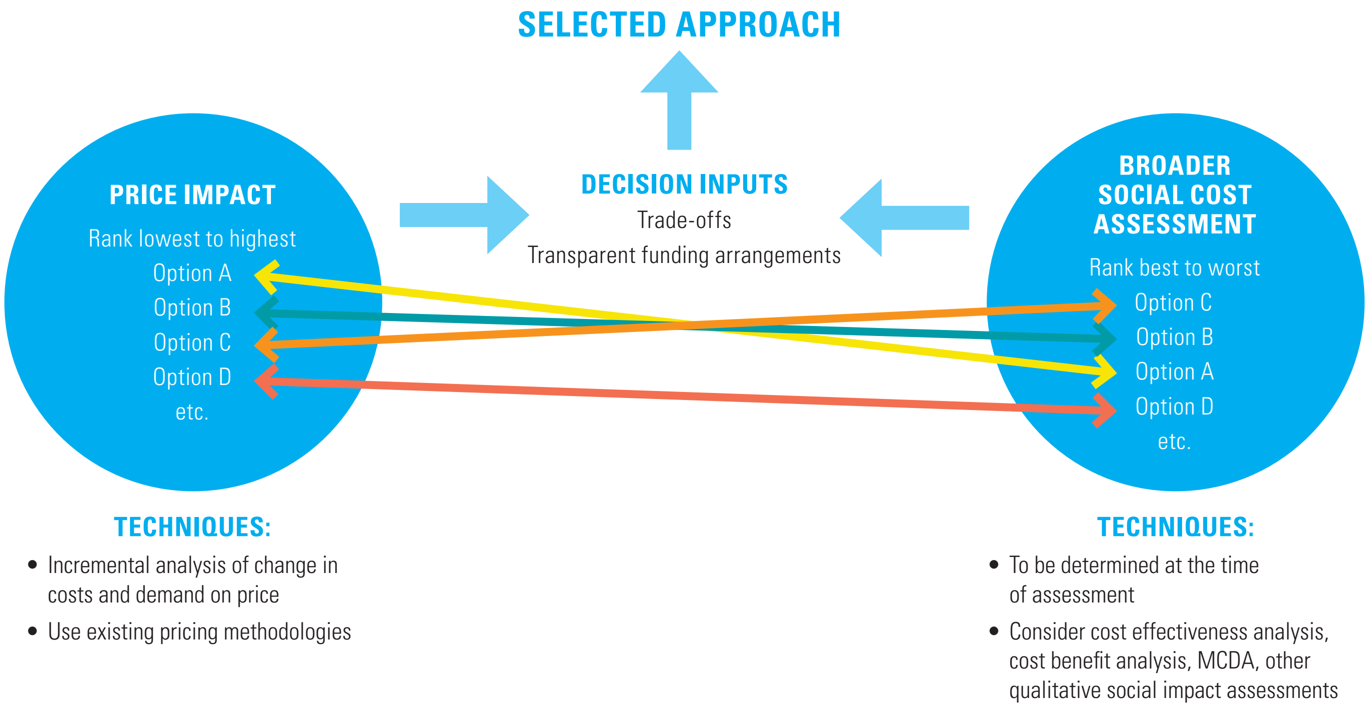


Figure 7-16 Potential future options assessment framework

08 Planning for **off-grid communities**

08 Planning for **off-grid communities**

Seqwater provides bulk supply services to a number of communities that are not connected to the South East Queensland Water Grid – known as off-grid communities. We are responsible for planning for the provision of bulk water supply services for the ongoing prosperity of these off-grid communities and surrounding areas.

This planning takes into account the need to service the ongoing growth of these communities, accommodate their usage characteristics and address a level of climate variability, to provide a secure water supply.

All off-grid communities, with the exception of Beaudesert, meet the level of service objectives set by the Queensland Government for the South East Queensland bulk water supply system (including off-grid communities). Beaudesert is planned to be connected to the grid by 2019. Once connected, Beaudesert will be compliant with LOS objectives.

This chapter provides an overview of the assessment and outcomes for all of the 16 off-grid communities. The detailed investigations and outcomes for each community are detailed in Appendix N.

8.1 Overview of off-grid water supply schemes

Off-grid communities are urban communities supplied by a water source that is not directly connected to the South East Queensland Water Grid. Each community has its own water treatment plant (WTP) and reticulation system. Although off-grid communities are not directly connected to the water grid, they are dependent on the water grid as a source for water carting during severe droughts and short-term water supply disruptions.

Seqwater provides bulk water to 16 off-grid community water supply schemes (shown in Figure 8-1).

- Amity Point
- Beaudesert
- Boonah-Kalbar
- Canungra
- Dayboro
- Dunwich
- Esk
- Jimna
- Kenilworth
- Kilcoy
- Kooralbyn
- Linville
- Lowood
- Point Lookout
- Rathdowney
- Somerset

Off-grid communities are subject to external influences on their water supply due to their size and single supply source. Influences include climate variability, changes to the economy or local industry (i.e. residential, commercial or industrial development, tourism, agriculture and/or changing demographics) and competition with other upstream users.

Climate variability impacts the off-grid communities more severely than grid-connected communities. They generally have one source of surface water and no direct connection to climate-resilient supplies such as desalination and purified recycled water. So during severe or extreme droughts, the normal surface water supply can be severely restricted or not available, requiring an alternative supply. Currently alternative supplies are limited to carting water from the grid to the off-grid community.

More details about contingent supplies is contained in the individual off-grid community reports in Appendix N and summarised in Table 8-4. Climate variability also impacts off-grid communities during floods for shorter periods of time but requiring the same alternative supplies.

Catchment management refers to human interaction with land management that may impact the ability of the WTP to supply drinking water. Catchment management is particularly important to off-grid communities reliant on their local WTP. If catchment management can improve the raw water quality, this would benefit WTP capacity, avoiding or delaying the need for future treatment plant upgrades. The converse will apply if the catchment degrades and the water becomes more difficult to treat. Seqwater will continue to work with our partners to improve management of all water supply catchments.

Changes to the economy including commencement, or closing of a major industry or large-scale residential developments can significantly impact demand, especially if they use large volumes of water and provide local jobs. For example, a 100-block subdivision in most of the 16 off-grid communities would significantly increase the population and corresponding demands by over 30%. So regular monitoring of growth and demand variation is essential to enable timely implementation of water security options.

Competition with other upstream users, such as irrigators and in some cases other off-grid communities has an impact on water security for the larger off-grid communities that are too big to allow for full substitution of supply through water carting. Monitoring of upstream use and specifically any impacts on run-of-river flows is essential to ensure water security for off-grid communities.

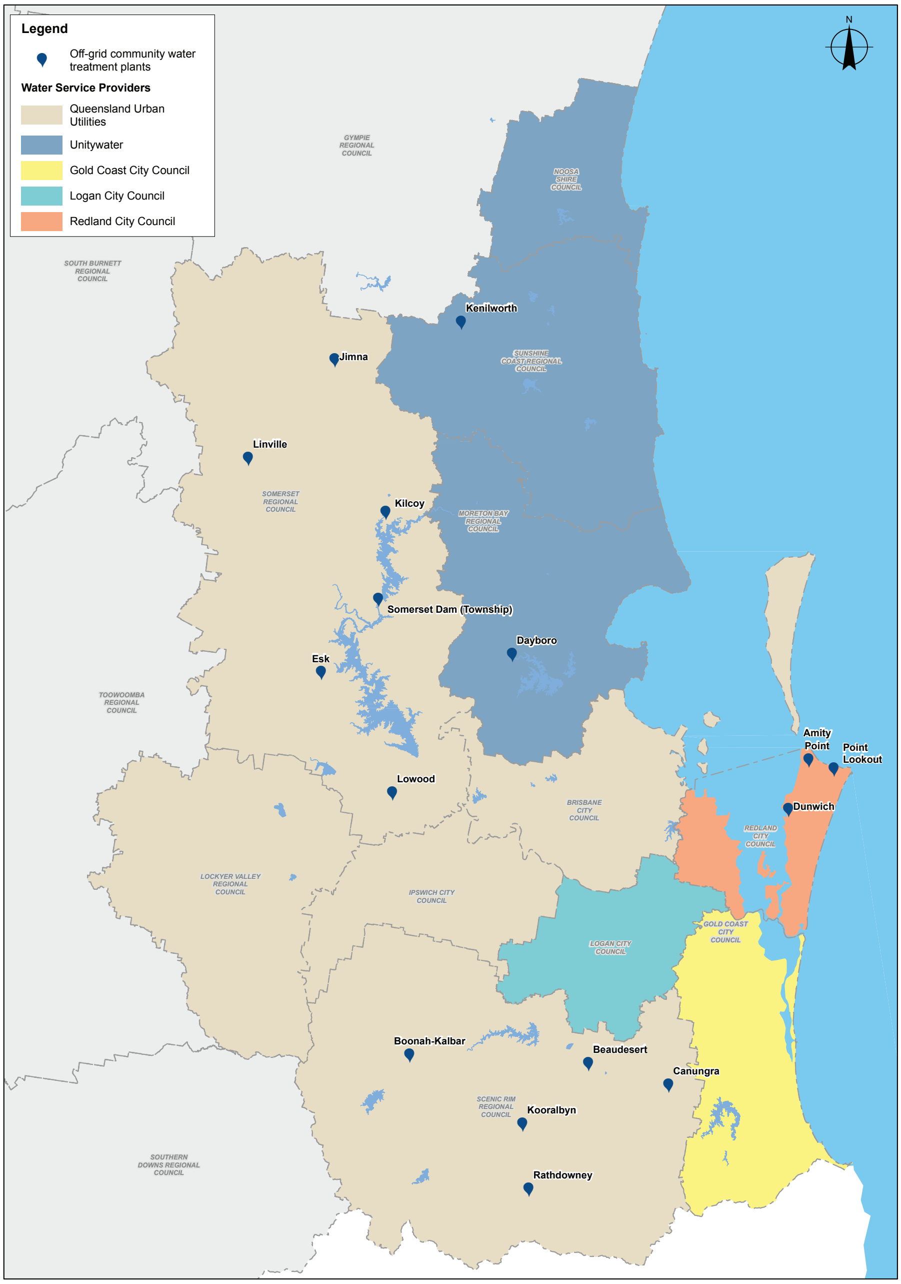


Figure 8-1 Off-grid communities supplied by Seqwater

8.1.1 OFF-GRID COMMUNITIES – ROLES AND RESPONSIBILITIES

The ability to supply water to an off-grid community commences with the capture of rainfall within a catchment. This is either through physical infrastructure such as a dam, weir or off-stream storage or direct extraction from a stream with no physical infrastructure. Once captured, water is extracted through pipes to the water treatment plant where it is treated to meet drinking water standards. Following treatment the water is transferred to a local water supply network for distribution to residential and non-residential customers.

Roles and responsibilities are separated across off-grid community supply chain in the following areas:

- Catchments – no single body is responsible for catchment management, responsibility is distributed between federal, state, local government, individual land owners/ managers and not-for-profit groups. Seqwater will continue to work with our partners and local communities to improve raw water quality through improved catchment management.
- Bulk supply – Seqwater is responsible for the bulk supply provision encompassing raw water storage and treatment at each of the off-grid water supply schemes. The WTP provides drinking water that is transferred to a drinking water reservoir.
- Local distribution – water service providers (i.e. Queensland Urban Utilities, Redland City Council and Unitywater) manage the delivery of the drinking water to households and businesses via the township distribution network for the 16 off-grid communities. Figure 8-1 shows the water service provider operational areas and the off-grid communities within their boundaries.

In many cases water from the off-grid community water supply scheme is also distributed outside of the urban water supply network to a wider rural area. This is by commercial water carting to top up of rainwater tanks. The treated water is sold to the commercial water carting company by the water service providers, accessed via filling stations or standpipes connected to the town water supply for delivery to non-connected rural consumers. This water use is generally accommodated within the existing supply and water treatment plant capacity, however during extended dry or drought periods it is expected that this additional water use may need to be sourced from outside of the off-grid community, most likely from the grid.

8.1.2 OFF-GRID COMMUNITY WATER SECURITY PLANNING

In the first version of the Water Security Program, Seqwater identified water supply schemes at risk of a water supply shortfall within the next five years and we outlined infrastructure plans for those off-grid communities requiring high priority intervention. This Water Security Program addresses future infrastructure needs for all 16 off-grid communities for the next 30 years to meet LOS objectives and peak demands.

This planning considers the influence of demand, supply and system operation to achieve the required level of water security for the off-grid communities.

8.1.2.1 Scope of planning – levels of service and peak demand

Guaranteeing full supply of water during all extreme weather events is not possible. As a result the Queensland Government has defined drought security objectives for the bulk water supply system, including bulk water supply to off-grid communities. These water security objectives, in conjunction with peak demand needs, form the basis of water security planning.

The Levels of Service (LOS) objectives as defined by the *Water Regulation 2016* and as they apply to the off-grid communities, are outlined in Appendix A.

The LOS objectives determine whether the source water available is adequate. In addition, there must be sufficient treatment plant capacity to treat enough water to meet drinking water requirements, under all weather conditions including peak demand periods. The treatment capacity is compared to growth in estimated peak demands over the next 30 years to plan adequate infrastructure.

The peak demand used to size bulk water infrastructure is known as Mean Day Maximum Month (MDMM) demand. MDMM is the maximum average or mean demand during a 30 day period or month. This demand is determined through the analysis of historic water use along with consideration of projected population growth of the community. An MDMM event is infrequent and is more likely to be during hotter months. These conditions induce additional consumption that drives peak (MDMM) demand events.

8.1.3 INFLUENCE OF DEMAND, SUPPLY AND SYSTEM OPERATION

Planning objectives may be addressed by demand, supply and system operation responses. To achieve appropriate long term outcomes for a community the approach typically incorporates all three levers (supply, demand and system operation). Following is an assessment of the existing system performance of the off-grid communities considering the levers of supply, demand and system operation.

8.1.3.1 Supply

All off-grid communities have their own water supply source. The sources include dams, bores and run-of-river supply. For each of these supply sources it is necessary to understand if their supply capacity is sufficient to meet current and future demand, with consideration to severe drought conditions. To determine if the water supply capacity is sufficient, each source is measured against the LOS objectives specific to the off-grid community.

Compliance with the LOS objectives requires demonstration of the performance of supply during:

- normal conditions – supply enough water to meet demand for the next 30 years
- drought conditions – limit the frequency, severity and duration of drought restrictions
- extreme conditions – provide an essential minimum supply volume to the community.

While the impact of the Millennium Drought is well known, it is possible that there will be more severe droughts in the future. Through the application of the LOS objectives, Seqwater is planning for these more extreme events.

The assessment of existing supply sources and potential requirements due to growth in demand over the next 30 years is summarised in Table 8-1. More detailed information about each off-grid community is provided in Appendix N.

The LOS compliance table is in Appendix I, Table I-8.

Table 8-1 Off-grid communities – annual demand comparison to current LOS yield

Off-grid community	Average Demand 2016	Average Demand 2046	LOS yield	Proposed augmentation and year required
[-]	[ML/annum]	[ML/annum]	[ML/annum]	[-]
Jimna	5	5	20[1]	> 2046
Linville	10	12	35[1]	> 2046
Somerset Dam Township	16	17	40[1]	> 2046
Rathdowney	23	23	80[1]	> 2046
Kenilworth	62	120	180	Further investigation post 2046
Amity Point	100	150	200[1]	> 2046
Canungra	100	120-390	165[2]	Possible off stream storage 2019 to post 2046
Dunwich	160	250	500[1]	> 2046
Kooralbyn	190	380	450[1]	> 2046
Dayboro	190	250	275	Possible off stream storage post 2046
Esk	220	300	375	> 2046
Point Lookout	280	410	750[1]	> 2046
Boonah-Kalbar	500	960	1,000	Further investigation post 2046
Beaudesert	690	5,000	2,500	Pipeline connection to the grid no later than 2032 to achieve LOS objectives
Kilcoy	790	1,300	1,480	Further investigation post 2046
Lowood	3,400	5,900	12,700[3]	> 2046

1. LOS yield is limited by the water entitlement limit

2. Current entitlement for Canungra is 150 ML/annum – LOS yield of 165 ML/annum based on existing storage, drought response plan and additional entitlement from town water reserve

3. LOS yield for Lowood is based on the future WTP capacity as Lowood shares the same source of supply as Mt Crosby

The assessment reveals the requirement for additional supply sources is minimal. However the water treatment plant must also be capable of supplying peak demands while maintaining safe drinking water quality as defined by the Australian Drinking Water Guidelines. Treatment capability can vary due to raw water quality conditions and hours of operation. A capability range has been provided and compared with the current demand predictions to account for the variable raw water quality. Water treatment plant capability, MDMM requirements and WTP augmentation year are summarised in Table 8-2.

Table 8-2 Off-grid communities MDMM requirements

Off-grid community	MDMM Demand		WTP capability[1]	WTP upgrade required
	2016	2046		
[-]	[ML/day]	[ML/day]	[ML/day]	[-]
Jimna	0.044	0.044	0.07-0.17	> 2046
Linville	0.054	0.063	Carting	New WTP planned for 2017 as more economical than carting all of the time
Somerset Township	0.081	0.086	0.21-0.27	> 2046
Rathdowney	0.099	0.099	0.25-0.40	> 2046
Kenilworth	0.25	0.49	0.43-0.52	2028
Amity Point	0.47	0.71	1.5-2.4	> 2046
Canungra	0.39	0.44-1.5	0.33-0.49	Commenced construction – 1.5 ML/day
Dunwich	0.64	1.0	1.2-1.4	> 2046
Kooralbyn	0.78	1.540	1.13-2.37	2027
Dayboro	0.785	1.022	0.9-1.29	2019
Esk	0.90	1.25	1.05-1.4	2028
Point Lookout	1.38	2	1.64-2.58	2036
Boonah-Kalbar	1.9	4	2.71-4.13	2029
Beaudesert	3	21	2.89-3.98	Connection to the grid proposed by 2019
Kilcoy	2.8	5	4-4.84	2032
Lowood	14	24	13.33-18.5	2021–35 ML/day planned by 2020

1. WTP capability varies depending on the hours of operation and raw water quality, hence a range has been provided

Most of the off-grid community WTPs will require further investigation and possible upgrades based on current capabilities. The treatment capability for the various WTPs may improve over time due to renewals, process improvements, improved treatment technology and/or raw water quality improvement from catchment management. This may defer the upgrades. Conversely if catchment conditions deteriorate, peak demands increase or drinking water quality regulations become more stringent, WTP upgrades may be required sooner.

8.1.3.2 Demand

Demand can influence the performance of the existing system. The management of demand can be an effective response to weather events such as drought, short-term water supply disruptions and peak demands. The first step in understanding the influence of demand is to quantify the future demand projection for the relevant off-grid community. The second step is consideration of demand management options to control demand and achieve a desired outcome.

Water demand into the future, is influenced by per capita usage and future population growth, without consideration of demand management options. A review of current usage and future growth projections was performed for each off-grid community. Future growth projections were sourced from the relevant water service providers.

Historical water production data and current population projections were used to understand the average demand characteristics for each of the off-grid communities. The average demands are used to assess compliance with the LOS objectives and consider any new water security options required to meet the LOS objectives. Mean day maximum month (MDMM) factors, which represent a ratio between peak demand and average demand were applied, based on analysis of historical production data for each scheme, to determine the MDMM demand. The MDMM demand is considered in the sizing of WTPs, trunk mains, reservoirs and some pump station infrastructure to provide appropriate quantities of potable water to the community.

The adopted demand forecasts are expressed in terms of average demand and peak demand in Table 8-3. The assessment for each off-grid community is located in Appendix N.

Table 8-3 Off-grid communities' demand forecasts

Off-grid community	Average Demand		Peak (MDMM) Demand	
	2016	2046	2016	2046
[-]	[ML/annum]	[ML/annum]	[ML/day]	[ML/day]
Jimna	5	5	0.044	0.044
Linville	10	12	0.054	0.063
Somerset Township	16	17	0.081	0.086
Rathdowney	23	23	0.099	0.099
Kenilworth	62	120	0.25	0.49
Amity Point	100	150	0.47	0.71
Canungra	100	120-390	0.39	0.44-1.5
Dunwich	160	250	0.64	1.0
Kooralbyn	190	380	0.78	1.5
Dayboro	190	250	0.79	1.0
Esk	220	300	0.90	1.25
Point Lookout	280	410	1.4	2.0
Boonah-Kalbar	500	960	1.9	3.7
Beaudesert	730	5,000	3.0	20
Kilcoy	740	1,300	2.8	4.9
Lowood	3,400	5,900	14	24

Demand forecasts are reviewed regularly by Seqwater and the water service providers to capture any significant variances to population growth and demand characteristics that may have implications to current planning.

In addition to forecasting demand, demand management is an essential consideration for long term water security. Demand management provides the potential to delay the development of alternative supply sources. It can also avoid introducing potentially higher cost system operation options such as water carting. Demand management may focus on:

- internal water use – water efficient devices including taps, showers and toilets
- behavioural change – education and communication programs
- external water use – efficient outdoor water use, including efficient devices and practices
- drought demand management – such as water restrictions (see Appendix N for the detailed drought response plan for each off-grid community).

8.1.3.3 System operation

The way the water supply system is operated can increase the water security of off-grid communities. System operation varies between communities and is described for each of the 16 off-grid communities in Appendix N. During normal times, the operation is simply to refill the local distribution reservoir every day from the nominated supply source. As demands increase over time or climatic conditions change, the WTP for the off-grid community will operate for additional hours throughout the day. During peak (MDMM) demand events it is expected that the WTP may operate an average of 20 hours per day in most cases. The WTP could operate 24 hours per day when raw water quality conditions allow, subject to asset condition and maintenance at the time.

When demand exceeds the supply capability due to drought, the local distribution reservoir ensures that demand can be met in the short term. As the distribution reservoir levels drop or the supply conditions reduce, operation is changed as per the community's Drought Response Plan and alternative or contingency supplies are introduced. Contingencies may include carting water from the water grid as required. Table 8-4 summarises how operation of each community may change in response to an extended drought, additional information is provided in Appendix N.

Table 8-4 Off-grid communities' operation summary

Off-grid community	Normal supply operation	Drought trigger indicator	Drought – contingency supply operation
Jimna	Yabba Creek	Creek flows	Carting from Kilcoy/grid
Linville	Upper Brisbane River	River flows	Carting from Kilcoy/grid
Somerset Township	Somerset Dam	Somerset Dam level	Carting from Lowood/grid
Rathdowney	Logan River/Maroon Dam	Maroon Dam level	Carting from Beaudesert/Woodhill/grid
Kenilworth	Mary River	River flows	Carting from Nambour/grid
Amity Point	Groundwater	Groundwater level	Carting from North Stradbroke Island grid WTP
Canungra	Canungra Creek	Creek flows	Carting from Beaudesert/Logan/grid
Dunwich	Groundwater	Groundwater level	Carting from North Stradbroke Island grid WTP
Kooralbyn	Logan River/Maroon Dam	Maroon Dam level	Carting from Beaudesert/Woodhill/grid
Dayboro	North Pine River	Bore level	Carting from Draper/grid
Esk	Wivenhoe Dam	Wivenhoe Dam level	Wivenhoe Dam
Point Lookout	Groundwater	Groundwater level	Carting from North Stradbroke Island grid WTP
Boonah-Kalbar	Reynolds Creek/Moogerah Dam	Moogerah Dam level	Carting or temporary pipeline from the grid
Beaudesert	Logan River/Maroon Dam/Grid	Maroon Dam level until connected to the grid	Connection to the grid
Kilcoy	Somerset Dam	Somerset Dam level	Carting from Woodford/grid
Lowood	Lower Brisbane River/Wivenhoe Dam	Wivenhoe Dam level	Wivenhoe Dam

8.1.4 NEXT STEPS

Seqwater will continue to review and analyse the water supply arrangements for all off-grid communities so that changing circumstances can be identified early and plans adjusted accordingly. Tasks that will be undertaken include the following.

- Ongoing monitoring of influencing factors so that plans can be adapted if the situation changes at any of the off-grid communities. This will include work with the water service providers to monitor and refine the demand projections as updated information becomes available.
- Review of each community's water supply disruption plan, including the drought response elements.
- Further development of the groundwater models that support planning for Dayboro and the three off-grid communities located on North Stradbroke Island.

09 Water **futures**

09 Water futures

To plan for the future, Seqwater needs to understand what South East Queenslanders want their region to be like in the future.

Gaining a deep understanding will require comprehensive community engagement over the duration of the planning period and close collaboration with local councils, the Queensland Government and water service providers.

The Water Security Program will continue to be reviewed and refined as Seqwater works toward meeting the United Nations definition of water security – which is much broader than the currently regulated requirements under the *Water Act 2000*.

To achieve this broader United Nations definition (Section 1.2), the scope of the region's water planning must expand to become more integrated across a range of planning functions at a regional and sub-regional level. Seqwater will seek to work collaboratively with government agencies and water service providers to ensure that water can positively contribute to the overall liveability of the region.

The water for life community engagement (Section 7.5) has explored the community's values in relation to water and expectations for future water planning, including expectations for future liveability.

To ensure Seqwater continues to support the growth and prosperity of our region it is important to take an integrated planning approach.

9.1 Liveability

It is not the role of Seqwater to define liveability, instead we aim to listen to the community. Our goal is to understand how the community's desires for liveability link with their views about water and future demand, supply and system operation options. The concept of liveability is unique to each community and can be unique to each individual. For this reason and to ensure good planning, it is important to understand what is 'common' to discussions of liveability.

At Seqwater's community forums, participants were introduced to the concept of liveability being the many characteristics that make a region, city or area an optimal place to live – these characteristics being dependent on place and community influences. They were asked to imagine living in the most liveable city in the year 2046 (assuming that they are the same age as they are today) and to describe what they considered to be the main liveability factors. The most frequent elements felt to make a location an excellent place in which to live were:

- environmental conservation, in the context of development having a minimal impact on the natural environment
- environmental sustainability in terms of pollution, natural resources, waste management and farming
- balanced development which retained large proportions of green space for recreation and community
- effective transport infrastructure
- the application of technology to enhance work-life balance and help keep people connected
- a strong sense of community and a high level of public safety
- equal access to services, resources and opportunities, in such areas as education, healthcare, employment and housing
- the application of technology to manage resource consumption
- for participants in Boonah – maintenance and improvement of the rural lifestyle.

your **say**

Year 7 students from Macgregor State High School have a vision for our region's water future. As part of the 2016 World Science Festival, the students participated in Brisbane City Council's Green Heart Schools Future BNE Challenge which was supported by Seqwater. They developed an innovative solution for our future water security in the year 2100.

The team's solution reimagines the design of a bathroom and includes new features. The design includes a toilet that has two filters to separate waste and diseases, a storm water pipe to capture water for storage in a tank, a water efficient sink and toilet and a waste recycling unit. The team envisioned that their solutions will reduce the amount of water used in bathrooms and wasted in flushing toilets.

Macgregor State School won the Practicality and Social Awareness category of the competition. View the students' submission at yourseqwater.com.au.

9.1.1 ENVIRONMENT

The most prominent liveability factor that emerged across all forums was the environment, which included a number of different facets as outlined below.

Environmental conservation – this included conservation of beaches and parklands, climate stability, protection of flora and fauna and ensuring that urban development has a minimal impact on the natural environment.

your **say**

"It's not good enough just to have a smattering of trees; you should be required to develop a sustainable ecosystem within these trees."

Environmental sustainability – this included a stable environment, limiting the pollution of air and water, ensuring sustainable water sources, recycling and management of waste products, and maintaining the integrity of farming land.

your **say**

"We need arable land to be able to grow crops to feed ourselves."

Green spaces – maintenance of current green spaces and the planning for new ones. This included a balance of urban and natural spaces, limiting high population and high density development, and ensuring green spaces for recreational activities and community gardens.

your **say**

"We need well planned building to ensure we have a lot of green spaces set aside… not just little parks, but also large spaces."

9.1.2 URBAN PLANNING

Strong planning in terms of urban planning and the utilisation of technology, were considered important liveability factors.

Transport infrastructure – this included the equal provision and accessibility of public transport networks irrespective of where you live or your financial situation, as well as easing congestion on roads and encouraging active commuting.

your **say**

"Cheap, efficient, reliable public transport that gets you where you need to be."

Connectivity – this included the concept of technology reducing the need for face to face contact, with flow-on implications for working hours, acceptability of working from home, and less reliance on travel to the heart of the city for business and social interaction.

your **say**

"Self-contained satellite cities where we would produce our own electricity and produce our own water."

9.1.3 SENSE OF COMMUNITY

Despite the prediction of an increasingly technology-driven society, participants felt that a traditional 'tribe mentality' and the need for face-to-face, personal contact would perpetuate a desire for a strong sense of community. Key liveability aspects of this factor included public safety, an inclusive culture, and cultural sustainability.

your **say**

"I don't want to live and work at home, I want to be part of a team still."

Maintaining rural lifestyle – for participants in Boonah, who preferred a rural lifestyle to that offered by a city, the focus was to maintain and improve the rural lifestyle.

your **say**

"Needs to be a balance between a country life and having the amenities that are offered by bigger towns or cities."

9.1.4 EQUITABLE MANAGEMENT OF RESOURCES

Effective management of resources and social infrastructure was a key liveability theme across all forums.

Equal access – to services, resources, and opportunities including the affordability of key natural resources for all people and the use of pricing structures to manage natural resources, as well as equal access to education, healthcare, employment, and housing.

your **say**

"Utilities aren't just for the people with a lot of money… there needs to be affordability of the essentials, the things that people have to have."

Technology in managing resource consumption – this included education around the sustainability of resources and household-level control of resource use.

your **say**

"Personal access to technology that informs how we use resources, how much resource we use, and how much we actually need access to."

9.2 Community's goals for a water plan

Water management affects the way individuals and communities experience their cities, regions and towns. When asked to consider water and water planning in the context of their vision of future liveability, the community's expectations were clear. The consistent responses to the potential goals of a regional water plan for the next 30 years – at both the community forums and in response to survey – were to deliver a secure water supply that is sustainable and reliable, one that provides clean/safe drinking water at an affordable price.

The most popular responses in the survey are outlined below in Figure 9-1.

Environmental themes were strong in the liveability visualisations and environment was considered most important amongst the four categories for water planning (Section 7.5). Community engagement and research both show that the community would like the goal of the Water Security Program to be realised by infrastructure and planning that takes the environment into consideration to a greater extent than other factors such as economic impacts.

9.3 Future options assessment framework

In future versions of the Water Security Program, Seqwater aims to explore how the options assessment framework can capture liveability factors important to the community. Liveability objectives could be developed and used to define water security objectives, in addition to use in quantitative economic assessment of options to achieve those objectives. In this way the guiding principles of water considerations (Appendix C) – used up until now to understand community views and comparatively assess options – could progress to a suite of liveability objectives and considerations to be assessed in planning for South East Queensland's long term water security.

In order to set such liveability objectives, Seqwater needs to clearly understand and align with the liveability objectives of the communities we supply. Seqwater recognise that planning authorities that manage liveability outcomes have defined objectives. While these objectives may not be termed specifically as liveability objectives, the processes such as regional planning and local government planning would nevertheless capture various aspects of liveability as informed by the communities they plan for.

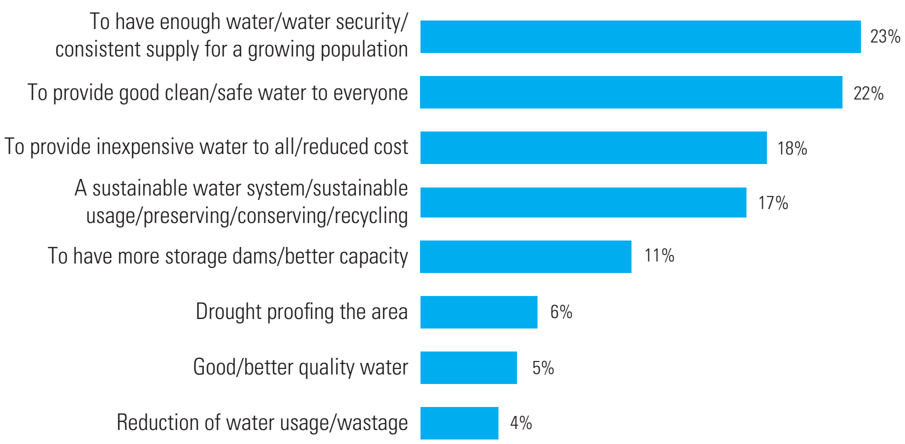


Figure 9-1 June 2016 Survey – Perceived priorities for a future regional water plan (n = 1,500)

Q: 'What do you think the focus should be of a regional water plan for the next 30 years?'

In future versions of the Water Security Program, Seqwater aims to define liveability objectives. These could be defined by extracting elements from existing planning documents, working collaboratively with various planning authorities and further engaging with the community. Seqwater recognises that objectives may vary across communities and aims to allow for flexibility in adapting the objectives to accommodate for sub-regional differences.

Once common liveability objectives are agreed, Seqwater aims to develop ways to quantify the role of a secure and safe water supply in supporting such liveability objectives. Seqwater also aims to work collaboratively with stakeholders and the community to quantify the impact of potential future water security options on liveability objectives.

9.3.1 MEASURING THE CONTRIBUTION OF WATER TO LIVEABILITY

To measure the contribution of water in achieving liveability objectives, a set of indicators will be required. The Water Service Association of Australia (WSAA) has identified indicators that could be supported by any of the services provided by water utilities in Australia. Seqwater could potentially use these or similar indicators for measuring the contribution towards liveability objectives for the future versions of the Water Security Program.

9.3.2 NEXT STEPS

As Seqwater provides a bulk drinking water service only, we need to consider how we define and select liveability objectives for future options assessment frameworks and how we may calculate their contribution. This would need to be done in consultation with water retail and sewerage service providers as well as regional and local planning authorities.

Seqwater wants to ensure that any adopted liveability indicators are aligned with the planning objectives of local and regional planning authorities and water service providers. To ensure alignment, Seqwater will take the following action.

1. **Pursue a joint approach** with local councils, water service providers and the Queensland Government for the inclusion of liveability objectives and indicators in the region's water planning.
2. **Engage communities** about liveability, how a bulk drinking water service can contribute, and what they think should be priority objectives.
3. **Work collaboratively** with local councils, water service providers and the Queensland Government to agree on liveability objectives for communities to inform Seqwater's options assessment framework.
4. **Define indicators** to help measure the impact various water security options may have on liveability and assess if liveability objectives are being achieved – these measures may be developed, or adopted and modified from existing papers.
5. **Conduct case studies** including further research to fill data and method gaps for calculating impacts on liveability objectives.

Seqwater has developed a roadmap (Figure 9-2) that indicates the approach that will be taken to identify and quantify our contribution to liveability in the communities we serve and enable quantitative assessment of water security options against these indicators.

We will then need to consider how this assessment is incorporated into a Total Economic Value assessment through the options assessment framework.

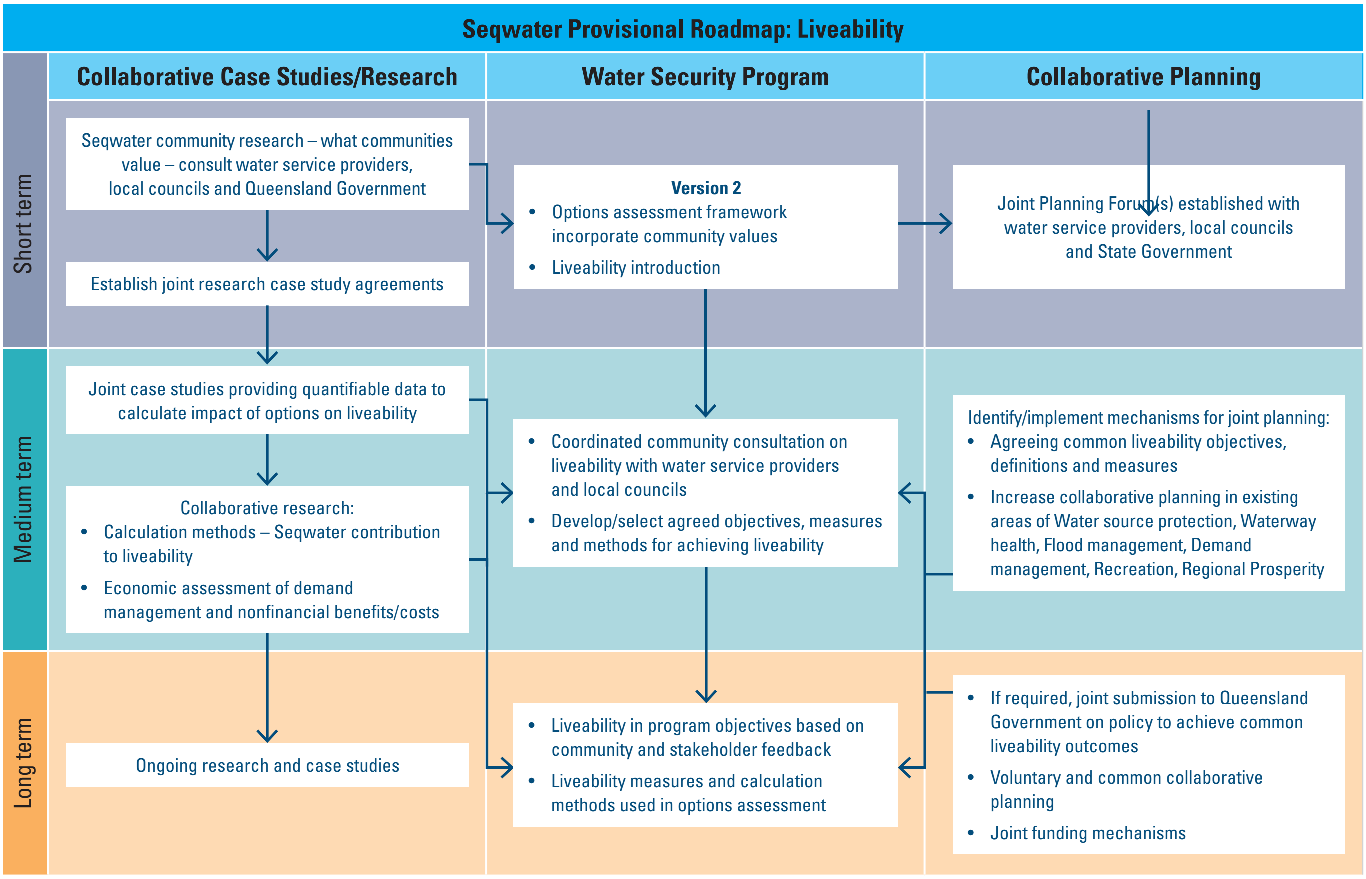


Figure 9-2 Roadmap for including liveability in water planning

10 Next **steps**

10 Next Steps

The iterative nature of the Water Security Program enables Seqwater to proactively and rigorously plan over short-, medium- and long-term planning periods. Through this version of the Program we have outlined plans for the following outcomes.

- Comfortably meet urban water demand for 20 years with the existing supply system (unless we have a severe drought or sharp increase in demand).
- Maintain adequate water supplies during droughts much worse than have ever been experienced in the region, with an adaptive drought response plan.
- Sustainable access to adequate quantities of water into the future with efficient water supply options identified for inclusion in any investment pathway. Two potential investment pathways have been presented that demonstrate how the system might be augmented to ensure ongoing water security for the region.
- Provide off-grid communities with the same level of water security as grid connected communities.

Ongoing community and stakeholder input, targeted planning, further research, and continued monitoring and review will enable further refinement of this Program so that it remains adaptive to external influences and community expectations. This chapter describes the steps Seqwater will take to progress the Water Security Program over the different planning horizons while continuing to meet statutory obligations and timeframes.

10.1 Community engagement

Seqwater is committed to engaging with our communities to achieve a shared vision for the region's water future. Our water for life engagement has so far aimed understand the community's values around water and water planning, the concept of liveability and views on the future water options available to us.

The needs and expectations of the community will almost certainly change over time, and will differ between South East Queensland communities. Accordingly our conversation with the community will be ongoing. Seqwater will continue to work within the framework of the International Association for Public Participation to engage the community in planning for future versions of the Water Security Program. The Water Security Program must be adaptable to change, including being able to respond to and reflect community views and values as they evolve. Seqwater intends to further integrate community engagement into future options assessment frameworks.

The next phase of community engagement will focus on the drought response approach. Seqwater will work with the community and the water service providers to gain an understanding of the implications of different drought response approaches at a region-wide as well as sub-regional level and adapt the approach accordingly.

The region's water security is currently medium-high but it is possible that the region may transition into drought before the next version of the Water Security Program is developed. If this occurs, the version 2 drought response plan provides appropriate action to be taken so that water supplies are maintained.

Responding to feedback received during engagement to date, Seqwater will seek to expand community education activities, providing information to children and adults about water, the water cycle and the concept of catchment to tap.

10.2 Liveability

Seqwater has commenced work to understand how the Water Security Program can contribute to the liveability of the region. Different communities have varying aspirations and different ideas as to what contributes to the liveability of their area. Often communities value unique qualities of their locale that provide them with a point of difference. Many agencies, such as local councils and the Queensland Government, contribute to the planning for liveability. Seqwater must consult with our communities and these agencies to define our role in achieving liveability outcomes for the region. We will then seek to understand how we can collaborate to deliver these outcomes.

The next step will be the development of Seqwater's liveability objectives. These must be complementary to the objectives of our partners. Once these objectives are developed we will seek to incorporate them in the options assessment framework to be developed for future versions of the Water Security Program.

10.3 Seqwater's partners

Seqwater is one of many entities that contribute to the provision of a secure and reliable water supply for South East Queensland. We will seek to broaden our involvement with these entities and partner with them in the ongoing development and review of the Water Security Program so that future versions can provide more integrated outcomes.

We understand that decisions made regarding the bulk water supply system will have consequential impacts for the distribution and retail systems, and eventually the wastewater systems. Working with South East Queensland's water service providers to understand these impacts will ensure that the best outcomes for the community can be achieved.

Seqwater has a number of planning and review cycles that are required to meet regulated outcomes and water security is one of these. We will seek to work with the Queensland Government to better align these cycles to improve the efficiency of outcomes for the community. An example is a potential improved alignment between the regulatory price path determination process, the review of the LOS objectives and Water Security Program.

10.4 Options assessment framework

Seqwater aims to progress toward meeting the United Nations definition of water security. This requires us to plan beyond the strict provision of the bulk water service. The framework for the next Water Security Program must balance multiple considerations and take into account broader societal impacts.

To do this, the Water Security Program options assessment framework will need to evolve to:

- incorporate liveability into the objectives of the framework
- broaden the consideration of the Total Economic Value of options
- expand the boundary of assessment (catchment-to-tap as opposed to a focus on the bulk water supply system in isolation).

Seqwater will work with the water service providers and regulatory agencies to further develop the options assessment approach for future version of the Water Security Program.

With increasing sophistication of the options assessment framework there will be a requirement to improve the framework's supporting systems. Ultimately there is a need to quantify the impacts that decisions will have on customer water prices and prices for end water users. A priority improvement will be to enhance and refine modelling tools (e.g. hydraulic, hydrologic, economic) that underpin the Water Security Program and to build integration between modelling tools.

10.5 Targeted investigation

In developing the Water Security Program, Seqwater has identified a number of opportunities, risks and influences that may shape future water security planning. We will work to better understand these issues over time and will incorporate the results in future reviews. The following investigations are prioritised for early work.

- Demand forecasting – Continue work to improve demand forecasting capability. This will focus on outcomes of the smart meter trials. Additionally there are opportunities to further segment the demand forecasts beyond the current residential and non-residential sectors so that impacts or external drivers on demand can be modelled.
- Flood mitigation and dam safety – Seqwater has an ongoing dam improvement program in place that responds to the changes in the assessed dam portfolio risk profile. Additionally Seqwater is investigating options to improve the flood mitigation outcomes that could be achieved using existing infrastructure. Options are available to improve dam safety and flood mitigation outcomes however these options may impact water security. Seqwater will continue to work to understand and evaluate these interdependencies to provide the best outcomes for the community. The pace of implementation must be aligned with these complementary programs.
- Broadened scenario planning – A number of scenarios have been considered in the development of this Program including some impacts of climate change and impacts of high and low demand caused by various influencing factors. Seqwater will expand this scenario planning as the understanding of the influencing factors develops. We will also consider the impacts of system shocks on water security. Dam failure or adverse step changes in source water quality are examples of system shocks that may be considered.
- Securing supply option sites – We will continue to investigate the most suitable sites for potential water supply options. Where appropriate, Seqwater will take steps to secure these sites to ensure that all water supply options remain available until final water supply augmentation decisions have been made. We will work with the Queensland Government and local governments to understand appropriate processes to secure these sites.
- Interstate water transfers – Progress studies on the hydrologic and regulatory feasibility of transferring water between Queensland and New South Wales.
- Decentralised water supply schemes – Continue investigations into the potential for implementing decentralised schemes on a sub-regional basis including cost and benefit implications.
- Groundwater models – Seqwater relies on groundwater sources for a number of water treatment plants. While current indications are that these water sources are secure, further work is required to refine these models to provide for improved management of these water sources.

10.6 Research and monitoring

Exploration of external influences and likely trends identified in Chapter 2 – Influences, highlight a number of variables that may impact the Water Security Program over the next 30 years.

Extensive shifts in climate, changing policy and regulation settings, rapid population growth and changes in societal expectation, competition for scarce water resources, economic growth or decline, environmental degradation in catchments and technological breakthroughs could all, singularly or in conjunction, have significant impacts on water security planning.

To respond to external influences, an iterative approach to water security planning has been adopted – informed by an ongoing program of investigation that includes environmental scanning, monitoring and research. Seqwater undertakes these activities internally and in partnership with government agencies, industry bodies and universities. Key influences and associated areas for future investigation to inform the next iteration of the Water Security Program are identified in Table 10-1.

10.7 Integrated planning

Integrated planning that recognises the importance of water security to the region is important to the implementation of this Program. Effective planning can help manage threats to water quality and quantity. Seqwater is committed to being involved in the integrated planning of the communities we service and will collaborate with a range of planning agencies to achieve positive liveability outcomes for the region.

Seqwater will continue to actively pursue partnerships with the water service providers, local government, non-government organisations and the Queensland Government. We will also continue collaboration on investments to reduce risk and improve resilience of water supply catchments. Through these partnerships regional Catchment Action Plans (CAPs) will be progressed for all major catchments in the region. These CAPs are designed to identify collaborative investment opportunities that will deliver multiple benefits to different stakeholders. Water supply is a recognised key priority of CAPs impacting Seqwater's surface water sources.

Table 10-1 Responding to influences

Influence	Key investigation areas
Climate	• Patterns and rapidity of climate change • Impacts of extreme events on asset performance • Changes in catchment fire regimes and potential impacts • Catchment response to extreme events • Ecological changes in catchments • Water supply and demand impacts • Legal review and revisions to limit liability • Quantify risk evolution to assets • Strategy and targets for service and pricing • Integrated catchment adaptation planning • Address immediate cross dependencies
Policy and regulation	• Impact of regional and local land use planning policies on raw water quality • Efficiency of economic regulatory regimes • Impact of water quality requirements and health-based standards • Regulation of recycled water and decentralised schemes
Society	• Patterns and locality of population growth • Population demographics • Community perceptions on water security • Barriers to demand management • Consumer demands and expectations • Liveability requirements • Liveability objectives
Resource Competition	• Changes in regional energy and food production • Impacts of tourism on water demand • Impacts of water based recreation
Environment	• Catchment land use change and water quality and quantity impacts • Catchment threshold trends and water treatment • Pollutant load reduction options • Lockyer flood predictive modelling • Hydrological investigations of Mid Brisbane River • Environmental impacts of existing and proposed infrastructure
Economy	• Patterns of industrial and agricultural production • Impacts of changes in Australian economy • Water pricing • Cost benefit analysis of drought response actions
Technology	• Advances in catchment monitoring • River and catchment restoration techniques • Quantification of dam storage using new technology • Advances in water treatment technology • Advances in water quality monitoring • Smart monitoring and use of big data • Analysis of emerging decentralised schemes

10.8 Annual assessment and report

The DEWS Water Security Program guideline formalises assessment and reporting requirements that are already integral to Seqwater's processes as a responsible water supply authority. The operating environment constantly changes, which means Seqwater monitors and reviews a range of influencing factors, from water consumption trends (daily, monthly, annually) and dam inflow patterns in the shorter term, to changes in population, technology, economic, environmental and social factors in the longer term.

Seqwater is required to conduct an annual water security assessment and publish a report containing the outcomes. This report will be published on the Seqwater website (seqwater.com.au) by the end of December each year. The aspects to be assessed and our approach to preparing the report each year are summarised in Table 10-2.

10.9 Five-yearly review

The outcomes of planning and research will be used to inform full reviews of the Water Security Program. Under the *Water Act 2000* the Water Security Program must be reviewed at least every five years beyond 2017. The Act requires Seqwater to review the Program earlier if there is a significant change in any matter affecting, or likely to affect, the achievement of the desired LOS objectives for water security. If there are no significant changes, the first major review will be published in 2022.

Community engagement and collaboration with the region's water service providers and regulatory agencies will be integral to future reviews and updates of the Water Security Program. As outlined in Chapter 7 – Planning for the future, a number of possible investment pathways could achieve the LOS objectives as the South East Queensland population grows. Demand, supply and system operation options are presented for ongoing assessment and community discussion.

All the various supply augmentation options – desalination, purified recycled water, groundwater, surface water, and decentralised supplies – are open to consideration and evaluation. Similarly, varying levels of residential and non-residential demand play a critical role in determining when additional supply may be needed. Seqwater intends to further gauge the community's desire to proactively manage demand as part of the system performance mix. Operation of the water grid and the development of triggers at the regional and sub-regional levels also need to be refined and adapted in line with community expectations.

The people of South East Queensland will have a real opportunity to shape their long-term water future. Seqwater will incorporate community views and values to adapting the Water Security Program to meet the region's needs and aspirations, and deliver water for life.

Table 10-2 Annual water security assessment and reporting process

Assessment item	Seqwater's approach
Bulk water supply system status	List the current bulk water supply system assets and their individual capacities. Describe any changes to the asset base and/or capacities during the year, and the rationale behind those changes.
Readiness of climate-resilient water assets	Provide information about the status of the GCDP and WCRWS assets, such as current standby mode, actions needed to bring the assets online, and time needed to reach required supply capacities.
Annual water usage and comparison with previous years	Provide a breakdown of the water demand into annual and monthly volumes and per capita usage and present an analysis of water use trends over time.
Annual assessment of the SEQ regional water demand forecast	Conduct an assessment of the long-term demand forecast used for the Water Security Program in conjunction with the SEQ water service providers and using the latest population forecast data from the Queensland Government Statistician's Office. Report the key findings of the annual demand forecasting assessment, including comparison with past years' actual consumption, and any changes to the inputs used for the long term SEQ regional demand forecast, e.g. population growth. If the results of the assessment indicate a 10% or greater variation from the current demand forecast, a full review of the Water Security Program will be triggered. Appendix E contains further information on the assessment process.
SEQ regional water balance	Review the LOS yield and projected date when future demand equals planned supply capacity, i.e. the water balance. Assess and report on the probabilities of reaching specific storage trigger level percentages.
Relevant drawdown scenarios	Based on the prevailing regional water balance, including the past year's drawdown scenarios, assess and report on projected storage drawdown scenarios for the coming year.

11 References, Glossary, **Acronyms & Abbreviations**

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Glossary

Term	Definition
aquifer	An underground body of porous rock that is able to store and yield water.
average day demand	Average of daily water demands for the region or each water demand zone over a period of years, months or days. Usually calculated as total demand for the year divided by 365.
blue sky	A conceptual term used to describe a list of things that are theoretically possible, but where economic, social, environmental, hydrologic, etc. considerations have not yet been applied.
borefield	A collection of bores in a particular location which extract groundwater from one or more aquifers
bulk water customer	SEQ water service provider; or an entity declared under a regulation to be a bulk water customer, including: a) Queensland Urban Utilities b) Unitywater c) Redland City Council d) Logan City Council e) City of Gold Coast f) Toowoomba Regional Council g) Stanwell Corporation Limited
Bulk Water Supply Code	Bulk Water Supply Code as made by the Minister under section 360M of the *Water Act 2000*.
bulk water supply system	The infrastructure for supplying water to bulk water customers in the SEQ region, including: a) Baroon Pocket Dam, Cooloolabin Dam, Ewen Maddock Dam, Hinze Dam, Lake Kurwongbah, Lake McDonald, Leslie Harrison Dam, Little Nerang Dam, North Pine Dam, Somerset Dam, Wappa Dam and Wivenhoe Dam; and b) the Western Corridor Recycled Water Scheme, and the Gold Coast Desalination Plant; and c) the main connecting pipelines (the Northern Pipeline Interconnector, Southern Regional Water Pipeline and Eastern Pipeline Interconnector).
bundle	A group of activities/actions from single option type (e.g. only demand management options list) that rely on each other to function effectively.
capability	The extent of a water storage, supply or treatment infrastructure's ability to perform under given operating conditions (e.g. raw water containing a nephelometric turbidity unit (NTU) of 0.3)
capacity	The performance output of a water storage, supply or treatment infrastructure under specific conditions (e.g. design capacity).

Term	Definition
category	A particular type of option (bulk water supply or demand management). Includes: a) desalination b) surface water c) groundwater d) recycled water – direct potable reuse e) recycled water – indirect potable reuse f) recycled water – non-potable reuse g) decentralised schemes h) unconventional supplies (i.e. cloud seeding) i) network augmentation j) water treatment plant augmentation k) non-structured, including demand management
contingency supplies	Additional water supplies which will be implemented immediately in response to emergency drought conditions at defined storage levels.
dead volume (aka dead storage volume)	The volume of water remaining at the bottom of a storage that cannot be accessed for water supply because it is below the level of outlet/release mechanisms. The dead volume is at or below the designated minimum operating level for the storage.
demand management	Includes: a) maintaining demand b) reducing demand for water c) increasing the efficiency of water supply works d) increasing the efficiency of the use of water by end water users e) substituting one water resource for another.
Direct Potable Reuse (DPR)	The addition of purified recycled water (i.e. potable water recovered from treated sewage effluent) directly into the potable water supply distribution system.
diurnal consumption profile	Cyclic nature of water consumption over a 24-hour period which typically sees consumption peaks in the mornings and evenings, steady consumption during the day and minimal consumption during the night.
drought	(Water Supply) A period of time for when the combined bulk water storages within the South East Quend region are at or below the drought response level. A prolonged, abnormally dry period when the region receives a deficiency in its water supply, whether atmospheric, surface or groundwater.
drought response	An action applied to bring forward commissioning of new infrastructure, system operation, or demand management measures as a result of supply shortfalls in the bulk water supply system, due to the length of drought.
drought response level	The level in the bulk water supply system stated in the SEQ Water Security Program that is the trigger for taking action in response to drought. (Section 82, *Water Regulation 2016*).
end water user	Residential, commercial and industrial customers supplied from the SEQ supply system, generally via a bulk water supply customer.
essential minimum supply volume	The volume needed to supply an average of 100 litres for each person for each day for residential and non-residential water use.
fair weather	Giving consideration to the infrastructure's ability to operate under average weather conditions.
greenfield	An area of land that has not previously had infrastructure on it.
water grid (SEQ Water Grid)	The interconnected bulk water supply system in SEQ, excluding off-grid community water supply schemes
historical no failure yield	The maximum amount of water that, if it had been extracted in each year for which flow data exists, the storage would not have reached the minimum operating level.
hydrologic cycle	The hydrologic cycle is a continuous process by which water evaporates and is transported from the earth's surface (including the oceans) to the atmosphere and back to the land and oceans.

Term	Definition
hydrology	Hydrology is the science of water that encompasses the occurrence, distribution, movement and properties of water and its relationship with the environment within each phase of the water or hydrologic cycle.
Indirect Potable Reuse (IPR)	The addition of purified recycled water (i.e. potable water recovered from treated sewage effluent) into the raw water supply prior to being further treated and fed into the potable water supply distribution system.
Investment strategy	An investment approach which describes how options are selected and combined to achieve water security objectives
Investment pathway	The option sequence and implementation triggers developed by applying an investment strategy to a portfolio of options. Together these options can be implemented in stages, and in response to specific triggers, to meet the long term water security objectives.
key bulk water storages	The key bulk water storages (sometimes called Grid12) are: • Hinze Dam • Little Nerang Dam • Leslie Harrison Dam • Somerset Dam • Wivenhoe Dam • North Pine Dam • Sideling Creek Dam (Lake Kurwongbah) • Ewen Maddock Dam • Cooloolabin Dam • Wappa Dam • Baroon Pocket Dam • Six Mile Creek Dam (Lake Macdonald)
levelised cost	The cost of a measure expressed in terms of dollars per megalitre. Levelised cost is generally calculated by dividing the net present value of the cost of the measure by the net present value of the water saved or supplied.
Level of Service (LOS) yield	The volume of water that can be supplied by the bulk water supply system, on average, every year in order to achieve the desired Level of Service objectives.
Level of Service (LOS) objectives	Objectives for water security which are based on expected frequency, severity and duration of water restrictions occurring within the region (*Water Act 2000*, Section 344, and *Water Regulation 2016* Section 78).
Mean Day Maximum Month (MDMM)	Design parameter used in Queensland to reflect demand persistence in response to climatic conditions. Calculated as the highest 30-day moving average daily water demand during a year.
medium level water restrictions	Water restrictions imposed on residential and non-residential water use in response to drought, when the level in the bulk water supply system is between the a) drought response level and b) safe minimum storage level. (*Water Regulation 2016* section 80).
minimum operating level	The lowest level within storage infrastructure (e.g. reservoir, dam) to which water supplies can be drawn down to (or released) under normal operating conditions. The minimum operating volume for any storage is included in the appropriate resource operations plan and might be referred to as the dead storage level. Water below the minimum operating level cannot be accessed with existing infrastructure.
non-residential water use	Water use that is not residential water use (e.g. commercial and industrial).
off-grid community water supply scheme	An urban community supplied by a source that is not directly connected to the water grid.
off stream storage	A water storage structure, e.g. a ring tank, built adjacent to a watercourse into which water is pumped from the watercourse when flows are sufficiently high and stored for later use.
option	Individual supply or treatment source, network augmentation or demand management measure that can form part of a portfolio which contributes towards long term water supply requirements.
Options Assessment Framework	The framework that is applied to assessing portfolios of options against each other and in the scenario analysis phase to transparently and robustly choose a recommended portfolio.

Term	Definition
ozonation	In relation to drinking water treatment, ozonation refers to the use of ozone to disinfect and to break down large organic compounds which are then removed with the use of activated carbon. According to the *Australian Drinking Water Guidelines* (NHMRC, NRMMC, 2011), 'ozone has a long history of use for disinfection, and for the control of taste, odour and colour'.
planned base case	A range of actions that will be undertaken regardless of our future water supply planning (refer to Section 7-8 for the specific actions)
planning criteria	Assessment parameters that broadly encompass the following areas: • regulated level of service objectives • network parameters that dictate capacity requirements (i.e. treatment, transport and network storage) • water quality and catchments Specific planning criteria are summarised within Appendix G.
portfolio	A group of options from which to select.
projected regional average day urban demand	The demand, expressed in litres for each person for each day, for residential and non-residential water use that is estimated for the South East Queensland region.
purified recycled water	Wastewater that has been treated to a very high standard using the world's best technology through an advanced water treatment process. The Public Health Regulation 2005 and the Water quality guidelines for recycled water schemes specify the water quality standards that must be met for recycled water and drinking water.
Regional Stochastic Model (RSM)	The model developed using the Water Headworks Network (WATHNET) computer program, used to determine the system yield based on existing infrastructure being operated in a specified arrangement. Based on stochastically generated inflow sequences derived from historical data.
reliability	The ability of the bulk water supply system to provide a reliable supply source in accordance with adopted planning criteria.
residential water use	Water use at a residence or for other domestic purposes.
resilience	The capability of the bulk water supply system to overcome failures in the system and to maintain reliability by returning quickly to its former state.
resource operations licence	A licence issued by the Queensland Government to a water supply scheme operator such as Seqwater. The licence specifies the infrastructure to which it applies, and a range of operating and water sharing rules to meet the flow objectives of the relevant water resource plan.
reticulated	A piped water network (as opposed to individual supply sources such as household rainwater tanks).
robustness	The degree to which the bulk water supply system can function correctly in the presence of multiple impacts or stressful environmental conditions.
safe minimum storage level	The level in the bulk water supply system stated in the SEQ Water Security Program that is the trigger for taking more severe action in response to drought, to minimise the risk of reaching the minimum operating levels (*Water Regulation 2016* Section 80).
scenario	A coherent, internally consistent and plausible description of a possible future state (e.g. environmental/social change) of the South East Queensland region.
scenario analysis	The testing of portfolios to identify those which perform well against different scenarios (e.g. climate change, demand forecast).
sensitivity analysis	The testing of portfolios to identify their robustness against external factors which have a wide range of influences (e.g. discount rate).

Term	Definition
South East Queensland (SEQ) region	Consists of: (a) The local government areas of the following local governments: • Brisbane City Council • City of Gold Coast • Ipswich City Council • Lockyer Valley Regional Council • Logan City Council • Moreton Bay Regional Council • Redland City Council • Scenic Rim Regional Council • Somerset Regional Council • Sunshine Coast Regional Council (b) Any local government area, or part of a local government area, adjacent to a local government area mentioned in paragraph (a) and designated by gazette notice. The SEQ region also includes Queensland waters adjacent to any of the local government areas mentioned above.
Seqwater	Queensland Bulk Water Supply Authority (established under the *South East Queensland Water (Restructuring) Act 2007*)
SEQ water service provider	Bulk water customer (see definition above – bulk water customers 'a' to 'e') which purchases bulk treated water from Seqwater and retails it to individual households and businesses via the urban reticulation system.
standpipe	A freestanding pipe to which hoses can be connected to access treated water, e.g. for fire-fighting or filling a water tanker.
stochastic	Of or pertaining to a process involving a randomly determined sequence of observations each of which is considered as a sample of one element from a probability distribution.
strategic reserve	A category of water in a water resource plan that is currently unallocated, but able to be allocated for consumptive use under certain conditions, for example, new water supply infrastructure is built by the State to access the water.
structured argument assessment	The use of multiple assessment criteria (levelised cost, yield, environmental, social, technical, risk) to describe and assess the trade-offs between options and investment strategies.
supply shortfall	The inability of the bulk water supply system to meet water demand.
water security objectives	Refers to LOS objectives and planning criteria
Water Security Program	The bulk water supply authority's water security program for the SEQ region (Section 350, *Water Act 2000*).
water supply demand zones	A demand zone under a bulk water supply agreement to which the bulk water supply authority and the bulk water customer are parties.
yield	The average annual volume that can be drawn from a supply source or a supply option to meet a specified demand at a specified probability of occurrence.

Acronyms and abbreviations

Acronym/abbreviation	Expanded form
AD	Average day
AHD	Australian Height Datum
CAPEX	Capital expenditure
CSIRO	Commonwealth Science and Industrial Research Organisation
DEWS	Department of Energy and Water Supply
DPR	Direct potable reuse
EMSV	Essential minimum supply volume
EP	Equivalent population
EPI	Eastern Pipeline Interconnector
FSL	Full supply level
GCDP	Gold Coast Desalination Plant
GIS	Geographic information system
HNFY	historical no failure yield
IPR	Indirect potable reuse
KBWS	key bulk water storages
KL	kilolitre (one thousand litres)
L/p/day	litres per person per day
L/s	litres per second
LOS	Level of Service
MCDA	Multi-criteria decision analysis
MD	Maximum day
MDMM	Mean day maximum month
ML	Megalitre (one million litres)
ML/annum	Megalitres per annum (year)
MOL	Minimum operating level
NFD	Northerly flow direction
NPC	Net present cost
NPI	Northern Pipeline Interconnector
OPEX	Operational expenditure
PRW	Purified recycled water
QGSO	Queensland Government Statistician's Office (Department of Treasury)
RAT	Rapid assessment tool
SEQ	South East Queensland
SFD	Southerly flow direction
SPAT	Strategic Portfolio Assessment Tool
SRWP	Southern Regional Water Pipeline
UN	United Nations
WCRWS	Western Corridor Recycled Water Scheme
WEMP	Water efficiency management plan
WSAA	Water Services Association of Australia
WTP	Water treatment plant

12 Appendices

12 Appendices

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Appendix A: Level of service objectives

The desired Level of Service (LOS) objectives for South East Queensland are prescribed in the *Water Regulation 2016*. The regulation prescribes the following.

PROJECTED REGIONAL AVERAGE URBAN DEMAND FOR SEQ REGION

1. The bulk water supply system is to be able to supply enough water to meet the projected regional average urban demand.
2. The bulk water supply authority must:
   a) Work out the projected regional average urban demand in collaboration with the SEQ water service providers, and publicly publish the projection in the way stated in the SEQ water security program; and
   b) Assess annually whether the projected regional average urban demand or latest projected regional average urban demand is still current, and publicly publish the outcome of the assessment in the way stated in the SEQ water security program.
3. In this section:

   Projected regional average urban demand means the demand, expressed in litres for each person for each day, for residential and non-residential water use that is estimated for the SEQ region for each year over the next 30 years.

BULK WATER DROUGHT SUPPLY

1. The bulk water supply system is to be able to supply enough water so that medium level water restrictions on residential water use
   a) will not happen more than once every 10 years on average; and
   b) will not restrict the average water use for the SEQ region to less than 140 L for each person for each day.
2. The bulk water supply system is to be able to supply enough water so that medium level water restrictions on non-residential water use that is incidental to the purpose of a business will not happen more than once every 10 years on average.
3. Medium level water restrictions on residential and non-residential water use are expected to last no longer than one year on average.
4. In this section:

   Drought response level is the level in the bulk water supply system stated in the SEQ water security program that is the trigger for taking action in response to drought.

   Medium level water restrictions means water restrictions imposed on residential and non-residential water use in response to drought, when the level in the bulk water supply system is between
   a) the drought response level; and
   b) the safe minimum storage level.

   Safe minimum storage level is the level in the bulk water supply system stated in the SEQ water security program that is the trigger for taking more severe action in response to drought, to minimise the risk of reaching the minimum operating levels.

MINIMUM OPERATING LEVELS AND ESSENTIAL MINIMUM SUPPLY VOLUME

1. Each of the following dams will not reach its minimum operating level more than once in every 10,000 years on average:
   a) Baroon Pocket Dam
   b) Hinze Dam
   c) Wivenhoe Dam.
2. The bulk water supply system:
   a) Will be able to supply the essential minimum supply volume; and
   b) Will not be reduced to being able to supply only the essential minimum supply volume more than once in every 10,000 years on average.
3. In this section:

   Essential minimum supply volume means the volume needed to supply an average of 100 L for each person for each day for residential and non-residential water use.

Appendix B: Summary of planning criteria

BULK WATER SUPPLY SYSTEM PLANNING

Adopted planning criteria

Planning criteria are a set of assessment parameters, which enable a balance between the requirement for a safe, secure, reliable, quality water supply and the desire for this service to be provided at minimal cost.

The application of planning criteria is an efficient way of assessing system performance and capability to inform future investment, however they are not intended to preclude the consideration of innovative options or to diminish the goal of least-cost planning in promoting efficiency. Actual infrastructure delivery will still be underpinned by appropriate planning investigations and developing effective investment triggers so all decisions meet the underlying service objectives in a demonstrably prudent and efficient manner.

In line with this requirement, the preliminary planning criteria provided in Table B-1 have been identified as being critical to progress planning activities.

Table B-1 Preliminary planning criteria

Elements	Planning criteria	Notes
Average day (AD) demands	185 litres per person per day (L/p/day) residential 285 L/p/day total	Sensitivity assessments to be undertaken to determine the impact of any significant departures from this base case demand
Sustained peak persistence demands Mean day maximum month (MDMM)	1.3–1.5 x AD Based on demand zone analysis	Consistent with *Planning Guidelines for Water Supply and Sewerage* (DEWS, 2014b) and *SEQ Water Supply and Sewerage Design & Construction Code* (SEQ-SP, 2013)
Large connected water treatment plants (>100 ML/day)	23 hours/day availability for production	Demonstrated cost-effective staged integration between water treatment and network in line with the proposed water quality specification and at a low risk for water quantity outages
New water treatment plants		
Desalination plants		
Medium connected water treatment plants (10-100 ML/day)	20 hours/day availability for production	
Small and off-grid water treatment plants		
Bulk transport mains	Gravity mains to transport MDMM over 24 hours	System to be configured and operated above minimum flow to achieve water quality objectives
	Pumped mains to transport MDMM over 20 hours	
Bulk transport pump stations	MDMM over 20 hours	Standby pump capacity to match the largest single unit pump capacity
Regional interconnector pipelines	Maximum operation in line with design basis	System to be configured and operated above minimum flow to achieve water quality objectives
	Pump design basis 23 hours/day availability	Standby pump capacity to match the largest single unit pump capacity.
	Serve as MDMM mains for distribution along regional interconnector corridor	Fully metered, flow-controlled off takes to SEQ water service providers' systems
		A future assessment to be made as to appropriateness of the regional interconnectors for this purpose

Elements	Planning criteria	Notes
Bulk network reservoirs	3 x (MD–MDMM) < Operating protocol effective reservoir operating volume	For direct service zone only
	Maintain supply above operating protocol minimum operating level after 3 x MD	Minimum desired reservoir operating levels to provide the initial basis for the assessment of bulk water supply network reservoir requirements.
Regional interconnectors reservoirs	No allowance for direct reservoir storage for demand zones	In accordance with design specifications
Extended period analysis for bulk system transport and treatment	3 x MDMM demands	Reservoir initial levels to correspond to top operating level and reservoirs to have a net positive inflow each day
Extended period analysis for bulk system transport, treatment and reservoir storage	3 x MDMM demands followed by 3 x MD demands	Reservoirs cannot empty below minimum operating level
Water quantity	Risk of outage to be planned as low risk under normal operation (i.e. non-contingency modes)	Aligned with consequence and probability parameters under Seqwater risk management system
LOS objectives	Based on nominated frequency, severity and duration of water restrictions across the region	As defined in the *Water Regulation 2016*, Part 6 Division 1
Water quality	Australian Drinking Water Guidelines (NHMRC, NRMMC, 2011) and health-based treatment targets for pathogens developed by Water Services Association of Australia (WSAA, 2014)	Current and emerging chemical and physical water quality parameters representing a low water quality risk approach, consistent with the catchment to tap philosophy
Catchment	Investigations to address extreme and high risks currently in progress	Evaluation studies of efficacy and efficiency including risk mitigation and benefit analysis will be undertaken so the natural asset may better support reducing source water risks prior to the treatment process

Appendix C: **Water considerations for planning**

Water considerations for planning were developed using a review of industry considerations for planning, consultation with South East Queensland water service providers and engagement with our communities (Figure C-1).

Industry considerations for planning were assessed for their relevance to South East Queensland water planning, their ability to differentiate between water security options and potential to be quantitatively or qualitatively measured.

This preliminary list of considerations was developed with the South East Queensland water service providers and was subsequently shaped by the community through two successive rounds of community engagement.

PEOPLE AND PLACE CONSIDERATIONS

- Provides a fair and equitable water supply for all users (urban and rural)
- Maintains safe, public access to land and water for recreation and social interaction
- Maintains adequate land and infrastructure for community purposes (paths, bikeways and transport corridors)
- Maintains the overall 'look and feel' of the surroundings
- Maintains harmony with local culture and traditions (including indigenous heritage)
- Provides a water solution that is acceptable to most people (households and businesses) in my community

ECONOMIC CONSIDERATIONS

- Protects resources (land and water) for industries that provide local jobs e.g. agriculture, tourism or other industries
- Provides a cost efficient and affordable water supply (delivers value for money)
- Balances competing needs (community, industry and urban planning) to create shared value

RESILIENCE CONSIDERATIONS

- Provides a reliable water supply in all climate and weather conditions including droughts and floods
- Uses innovative technologies and flexible methods to maintain a continuous water supply
- Reliability of systems, technologies or programs to deliver drinking water that is consistent in its taste and smell

ENVIRONMENT CONSIDERATIONS

- Protects the biodiversity of natural waterways
- Protects land and soil that impacts plants and wildlife and limits erosion
- Preserves tree cover and canopies to provide shade in parks, gardens and urban areas
- Produces minimal greenhouse gas emissions or waste

Figure C-1 Water considerations for planning

Considerations were grouped into the four categories of economic, resilience, environment and people and place.

Appendix D: **Asset summaries**

The South East Queensland bulk water supply system is designed to efficiently treat and transport potable water to bulk water customers for distribution to consumers. The SEQ bulk water supply system assets include:

- catchments, dams and weirs (surface water storage assets)
- bores (groundwater source assets)
- the Western Corridor Recycled Water Scheme and the Gold Coast Desalination Plant (climate-resilient water assets)
- raw water pipelines
- water treatment plants
- bulk transport pipelines
- pump stations
- reservoirs
- water quality management facilities.

Characteristics of the key bulk water supply system assets (as at mid-2016) that supply, produce and deliver most of the region's treated water are summarised in Tables D-1 to D-5.

Table D-1 Surface water storage assets[1]

Storage asset	Full supply volume (ML)	Dead volume (ML)	Storage lowering
Little Nerang Dam*	6,705	203	None
Hinze Dam*	310,730	2,180	None
Maroon Dam	44,319	2,190	None
Cedar Grove Weir	1,144	100	None
Bromelton off-stream storage	8,210	1,131	None
Wyaralong Dam	102,884	264	None
Moogerah Dam	83,765	1,200	None
Leslie Harrison Dam*	24,868	787	Lowered to 53% FSL[2]
Enoggera Dam	4,567	2,557	None
Somerset Dam*	379,849	4,000	Lowered to 80% FSL[2] (2016 to 2021)
Wivenhoe Dam*	1,165,238	4,886	Lowered to 90% FSL[2] (2016 to 2021)
Cabbage Tree Creek Dam	26,409	2,652	None
Mt Crosby Weir	2,200	1,800	None
North Pine Dam*	214,302	1,310	90% FSL2 (189,268 ML)
Sideling Creek Dam	14,370	197	Lowered to 60% FSL[2]
Ewen Maddock Dam*	16,587	542	None
Cooloolabin Dam*	13,800	600	Permanent Lowering to 59%FSL[2]
Wappa Dam*	4,694	75	None
Baroon Pocket Dam*	61,000	4,500	None
Borumba Dam	45,952	1,200	None
Six Mile Creek Dam*	8,018	22	None
Poona Dam*	655	-	None

** key bulk water storages*

1 Irrigation, recreation assets and minor weirs are excluded

2 FSL: Full supply level

Table D-2 Groundwater source assets

Water source asset	Production capacity (ML/annum)
North Stradbroke Island Borefield	8,250
Dunwich Bores	500
Amity Point Bores	200
Point Lookout (Bores 2,3 & 4)	750
Bribie Island Borefields	1,580*

** approval holder must limit groundwater extraction from the Northern Borefield to no greater than an annual average of 4.32 ML/day, at a maximum daily rate of 5 ML/day and totalling no more than 1580 ML/annum*

Table D-3 Climate-resilient water source assets

Water source asset	Production capacity (ML/annum)
Gold Coast Desalination Plant	45,625
Western Corridor Recycled Water Scheme	66,430

Table D-4 Water treatment plant assets[1]

WTP	Rated capacity (ML/day)[2]
Mt Crosby – East Bank	500
Mt Crosby – West Bank	250
Enoggera	6.3
Molendinar	145
Mudgeeraba	80
Capalaba	24.2
North Stradbroke Island	49.3
Petrie	34.5
North Pine	150
Banksia Beach AWTP	4.5
Landers Shute AWTP	140
Image Flat	25.2
Ewen Maddock AWTP	14.3
Noosa AWTP	35
Lowood	16.00
Somerset	0.25
Esk	1.26
Kilcoy	4.80
Linville	0[3]
Point Lookout	1.97
Amity Point	1.80
Dunwich	1.38
Beaudesert	3.47
Boonah-Kalbar	3.25
Jimna	0.08
Kooralbyn	1.36
Rathdowney	0.30
Canungra	0.40
Dayboro	1.08
Kenilworth	0.52

1 Does not include recreational water treatment plants
2 Based on median water quality and 24-hour production
3 Linville WTP is planned for upgrade, current supply arrangements to the community are via water carting

Table D-5 Key bulk water transport assets

Bulk mains and associated infrastructure	Direction	Max flow rate (ML/day)	Min flow rate (ML/day)
Southern Regional Water Pipeline (SRWP) Southern leg – Molendinar to Staplyton	Southerly flow direction	65	20
	Northerly flow direction	130	20
Southern Regional Water Pipeline (SRWP) Central leg – Staplyton to North Beaudesert	Southerly flow direction	65	20
	Northerly flow direction	130	20
Southern Regional Water Pipeline (SRWP)	Southerly flow direction	171	20
Northern leg – North Beaudesert to Brisbane	Northerly flow direction	90	20
Eastern Pipeline Interconnector (EPI)	Easterly flow direction	22	4
	Westerly flow direction	22	4
Northern Pipeline Interconnector (NPI) Stage 1	Southerly flow direction	65	20
	Northerly flow direction	65	20
Northern Pipeline Interconnector (NPI) Stage 2	Southerly flow direction	18	5
	Northerly flow direction	35	5

Appendix E: Overview of demand forecast

Seqwater medium, low and high planning demand used in version 2 of the Water Security Program are constructed with consideration of key water demand input factors and drivers. Table E-1 provides a summary of these input factors and considerations for each planning demand level. Derivation of each input factor is provided in Table E-2.

The medium demand forecast is used for planning, with high and low demand forecasts used for scenario analysis. Using the medium forecast for planning provides an approach that balances the risks of inaccurately estimating the timing of system augmentations.

As a minimum, this demand forecast methodology will be reviewed when the Water Security Program is reviewed.

The "+/-" sign in the table refers to the escalation (+) or reduction (-) influence in water consumption from the given water consumption driver. These are collectively considered when reviewing the demand forecast. Each water consumption driver is monitored in the annual review and output consumption estimates adjusted accordingly.

ANNUAL ASSESSMENT OF SOUTH EAST QUEENSLAND DEMAND

Each year South East Queensland's water service providers will submit their demand forecast to Seqwater. The revised Seqwater-generated demand forecast and the updated water service provider forecasts will be compared to the agreed forecast from the previous year. If the demand forecasts do not exceed a 10% threshold variation trigger, then the previous forecast remains applicable for long-term planning with an extension of an additional year.

If the demand forecasts exceed a 10% variation trigger then Seqwater in collaboration with the water service providers, will review the factors that could be causing the variation and update the forecast. Any updates to the forecast will be endorsed by Seqwater and the water service providers. If the updated endorsed forecast exceeds the 10% variation threshold, this will trigger an update of the demand forecast and a review of the Water Security Program.

Seqwater will also conduct an annual assessment to compare the annual demand recorded each year against the forecast demand for the same year.

This allows for an assessment of trends in production data and retail billing information. This assessment will commence when retail data that incorporates actual usage over the financial year becomes available. Outcomes of the assessment will be published on the Seqwater website.

If there are any differences in the portion of residential and non-residential water consumption, and the residential and non-residential consumption and account growth trend, when comparing the actual demand against forecast demand, an analysis of the key reasons for any divergence will be conducted and the 30-year long-term demand forecast will be updated. This may trigger a review of the Water Security Program.

South East Queensland water service providers and the Department of Energy and Water Supply will be formally advised of the outcome of the annual assessment of demand. This will incorporate an update on the impact to the water balance position for the region, and potential implications for timing of infrastructure needs. The annual assessment of South East Queensland demand will be published on the Seqwater website in December as part of the annual water security assessment.

Table E-1 Demand forecast – assumptions, uses and outputs

Scenarios	1. Low demand	2. Medium demand	3. High demand
FACTORS			
Population	QGSO low growth forecast[1]	QGSO medium growth forecast[2]	QGSO high growth forecast[3]
Consumption residential	**Observed current use** +/- adjustment for climatic conditions - impact of structurally efficient new accounts + failure of water-efficient structural devices +/- impact of price increases and demand management initiatives	**Most likely use** +/- adjustment for climatic conditions + impact of likely change in water use behaviour[4] - impact of structurally efficient new accounts + failure of water-efficient structural devices +/- impact of price increases and demand management initiatives	**Most likely use** + impact of possible higher change in water demand for liveability outcomes
Consumption non-residential **Contract demand**	**Observed current use** + Forecast for customers under contract (having regard for current and future conditions)	**Most likely use** + Impact of likely change in water use behavior + Forecast for customers under contract (having regard for current and future conditions)	**Most likely use** + Impact of possible higher change in water non-residential customer growth[5] + Forecast for customers under contract (having regard for current and future conditions)
Network loss	Total bulk and distributor-retailer network loss	Total bulk and distributor-retailer network loss	Total bulk and distributor-retailer network loss
Used for	• Water supply balance assessments • Determining when infrastructure is needed to meet minimum demand • Drought response planning (before restriction trigger point) • Considered for pricing purposes	• Water supply balance assessments • Determining when infrastructure is needed to meet minimum demand • Drought response planning (before restriction trigger point) • Considered for pricing purposes	• Water supply balance assessments • Determining when infrastructure could be needed to meet upper demand • Long-term security • Ensuring long-term planning preparedness
Outputs Consumption (L/person/day)	**Residential/Non-residential** 169/89	**Residential/Non–residential** 185/100[6,7]	**Residential/Non-residential** 200[8]/100

1 *The starting population of the low growth forecast is determined by considering the most closely aligned population series released from the Queensland Government Statistician's Office (QGSO) and the most recent available actual SEQ water service providers' customer account growth observation. The low growth population projection then grows at the same rate as the QGSO low series population.*

2 *The medium growth forecast is determined by either seeking specific advice from QGSO about the medium population forecast series that should be used, or by comparing prior observed population growth figures against what was previously forecast to see what series the readings align most closely with.*

3 *The starting population of the high growth forecast is determined in the same manner as the low growth forecast then grows at the same rate as the QGSO high series population.*

4 *Based on the actual observed water usage reduction, that has been achieved through behavioural change in isolation of any structural water restrictions witnessed during the Millennium Drought, future forecast residential per capita demand may grow beyond the current demand level as potential non-structural related water saving behaviour subsides, however the timing and level of per capital demand growth remains with high level of uncertainty with changing technology, climatic conditions, water pricing and new housing composition. The timing and level of growth will be monitored closely and reviewed annually.*

5 *The same non-residential forecast consumption rate as the medium demand is used for high demand modelling purposes for version 2 of the Water Security Program only on the assumption that any difference between likely change and higher change in use in South East Queensland is captured in the higher residential demand which will be used as a proxy for a number of influences which may drive up demand across the region. This approach has been used due to constrained timeframes. This assumption will be revised when further non-residential demand trend and growth projection analysis are completed.*

6 *Incorporates reduced power station demand as advised by the electricity producers.*

7 *Incorporates reduced usage from10+ ML/yr customers, due to the impact of Water Efficiency Management Plans.*

8 *Based on observed maximum daily water demand readings reached, namely 200 L/p/day, under Permanent Water Conservation Measures (PWCM) and during mid to late 2013, when the weather was dry and temperatures were above average for a sustained period of time. As South East Queensland is no longer under PWCM, it is feasible for future average consumption to reach this maximum daily water demand level. This figure represents higher than current demand which may result from a change to a range of influences including greater demand for liveability outcomes and return to maximum consumption level under PWCM.*

Table E-2 Medium demand forecast input factor details

Input factor	Input factor source/derivation
Actual annual demand starting point (residential and non-residential)	Measured recorded demand for the previous financial year for each local government area.
Future demand consumption – residential	It is possible that South East Queensland residents will increase their daily water use over time, given the removal of water restrictions and permanent water conservation measures. Water usage patterns in areas of South East Queensland that were not subjected to restrictions were analysed to provide information of possible future increased consumption levels. It is expected that residential per capita consumption will increase from around 169L/p/day to 185L/p/day. The medium demand forecast also takes into consideration the lower usage levels of new housing stock with more efficient water-use devices installed.
Future demand consumption – non-residential	It is expected that the non-residential sector water use will remain fairly stable. This is due to the significant permanent water efficiency changes that were implemented by the sector (in particular the highest water users) during the Millennium Drought. It is expected that the non-residential sector consumption will remain stable around 100L/p/day.
Unaccounted for water (fire fighting, illegal water connections and system losses)	Seqwater needs to produce sufficient water so that the South East Queensland water service providers can supply households and businesses. The overall estimated loss factor for the region's entire bulk and distribution network is estimated as being about 11% per annum. The estimated loss volume is accounted for in the non-residential forecast component noted above. Demand management business as usual pressure and leakage management programs work to minimise this loss factor.
Residential demand growth	South East Queensland's population will increase over the 30-year planning period and Seqwater needs to plan for this growth. The population growth profile used for the medium demand forecast was revised down at the start of the planning period to reflect the lower than expect growth reported by the QGSO. Long term population growth expectations remain the same as previous QGSO medium series expectations.
Non-residential demand growth	The growth in the non-residential sector is linked to the region's population forecasts due to the 30-year timeframe.

Appendix F: **Demand management options summary**

Seqwater worked with South East Queensland water service providers to develop and assess a range of demand management options. This process has occurred over the planning period of version 1 and 2 of the Water Security Program. Version 1 provided a macro assessment, with version 2 building on this assessment to include economic impacts. This appendix details the process for assessing and selecting demand management options.

The macro assessment included the steps outlined in Table F-1.

Table F-1 Demand option assessment steps

Version	Gate (where applicable)*	Action
1	A	1. Establishment of a long list of demand management options by Seqwater and the water service providers. This long list was not constrained by costs, social acceptance, effectiveness, or current technology. This stage also included a jurisdictional review of demand management across Australia and a review of the Millennium Drought water restrictions.
1	A	2. Coarse screening (considering social, environmental and economic matters) by experienced demand management officers from Seqwater and the water service providers to develop a medium list of options.
1	B	3. Estimation of implementation costs for each medium list option in collaboration with the SEQ water service providers.
1	B	4. Estimation of effective demand savings for each medium list option. This was completed using Seqwater's demand model.
1	C	5. Determination of a cost per ML (based on financial cost (3) and estimated demand savings (4)).
1	C	6. Review of the medium list of options and the associated savings and costs to develop a short list of options by experienced demand management officers from Seqwater and the water service providers.
1	C	7. Placement of options into portfolios (business as usual, drought and measures to defer infrastructure).
2	-	8. Review of the options in the portfolio for version 2 of the Water Security Program by Seqwater in collaboration with the SEQ water service providers.
2	-	9. Cost/benefit analysis for demand management options drought and to defer infrastructure, including community economic impact (costs and benefits). Refer below for more detail on the cost benefit analysis.
2	-	10. Determination of a cost per ML (based on economic cost) for demand management options for drought and to defer infrastructure demand management options. The business as usual measures are largely in place and have been implemented based on a business case.
2	-	11. Assessment of demand management options for business as usual, drought response and to defer infrastructure using the established criteria of economics, people and place, environment and resilience.

** Assessment gates used to assess options are explained in detail later in this appendix.*

DEMAND MANAGEMENT OPTION ASSESSMENT

A structured and repeatable process was developed as part of version 1 of the Water Security Program and has been repeated in part for version 2. Due to the short timeframe between versions it was not necessary to complete the entire assessment process again as demand and technology are similar compared to version 1. A macro review was completed in collaboration with the water service providers which determined that the version 1 demand options would remain the same for version 2 of the Water Security Program.

Version 1 demand management option assessment

Option assessment for version 1 of the Water Security Program was at a macro level and set the structure for future demand option reviews. Seqwater and the water service providers worked collaboratively to identify and develop the most effective demand management options for South East Queensland.

The process commenced with a review of historical information and demand management measures in other jurisdictions. Particular consideration was given to the effectiveness of demand management measures implemented during the Millennium Drought e.g. water restrictions and rebate/retrofit programs.

A 'blue sky' list of possible demand management options was generated from the initial review. That list was passed through a series of assessment gates to arrive at a short list of preferred demand management options including the approach to drought response.

Each option was assessed against the demand saving it could achieve (in ML/day), the estimated cost of implementation, and environmental and social impacts. Any options more expensive than the levelised cost of $8/kL were removed from the list.

Table F-2 provides a summary of the assessment gates used for demand options for version 1 with further details about gates A, B and C provided below the table.

Table F-2 Summary of assessment gates completed for version 1 of the Water Security Program

Gate	Purpose	Criteria	Assessment method	Supporting documents/tools	Number of options assessed	Number of options progressed
DEMAND						
A	Preliminary review and coarse screening	Social, economic and environmental criteria	Seqwater and water service providers – value judgement informed by the available data and experience.	Queensland Water Commission coarse screening tool	177	85
B	Review of costed options and potential demand savings	$8/kL (the levelised cost criteria used to remove inefficient supply options)	Seqwater and water service providers Cost effectiveness analysis and value judgement informed by the available data and experience	Demand program model	85 (including 37 bundled options)	80
C	Demand drought response portfolio – costed options and potential demand savings: To understand the combined potential costs and savings of a bundle of demand drought response options	Drought response principles Logical flow of measures from voluntary through to regulated as the regional dam level declines Staggered resourcing requirements for the water service providers Potential drought infrastructure triggers Possible community perception (note this will need to be regularly tested through the community engagement process)	Seqwater and water service providers – value judgement informed by the available data and experience	Drought response principles		51 Business as usual options 35 Drought response options 11 options to defer infrastructure

GATE A – DEMAND OPTIONS PRELIMINARY REVIEW AND COARSE SCREENING

A blue sky list of demand management options was developed by Seqwater and South East Queensland water service providers combining current experience with experience gained during the Millennium Drought, a jurisdictional review, current demands, and a Millennium Drought restrictions review. This process produced 177 demand management options for consideration.

The options were assessed in a preliminary review, which aimed to remove duplication, consolidate options where appropriate and clarify the detail of options. The options were screened against potential savings, and social, economic and environmental criteria. Options were removed due to cost, available technology, learnings from the Millennium Drought and water reform. Some options excluded at this stage of the assessment can be considered in future Water Security Programs should influences and costs change.

Following the preliminary review and coarse screening, the remaining options included:

- 37 bundled options
- 25 non-costed options (activities of minimal cost, which focused on building critical relationships required to achieve effective implementation of future demand management options)
- 23 options that were set aside for future consideration (further research and assessment required and therefore to be considered in future versions of the Water Security Program)
- Options removed included water efficiency campaigns and education programs (i.e. industry-specific education programs)
- web-based or app-based options (i.e. water efficiency videos on the website)
- rebates
- water efficiency programs (e.g. in hospitals)
- policy or regulatory options (i.e. introducing new regulations that require mandatory specific water-efficient requirements to be incorporated into new residential, commercial and industrial developments).

GATE B – REVIEW OF DEMAND OPTIONS

Seqwater assessed the potential water savings of the 37 bundled options to derive a levelised cost (cost per unit volume of water saved). These are only costs to implement the option, and do not include any broader economic costs to the community or willingness to pay considerations.

Any option with a higher cost than the marginal cost of desalination was removed at this gate. The $8/kL levelised cost was chosen as an appropriate benchmark against which supply options were compared and if inefficient, removed from further assessment. A total of five options were removed:

- permanent water conservation measures
- pre-drought water restrictions
- landscaper water efficiency training programs
- irrigation workshops
- irrigation guide development for the non-residential sector.

The potential savings for each option were calculated through a demand program model, using a series of assumptions such as estimated take-up rate and volume savings per activity.

For example, the replacement of a 20 L/minute shower rose with a 9 L/minute water-efficient shower rose would save approximately 44 L per four-minute shower. Estimates of take-up rates were based on a percentage of remaining homes assumed to be without a water-efficient shower rose. This was based on data obtained from the Queensland Government's former Home WaterWise and ClimateSmart programs, coupled with development requirements for new homes.

The demand program model calculates a possible saving for a device within those parameters. By grouping the measures and processing them through the model, potential savings were counted once with no double-counting potential demand savings.

GATE C – GROUPING OF DEMAND OPTIONS

To determine the appropriate use and timing of the preferred demand management options, the options were grouped into one of three demand management categories:

- business as usual (options designed to achieve system efficiency and generally already in place such as leakage management)
- options to defer infrastructure (options designed to delay major investment in infrastructure solutions)
- drought response (options implemented when water security is declining).

This grouping resulted in 51 business as usual options, 35 drought response options and 11 options to defer infrastructure. Examples of the preferred options are listed in Table F-3.

Table F-3 Sample of preferred demand management options

Preferred demand management option	Demand management category
Residential outdoor water use efficiency program with relevant industry association. Low level consistent messaging using existing communications methods with the community (approx. 100-70% regional water supply.	Business as usual
Residential outdoor water use efficiency program with relevant industry association. Increased outdoor water efficiency messaging (approx. 70-50% regional water supply).	Business as usual
Residential outdoor water use efficiency (excluding gardening) messaging. Low level consistent messaging using existing communications methods with the community (approx. 100-70% regional water supply).	Business as usual
Residential outdoor water use efficiency (excluding gardening) messaging. Increased outdoor water efficiency (approx. 70-50% regional water supply).	Business as usual
Residential indoor water efficiency messaging. Low level consistent messaging using existing communications methods with the community (approx. 100-70% regional water supply).	Business as usual
Residential indoor water efficiency messaging. Increased indoor water efficiency messaging (approx. 70-50% regional water supply).	Business as usual
Non-residential water audits.	Business as usual
Non-residential water audits available on the internet with customers advised they are available as part of standard customer relations activities.	Business as usual
Joint messaging with Energex about peak time demand for activities that use both water and energy e.g. showering and dishwashers.	Deferral of infrastructure (but will also be of benefit in drought)
General messaging with Energex (not specific to peak demand).	Deferral of infrastructure (but will also be of benefit in drought)
Joint messaging with Energex about peak demands in the heat of summer.	Deferral of infrastructure (but will also be of benefit in drought)
Retrofit-style service (exact make-up of product will depend on the technology available at the time).	Deferral of infrastructure and drought response
Rebate for a leak detection device and installation. Note costs only include the device and rebate program.	Deferral of infrastructure and drought response
Active playing surface guideline and workshop program.	Deferral of infrastructure and drought response
Non-residential water audits with assistance from the SEQ water service providers.	Deferral of infrastructure and drought response
Nursery water efficiency program working with relevant industry associations.	Deferral of infrastructure and drought response
Major sporting grounds water efficiency program.	Deferral of infrastructure and drought response
Water efficiency management plans (WEMPs).	Drought response
Sub-regional targeted messaging.	Drought response
Sub-regional retrofit style program.	Deferral of infrastructure and drought response
Sub-regional targeted rebate program.	Deferral of infrastructure and drought response
Sub-regional gardening program to educate about irrigation needs in the area based on soil type and the types of plants generally in the area. Note, where this program is applied to more than one region the cost will reduce.	Drought response
Pre-drought messaging on indoor and outdoor water use (including gardening). Messaging to focus on medium level water restriction (encouraged not enforced) along with shorter showers etc. to avoid drought response triggers. Target of 150 L/p/day.	Drought response
Drought messaging target of 140 L/p/day. Drought messaging, including medium level water restrictions, likely four-minute showers and other stronger water efficiency messages (approx. 40-30% regional water supply).	Drought response

Preferred demand management option	Demand management category
Drought response messaging target of 125 L/p/day. Stronger messages, still only medium level water restrictions (30-20% regional water supply).	Drought response
Drought response messaging target of 120 L/p/day (20-15% regional water supply) with stronger messages. Opportunity to impose high level water restrictions.	Drought response
Drought response messaging target of 115 L/p/day (15-10% regional water supply) with stronger messages. Opportunity to continue high level water restrictions.	Drought response
Drought response messaging target of 100 L/p/day (10% regional water supply – emergency response) with stronger messages. Opportunity to impose extreme level water restrictions.	Drought response
Medium level water restrictions (target of 140 L/p/day residential demand). This restriction would not be implemented until drought response was triggered. Note, there are no water restrictions prior to drought response, just messaging.	Drought response
High level water restrictions (Target of 120 L/p/day residential demand).	Drought response
Extreme level water restrictions (Target of 100 L/p/day residential demand).	Drought response
Emergency level water restrictions (Target of 100 L/p/day combined residential and non-residential).	Drought response

Version 2 demand option assessment

Version 2 assessment included additional steps to the assessment undertaken for version 1. The demand management options were progressed with research to better understand the impact of the demand options, consideration and quantification of societal impacts. Further detail about these additional steps is outlined below.

Economic impact of options for drought and to defer infrastructure

For version 2 of the Water Security Program, Seqwater completed a cost benefit analysis of the drought demand management options. This analysis allowed for comparison with the other levers to optimise the drought response.

Many of the drought response options are also applicable to defer infrastructure, so economic impacts were also calculated for demand management options to defer infrastructure. This analysis to consider the economic impact of drought demand management – rather than financial costs only – was the first analysis of its type in South East Queensland. Both the costs and benefits of the drought demand management options were considered.

Figure F-1 details the components of the cost benefit analysis. There are six components and varying levels of work has been undertaken for each component. The greatest focus of the cost benefit analysis was on the external economic impacts of drought demand management options.

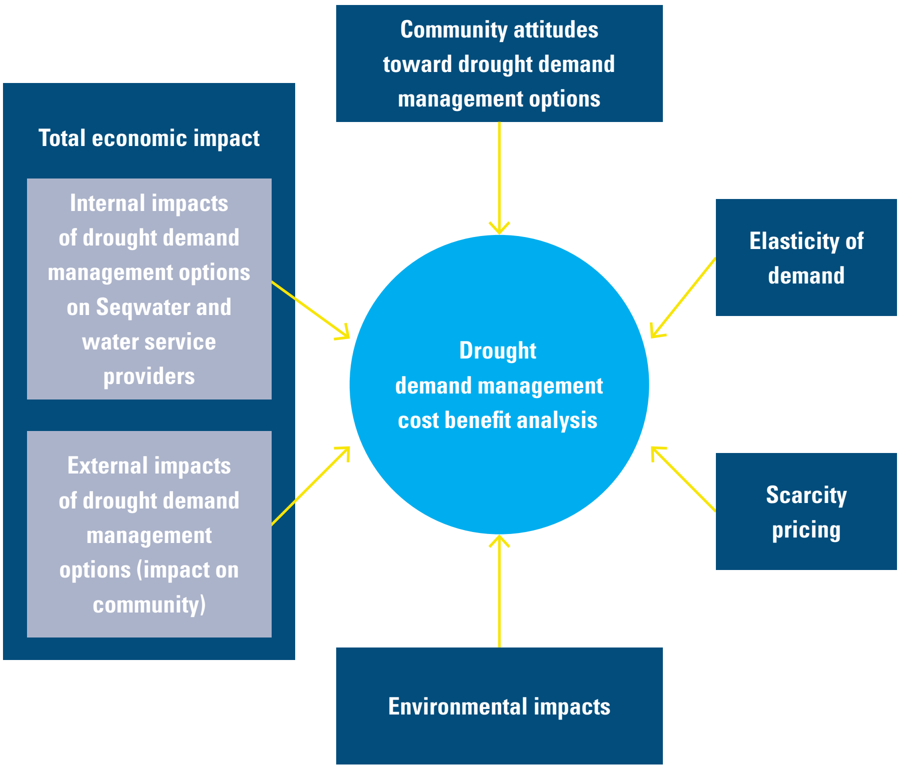


Figure F-1 Components of the cost benefit analysis of drought demand management options

Community attitudinal research

A range of existing community attitudinal reports were reviewed and generally found the community:

- has retained the behavioural changes initiated during the Millennium Drought
- continues water efficient practices and use of water-efficient devices – evidenced by the continued lower per-person water demand compared to the period prior to the Millennium Drought
- without the detail of the water restrictions, appear supportive of the concept of water restrictions in response to drought.

Future versions of the Water Security Program will engage the community about the drought response approach.

Elasticity of demand

While it is important to understand elasticity of demand, there has been insufficient recent research to effectively quantify a figure or range for South East Queensland. A review of existing research was completed and considered as part of the external impact of drought demand management options component. Future versions of the Water Security Program may consider elasticity of demand.

Scarcity pricing

Scarcity pricing was considered as an option to implement prior to drought water restrictions but the impact of scarcity pricing and its possible implementation were not analysed.

A research paper on the possible implications of scarcity pricing in South East Queensland was developed. The key findings were:

- there are material challenges to implementing a scarcity pricing regime, including institutional structure (e.g. where in the value chain the scarcity price should be applied) and the associated pricing arrangements (e.g. the Bulk Water Price Path context)
- the implementation of scarcity pricing may be inconsistent with the application of other demand management options (especially water restrictions).

Environmental impacts

Environmental impacts were only considered at a macro level. Where data is available, the following impacts may be considered as part of future versions of the Water Security Program.

Positive impacts may include:

- continuation of some environmental flows from dam sources
- reduced energy and greenhouse gases from more water-efficient appliances, due to reduced water treatment, network pumping and reduced water heating at the home/business
- continuation of some watering of gardens and lawns (albeit restricted watering) to maintain local ecosystems.

Negative impacts may include:

- loss of vegetation coverage (in community spaces as well as residential and non-residential gardens) in severe drought due to restriction of irrigation frequency and devices
- loss of canopies in community spaces which may contribute to increased urban heat island effect and localised environmental impacts.

The environmental impacts of drought demand management options will be considered in more detail in future versions of the Water Security Program.

Total economic impact

There are two components to determining the total economic impact – external to Seqwater and the water service providers (i.e. community impacts) and internal (i.e. implementation and operating costs, and foregone revenue).

External impacts of drought demand management options

The analysis considered each of the drought demand management options and their potential costs and benefits on the community. Costs of Essential Minimum Supply Volume demand restrictions have not been included.

The costs include:

- adverse impacts on garden aesthetics, resulting in loss of amenity for some households
- inconvenience costs from restrictions on how much water can be used, when and for what purpose
- cost of adapting to lower water availability through installation of water-efficient devices.

The benefits include:

- reduced consumer water bills
- benefits of installing water-efficient devices (e.g. reduced water and energy bills and potentially a higher quality water device)
- community spirit of working together for a common cause (as evidenced in the Millennium Drought, Brisbane flood events and other natural disasters)
- increased profits for businesses producing and installing water-efficient products.

Internal impacts of drought demand management options

Introducing drought demand management options will result in implementation costs, changes to operation (costs and benefits) and foregone revenue for Seqwater and the water service providers. The implementation costs and known operational impacts have been included in overall economic impact of the drought demand management options, however the foregone revenue has been considered to be neutralised by the community benefit in their bill savings.

Assessing the options

The options were scored against the water considerations outlined in Appendix C. Each demand management option was scored. The resulting scores established ranking for each option. The ranking helped to determine implementation timing of options, for example the drought demand management options which scored less favourably (generally due to social impacts and costs) will trigger at low KBWS triggers.

Appendix G: Supply options summary

Version 1 of the Water Security Program identified a list of potential efficient supply options. This was done using a structured supply option assessment framework comprising six gateways. The assessment identified supply options that can efficiently contribute to water security. These supply options were then considered collectively with demand and system operation options to assess their contribution to long-term water security objectives for South East Queensland.

The six gateways include cost effectiveness assessments and qualitative assessments, with the final potential options characterised using the water considerations.

Table G-1 provides a summary of the assessment gates used for supply options.

METHOD

An extensive range of existing studies and investigations were used as the starting point for the preliminary identification and assessment of potential supply options assessed in version 1 of the program.

Information that was considered out-dated, incomplete or no longer applicable was updated and some new water supply options were identified based on proposals by industry professionals, stakeholder groups, external parties and the community via media and/or correspondence.

Further studies undertaken for this Water Security Program identified additional options and better characterised the potential future water supply options, particularly those where information was limited in the version 1 assessment process.

The options were put through a structured assessment process to identify those that can efficiently contribute to the integrated planning objectives and provide best value to the community when assessed against the considerations. The options which were refined based on further information in version 2 were re-assessed through this process to determine if they remained efficient.

Figure G-1 provides an overview of the process for selecting the most efficient supply options. At the start of the process, virtually every conceivable option for water supply for the region was identified and included in a blue sky list. Additional options were added to this list as a result of further investigations. This list was then systematically reduced based on technical feasibility, cost-efficiency, people and place, resilience and environmental considerations.

Each individual water supply option was passed through a series of assessment gates to determine if it was able to efficiently contribute to the water security of the region.

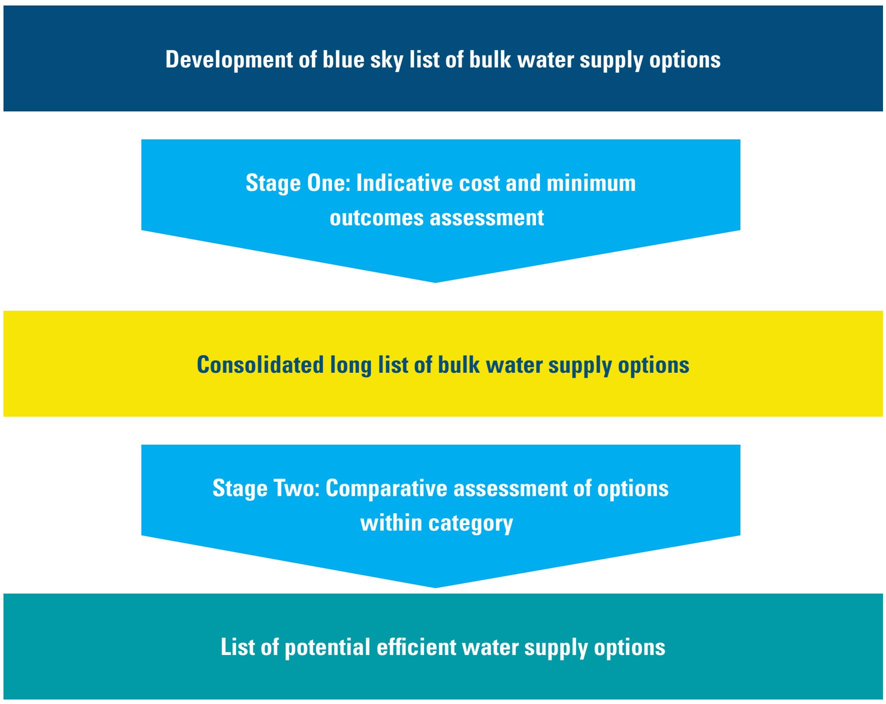


Figure G-1 Options development and assessment process

BLUE SKY LIST OF OPTIONS

To commence the options selection process, a 'blue sky' list of all potential options was developed under the following six categories of supply:

- surface water (dams and weirs) coupled with treatment plants
- desalination
- ground water
- purified recycled water for drinking
- decentralised water schemes (includes domestic rainwater tanks, sewer mining, water recycling for non-potable use and stormwater harvesting)
- 'unconventional' supplies (for example water tankering, iceberg towing, cloud seeding).

Each category of supply options has different characteristics for contributing to the water security of the region. To avoid ruling out options too early in the assessment because of their cost, only those options that were clearly inefficient, technically unviable or not consistent with water resource plans and environmental protection objectives were removed at this stage.

From the 'blue sky' list of options, all options were assessed against the water considerations for planning including economic, resilience, environment and people and place outcomes to develop a 'long-list' and finally a list of potential future long-term water supply options.

Table G-1 Summary of assessment gates for supply options

Gate	Purpose	Criteria	Assessment method	Supporting documents/tools	Number of options assessed	Number of options progressed
SUPPLY						
1	Coarse screening	1. Ability to generate yield estimate; OR ability to contribute to MDMM; AND 2. Levelised cost <$8/kL	1. Mandatory criteria: Yes/No 2. Cost effectiveness analysis	Graph of levelised cost	177	154
2	Comparative options assessment	1. Meet Water Resource Plan objectives (surface water only); AND 2. Social, environmental, resilience considerations	1. Mandatory criteria: Yes/No 2. Structured argument*	Options summaries Summary table of qualitative assessment.	154	83
3	Screening	1. Too small to assess (LOS yield <7,500 ML/annum) OR 2. Reserved for drought (temporary solutions) OR 3. Insufficient information and further assessment required (e.g. hydrology for interregional transfers) OR 4. Already included as an efficient existing system augmentation OR 5. Contributes to MDMM 6. Consolidated into one decentralised scheme option	Yes/No	Regional Stochastic Model (RSM) RAT	83	42
4	Options screening	1. Best in sub region; a. DPR $2.00/kL (Capex); b. IPR $3.00/kL (Capex); Option consolidation/ consistency review (e.g. remove water treatment plant upgrades with no additional yield)	a) Sub-regional cost effectiveness analysis b) Value judgement informed by the available data	Individual assessments of best in sub-regional (North/South/ Central). Graphs	42	25

Gate	Purpose	Criteria	Assessment method	Supporting documents/tools	Number of options assessed	Number of options progressed
SUPPLY						
5	Inefficient option removal	Cost-efficient contribution to LOS or MDMM	Clear judgement call on a small number of options	RSM	25	21
6	Inefficient staging removal (sequencing contribution)	1. Contribution to LOS as first augmentation <40,000 ML/ annum (for options contributing to LOS only) 2. Net present cost (NPC) 3. Ability to meet planning objectives	Yes/No Cost effectiveness analysis – preliminary. Yes/No	RSM SPAT RAT	21	14

** Structured argument: a systematic qualitative assessment against defined criteria (excluding weighting of criteria).*

Gate 1 – Coarse screen of supply options

A preliminary blue sky list of 131 supply options was developed during Version One. For Version Two, forty six additional options have been identified for northern and central desalination, northern surface water options, treatment options and drought response options and this makes a total of 177 options. Due to the nature and number of potential options, assessments have been at a strategic level and are subject to change pending detailed investigations and community feedback.

The 177 supply options were divided into categories, namely:

- surface water
- desalination
- groundwater
- purified recycled water (indirect potable reuse and direct potable reuse)
- decentralised schemes
- water treatment plant upgrades
- network augmentations
- unconventional supply options (i.e. tankering, purchase of irrigation allocations, cloud seeding, etc.).

A coarse screen of the options was made based on the following criteria:

- A yield estimate can be generated and
- The indicative levelised (cost per unit volume produced) cost is less than $8/kL.

The outcome of this process is summarised in Table G-2.

Table G-2 Gate 1: Coarse screen supply options assessment

Blue sky list	177 options
Removed	23
Long list	**154**

Options which did not progress through this gate either did not meet the levelised cost criterion, did not produce a yield or did not contain sufficient information to generate a yield or were superseded as a result of further investigations.

The coarse screening of the blue sky list resulted in a long list of supply options for consideration. Options excluded from further assessment at this gate are listed in Table G-3. Further assessment of the three options put aside under Version One has been completed and they are now recommended to be excluded

Table G-3 Supply options excluded through gate 1 of the assessment process

Option	Reason for exclusion
Small direct potable reuse options	High levelised cost
Small indirect potable reuse options	High levelised cost
Development of existing undersea aquifers	High levelised cost
Wivenhoe Dam to Borumba Dam bi-directional pipeline	High levelised cost
Inter-regional transfers from Burdekin Falls	High levelised cost
Towing icebergs	High levelised cost
Water tankering	High levelised cost
Sewer mining	High levelised cost
Development of new aquifers	No yield
Expansion of the Bromelton off-stream storage	Expansion of the Bromelton off-stream storage: The existing BOSS is not currently utilised in supplying water needs. Requirements for the BOSS into the future are expected to be beyond the next 15 years. The existing BOSS pump station and the dam have recently been approved for temporary decommissioning. Modelling results indicate that an expansion of BOSS would provide an insignificant contribution to overall yield. This option has been excluded from further investigation.
Cloud seeding	No further information is available since the Queensland Cloud Seeding Research Program was complete in 2012. It is recommended that this option be excluded due to cost inefficiency and unreliable yield.
Development of managed aquifer recharge scheme	No opportunities have been identified for SEQ. On a national scale, there is still a lot of work to be done to justify the scheme in terms of policy and commercial opportunities. It is considered not worthwhile for this option to be further considered for SEQ.

Gate 2 – Comparative Supply Options Assessment

This gate involved a comparative assessment of supply options within a category and sub-region. This step also included mandatory and non-mandatory criteria:

- mandatory criteria – compliance with Water Resource Plan objectives (relevant to surface water category only)
- non-mandatory criteria – comparative assessment against people and place, environmental and resilience criteria.

Based on this comparative assessment, options which were best within a category and sub region progressed to gate 3. An outcomes summary of the gate 2 assessment process is presented in Table G-4. A summary of the supply options removed is provided in Table G-5.

Gate 3 – Further Supply Options Screening

Further screening of the short list was based on the option's contribution to the LOS yield within the regional stochastic model, the efficiency of the option and the type of solution presented by the option.

At this stage, desalination options were consolidated into northern, central and southern options, as the modelling of contribution to LOS yield would not differ between desalination options of the same size for a particular sub-region. Decentralised schemes were consolidated into one option and considered for final efficient option assessment at gate 6. Table G-6 provides a summary of the gate 3 assessment process outcomes. Options that were identified as highly efficient (exceptionally more effective than any other alternatives under consideration) and related to augmentations of existing assets are assumed to be included in every case and thus removed from further assessment as an additional augmentation option.

Options were excluded from further assessment at this stage due to:

- the yield contribution (yields <7,500 ML/annum were too small to assess in the model and thus excluded from the assessment at this stage and considered for local optimisation)
- temporary solutions reserved for drought response, i.e. mobile desalination plants
- options that require further hydrologic assessment were set aside for future versions of the Water Security Program.

Options removed at this gate are listed in Table G-7.

Table G-4 Gate 2: Summary of the supply options assessment process

Long list	154 options
Removed	72
Short list	**83**

Table G-5 Supply options excluded through gate 2 of the assessment

Option category	Number removed
Desalination	32
Surface water	30
Groundwater	4
Indirect potable reuse	0
Direct potable reuse	0
Decentralised schemes	0
Network augmentations	0
Treatment plant upgrades	2
Unconventional supply options	4

Table G-6 Gate 3: Summary of the supply options assessment process

Short list	83
Individual desalination options merged within sub-region	0
Individual surface water options merged within sub-region	11
Very efficient existing system augmentation options	6
Individual decentralised options merged for further investigation	7
Drought response options	6
Local optimisation options	8
Additional information obtained through further investigations	3
Carried forward to options assembly	**42**

Table G-7 Options excluded at gate 3 of supply options assessment process

Option	Reason for Exclusion
NPI coastal mains off take	Already included in every case going forward, as is an efficient existing system augmentation
Aspley pump station northerly flow pumping	Already included in every case going forward, as is an efficient existing system augmentation
Upgrade North Pine Water Treatment Plant	Already included in every case going forward, as is an efficient existing system augmentation
Upgrade Mt Crosby water treatment plants	Already included in every case going forward, as is an efficient existing system augmentation
Southern NPI augmentation – North Pine to Narangba	Already included in every case going forward, as is an efficient existing system augmentation
North Pine WTP pump station reconfiguration	Already included in every case going forward, as is an efficient existing system augmentation
Land-based temporary desalination plants	To be assessed as a drought response option
Barge mounted temporary desalination plants	To be assessed as a drought response option
Redevelop Brisbane aquifers	Drought response option
Remobilise Enoggera Water Treatment Plant	Drought response option
Raise Baroon Pocket Dam	Minor yield contribution (<7,500 ML/annum)
Cedar Grove Weir Stage 2	Minor yield contribution (<7,500 ML/annum)
New connection from Lake Manchester to Mt Crosby Weir	Minor yield contribution (<7,500 ML/annum)
Raise Mt Crosby Weir	Minor yield contribution (<7,500 ML/annum)
Replace connection from Lake Manchester to Brisbane River	Minor yield contribution (<7,500 ML/annum)
Murrumba Downs IPR Scheme – AWTP recommissioning and connection to North Pine Dam	Drought response option
Coombabah IPR scheme to supplement environmental flows	Minor yield contribution (<7,500 ML/annum)

Option	Reason for Exclusion
Non-potable use of recycled water for businesses and dust suppression	Drought response option
Water harvesting from Mary River off-stream storage to Noosa	Minor yield contribution (<7,500 ML/annum)
Cedar Grove DPR scheme	Minor yield contribution (<7,500 ML/annum)
Propose dam at Linville	Government's position is that further investigation of this option will not proceed unless Wivenhoe Dam raising proves impractical and/or uneconomic. The proposed dam at Linville is intended to be used for flood mitigation rather than water security.
Inter-regional transfers from Northern NSW	This option has been raised due to the large quantities of water from the rivers of Northern NSW, such as the Tweed, Brunswick, Clarence, Richmond and Wilson River Catchments. The cost of purchasing the raw water from NSW Water (the Bulk Water Authority for NSW), together with the cost of pumping the water to SEQ has been found to have a high levelised cost compared to options located with the SEQ region.
Decentralised schemes	Decentralised schemes have been consolidated for further assessment from Gate 6. Further assessment of decentralised schemes has been undertaken in Version 2 of the Water Security Program to understand what the maximum potential benefit in offsetting potable demand. Information on the assessments undertaken is provided in Chapter 4 – Supply). Further detailed assessment will be undertaken in Version 3 of the Water Security Program to understand how decentralised schemes can contribute to offsetting future potable demand.
Automated system to manage licence requirements downstream of Mt Crosby Weir	Option excluded due to limited feasibility for practical operations

Gate 4 – Supply Options Analysis and Consolidation

The options that progressed through gate 3 were further assessed to identify those that provide the ability for staging and contribute to an efficient outcome both regionally and sub-regionally. The assessment included modelling to determine the LOS yield contribution of the option as the first augmentation to be implemented after the efficient existing asset augmentation options are delivered. Options that did not align with program objectives (i.e. were much larger than required) were also excluded at this gate. A summary of the gate 4 assessment process is included in Table G-8.

Options excluded from further assessment are presented in Table G-9.

Table G-8 Gate 4: Summary of the supply options assessment process

Options assembly	42
Removed	17
Category options assembly	25

Table G-9 Options excluded at gate 4 of the supply options assessment process

Option	Reason for exclusion
Various IPR schemes	Small LOS yield contribution
Various DPR schemes	Small LOS yield contribution
Landers Shute Water Treatment Plant upgrade	Small LOS yield contribution

Gate 5 – Inefficient Supply Option Removal

The 25 options that progressed to this gate were assessed for their sub-regional contribution and also their contribution to LOS yield as the first augmentation option. This assessment occurred using the RSM model. A summary of the assessment outcomes is provided in Table G-10.

This assessment identified that augmentations in the northern sub region contributed more significantly to LOS yield, primarily as they were addressing the system deficiencies in this more vulnerable region. Further, the size of the augmentation also defined the efficiency of the option. For example a 100 ML/day augmentation only had a marginal improvement to LOS yield compared with a 50 ML/day option, however incurred a greater cost. Thus a 50 ML/day plant that could be expanded as demand increased provided a more efficient outcome than building a bigger plant at the outset.

Note that while northern sub-regional augmentations were more efficient than augmentations in other sub-regions for the first augmentation, only two options were excluded at this stage. Other options remained, as their relative contribution to LOS yield as a second augmentation proved efficient once the initial augmentation occurred in the northern sub-region, resolving the vulnerability of that area.

Table G-10 Gate 5: Summary of the supply options assessment process

Category options assembly	25
Local optimisation	2
Removed	2
Category compilations	21

The two options that did not proceed further in the assessment process were deemed potentially suitable as local optimisation options due to their negligible contribution to LOS yield. These options included the NPI off take that supports the towns of Beerburrum, Landsborough, Beerwah and Mooloolaba as well as the Sparkes Hill to Aspley augmentation.

The two options removed at this stage were the SRWP augmentation/duplication and the duplication of the Gold Coast Desalination Plant. Both options were inefficient for all augmentation stages.

Gate 6 – Inefficient Supply Option Staging Removal

This gate assessed the relative contribution of an option to LOS yield as a first, second, third or fourth augmentation within a category (i.e. desalination, surface water). Where the option did not contribute significantly to LOS yield for any augmentation, the augmentation was not cost effective and/or did not meet planning criteria, that option was removed. A summary of the Gate 6 assessment process is presented in Table G-11.

Eleven options were removed from further consideration at this stage as they were not cost-effective in any sequence of augmentation. Those removed included four desalination options, three DPR options, two IPR options, one surface water option and the option of constructing a pipeline from the Bromelton off-stream storage to Wyaralong.

The raising of the Wivenhoe Dam wall was set aside as it was being assessed within the Flood Storage Infrastructure Study (DEWS, 2014a).

The two options that did not proceed further in the assessment process due to small LOS contribution (less than 7,500 ML/annum) were deemed potentially suitable as local optimisation options.

These were the Lake Kurwongbah to North Pine Dam pipeline and the upgrade of Image Flat Water Treatment Plant.

Four recycled water options were set aside for further investigation

Table G-11 Gate 6: Summary of the supply options assessment process

Category compilations	21
Additional options from expanded staging opportunities	10
Total options assessed	**31**
Assessed separately	1
Local optimisation	2
Removed	11
Recycled water options for further investigation	4
Consolidated decentralised scheme option added	+1
Supply options for investment pathway assembly	**14**

All remaining options have been deemed efficient so they progressed to the assessment process for potential water security investment pathways required to meet long-term water security requirements for SEQ. Efficient options remaining after this gate are listed in Table G-12.

Table G-12 Efficient supply options

Efficient supply options		
Option type	**Region**	**Option**
Desalination	Northern	Build a northern desalination plant – moderate size, expandable
		Build a northern desalination plant – major facility, expanded from moderate size
		Build a northern desalination plant – major facility
	Central	Build a central desalination plant – moderate size, expandable
		Build a central desalination plant – major facility
	Southern	Upgrade the Gold Coast Desalination Plant (Stage 2) (45 ML/day)
Surface water	Northern	• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into the existing Borumba Dam • Upgrade the Noosa Water Treatment Plant, expandable
		• Harvest water from the Mary River in the Gympie region, pump into a new off-stream storage and from there into Borumba Dam with increased storage capacity • Upgrade the Noosa Water Treatment Plant
		• Build a new weir on the Mary River in the vicinity of Coles Crossing • Increase the storage capacity of Borumba Dam • Upgrade the Noosa Water Treatment Plant
	Central	Build Wyaralong Water Treatment Plant – moderate size
		Build Wyaralong Water Treatment Plant – major facility
Treatment	Central	Upgrade the Mt Crosby water treatment plants to 950 ML/day (no LOS yield increase)
	Southern	Upgrade the Molendinar Water Treatment Plant to 190 ML/day (no LOS yield increase)
Decentralised schemes	All	Invest in decentralised schemes on an opportunistic basis.

Appendix H: Operational plan and approach

System operation is one of the three levers of system performance. This appendix provides further information on the following elements of operational planning:

- overview of triggers
- regional trigger development
- sub-regional trigger development
- asset mode of operation
- long-term (30-year) operational planning process

OVERVIEW OF TRIGGERS

Regional triggers are focused on the need to satisfy longer term LOS objectives, while sub-regional triggers are used to mitigate the impacts of declining water storages, at a sub-regional level, based on an assessment of storage levels at the time and the short- to medium-term climate outlook.

The triggers of operation are usually planned to correspond to specified storage volumes, either as a percentage of the key bulk water storage volume in total (regional triggers) or as a percentage of the volume of an identified storage/s (sub-regional triggers).

In some cases, the operational change can be made in a short timeframe, at the specified trigger level. Where this cannot be achieved, it is possible that a pre-operational trigger will also be identified. This could occur in the following cases:

- for a complex operational change
- where it is planned to undertake re-commissioning of certain assets (this could also include a planning or review phase)
- where it is planned to design, construct and commission new assets (such as drought response infrastructure) before operation can commence – this can include concept planning and obtaining approvals.

REGIONAL TRIGGER DEVELOPMENT

Regional triggers focus on satisfying longer term LOS objectives, They also aim to balance economical use of resources while they are available against conservation of those resources during drought periods. Figure H-1 provides a general overview of the process to develop regional triggers. The adopted regional triggers were refined as part of the drought response planning detailed in Chapter 6 – Planning for resilience. A summary of the adopted regional system operation triggers is shown in Table H-1.

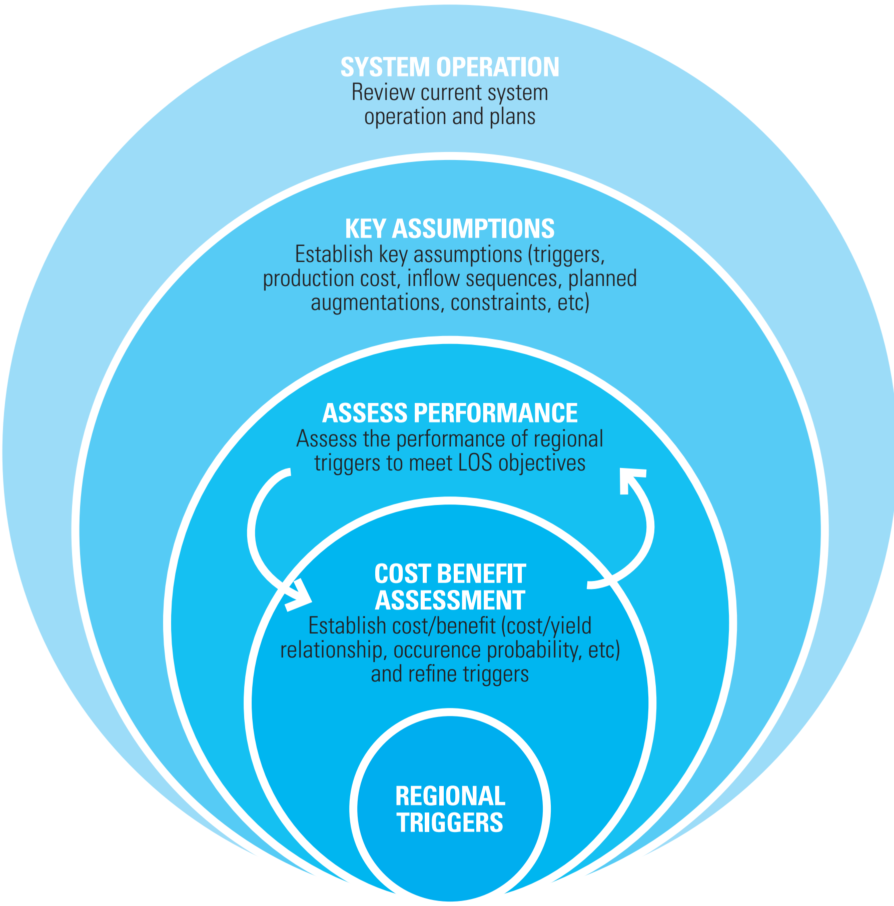


Figure H-1 Development of regional triggers

Table H-1 May 2016 Regional triggers based on key bulk water storages

KBWS level	Triggers/Targets O – Operational PO – Pre-operational C – Capital	Actions	Estimated climate-resilient water production (ML/day)
60%	O	• Gold Coast Desalination Plant up to 100% production	125
60%	PO	• Initiation of the Western Corridor Recycled Water Scheme recommissioning	-
40%	O*	• Western Corridor Recycled Water Scheme 100%	182
20%	C	• Possible contingent drought infrastructure construction triggered	-
5%	O*	• Contingent drought infrastructure operation	

** Operational target. If infrastructure is ready (including approvals) prior to the target, it may be operated after consultation with relevant stakeholders.*

SUB-REGIONAL TRIGGER DEVELOPMENT

The main objective of sub-regional triggers is to mitigate the impacts of drought at a sub-regional level, therefore these triggers have a short- to medium-term outlook.

Figure H-2 provides an overview of the process employed to develop sub-regional triggers.

Sub-regional triggers have primarily been set for storages in the northern sub-region, which comprises seven of the 12 key bulk water storages. Sub-regional triggers have not currently been attributed to storages in the southern and eastern sub-regions as these are typically maintained at levels approximating the key bulk water storage levels. Future reviews will address the need for triggers at these storages. Central sub-regional triggers are not required as these are effectively the regional triggers. The sub-regional triggers levels adopted in Seqwater's most recent medium-term operational planning are shown in Table H-1 and Table H-3. It should be noted that these trigger levels are revised bi-annually and will also be influenced by the recommendations of this Water Security Program.

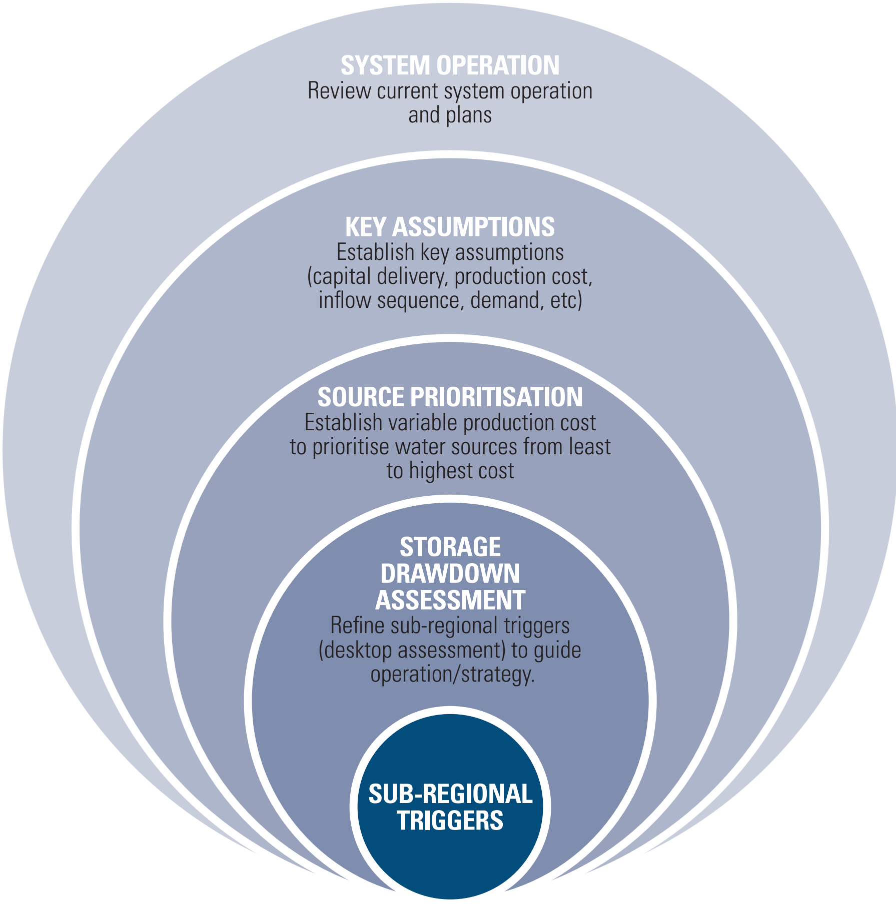


Figure H-2 Sub-regional trigger development process

Table H-2 Northern sub-region, Lake Baroon and Landers Shute water treatment plants – pre-operational and operational triggers

Baroon Pocket Dam storage level	Trigger O – Operational PO – Pre-operational C – Capital	Action	Estimated Landers Shute WTP production (ML/day)
60%	O	• Reduce export to the NPI to achieve minimum operational requirements in the NPI • Minimise import from the NPI to Maroochy via the Nambour off take • Noosa WTP increases production to supply local Noosa demand and export 15 ML/day into the NPI2 in SFD	85
50%	O	• Stop all exports to the NPI and operate NPI1 in a northerly direction (i.e. 40 ML/day from North Pine/central sources) • Eudlo pump station import of 15 ML/day to Landers Shute supply area from NPI1 and NPI2	45
40%	PO	• Review Ewen Maddock and Banksia Beach WTP operational need	45
35%	PO	• Initiate hot standby operation planning for Ewen Maddock and Banksia Beach WTPs (i.e. 6 month notice period begins)	45
25%	O	• Maximise Ewen Maddock and Banksia Beach WTPs and reduce import from NPI by approximately 5 ML/day • Eudlo pump station import of 20 ML/day to Landers Shute supply area from NPI1 and NPI2	40

Table H-3 Northern sub-region, Lake Samsonvale and North Pine Water Treatment Plant – pre-operational and operational triggers

North Pine Dam storage level	Trigger O – Operational PO – Pre-operational C – Capital	Action	Estimated North Pine WTP Production (ML/day)
100%	O	• Normal operation	142
80%	PO	• Investigate/implement disinfection residual options (i.e. 12 month notice period begins) for Mt Crosby flows north	100
20%	O	• Transfer flow from Mt Crosby to North Pine (greater than 60 ML/day)	0-35

Further optimisation and development of sub- regional triggers for all sub-regions will underpin the next iterations of the Water Security Program and will be prioritised according to the water security status of the sub-regions. The optimisation for the northern sub-region will also explore triggers aligned to the proposed existing asset augmentations including the bi-directional augmentation of Aspley pump station and the Paynters Creeks NPI off take.

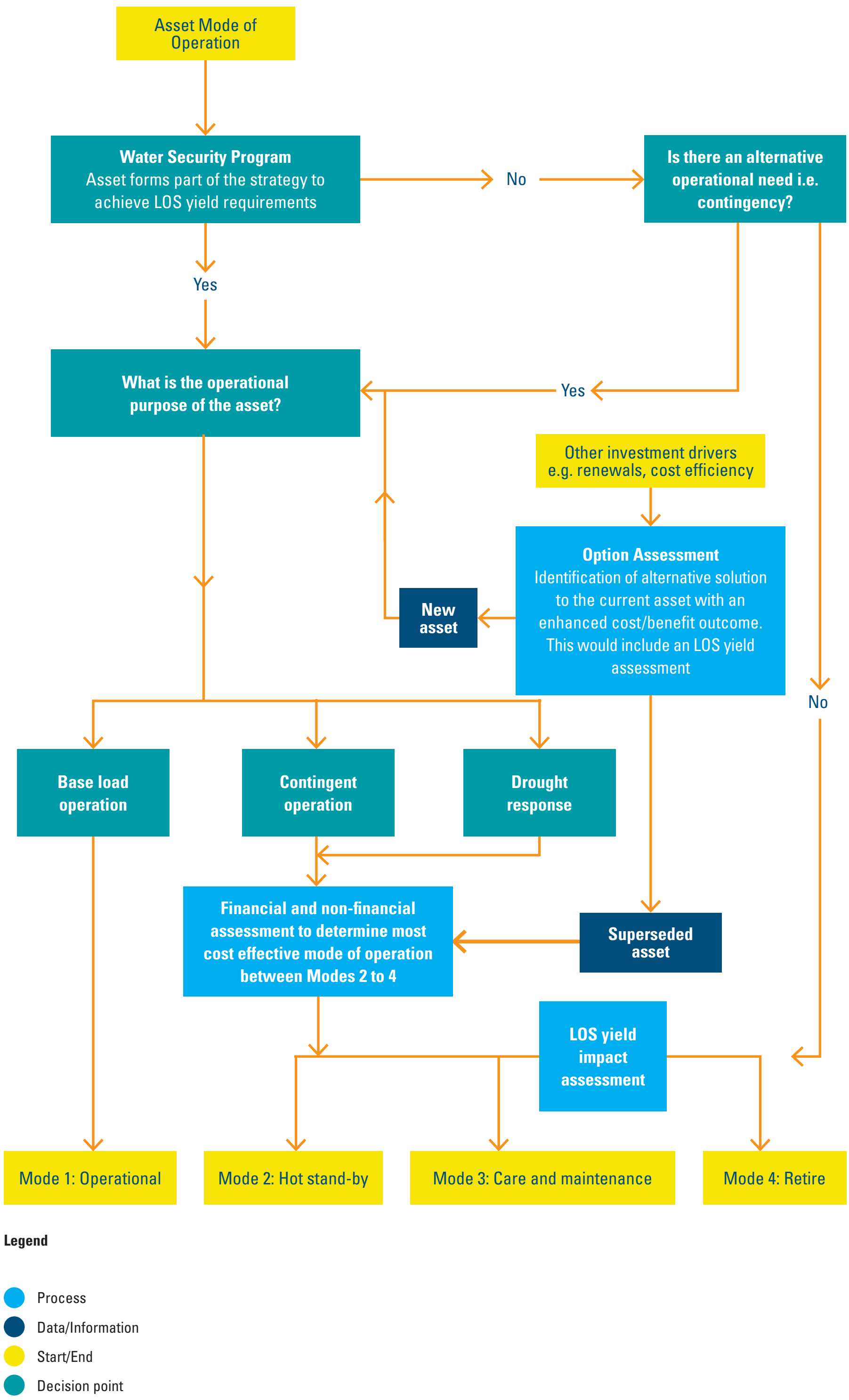
ASSET MODES OF OPERATION

Seqwater considers the following modes of operation across its asset portfolio:

- Operational: Under this mode the asset is used on a day-to-day basis so that supply meets demand.
- Hot standby: In this mode, an asset can be made available at short notice and is usually linked to the asset being used as a contingency measure as its primary mode of operation. Assets maintained in the hot standby mode of operation are used in response to short-term supply disruptions (to maintain reliability, for example in response to an extreme weather event such as flooding in the catchments) and in responding to drought.
- Care and maintenance (cold standby): Care and maintenance mode is where an asset is considered to be in a long-term shutdown with defined maintenance and care considerations to allow for the agreed operational notification periods to be achieved. These assets still contribute to water security for the region, particularly in response to drought.
- Decommission/Retire: An asset is considered to be no longer required. The decision to decommission/retire an asset is based on cost consideration and impact on regional water security.

The decision process to establish the preferred mode of operation for an asset is illustrated in Figure H-3.

Figure H-3 Mode of operation – selection process



The decision to decommission/retire an asset is ultimately based on the following considerations as part of the process of establishing an asset's mode of operation:

- Need – a review of the asset is undertaken to determine if it has been considered as part of Seqwater's infrastructure planning (i.e. under the Water Security Program or as required at the master planning level) or if the asset meets an operational need (i.e. redundancy or maintenance). If the asset does not fit into any of these categories it may be considered for decommissioning/retirement.
- Alternative solution – at times an alternative solution may be considered, which provides an equivalent outcome to an existing asset, but is considered superior on financial and non-financial grounds. This could be triggered for a number of reasons including renewal and maintenance costs or a proposed augmentation need. The former asset may then be considered for potential decommissioning/retirement.
- Likely operation – assets that are classified as being required for a drought response or for a contingent operation (i.e. reliability) may also be considered for decommissioning/retirement if their likely future operation is limited.

If an asset forms part of the day-to-day operations to supply water (i.e. base load operation), then the asset falls into Mode 1: Operational. However, if the asset is considered to be a contingency measure for reliability and or drought response, then the optimum mode of operation considering a financial and non-financial assessment is determined (i.e. hot standby, care and maintenance and/or retire).

LONG-TERM (30-YEAR) OPERATIONAL PLAN

The process for the development of a long-term (30-year) operational plan is presented in Figure H-4.

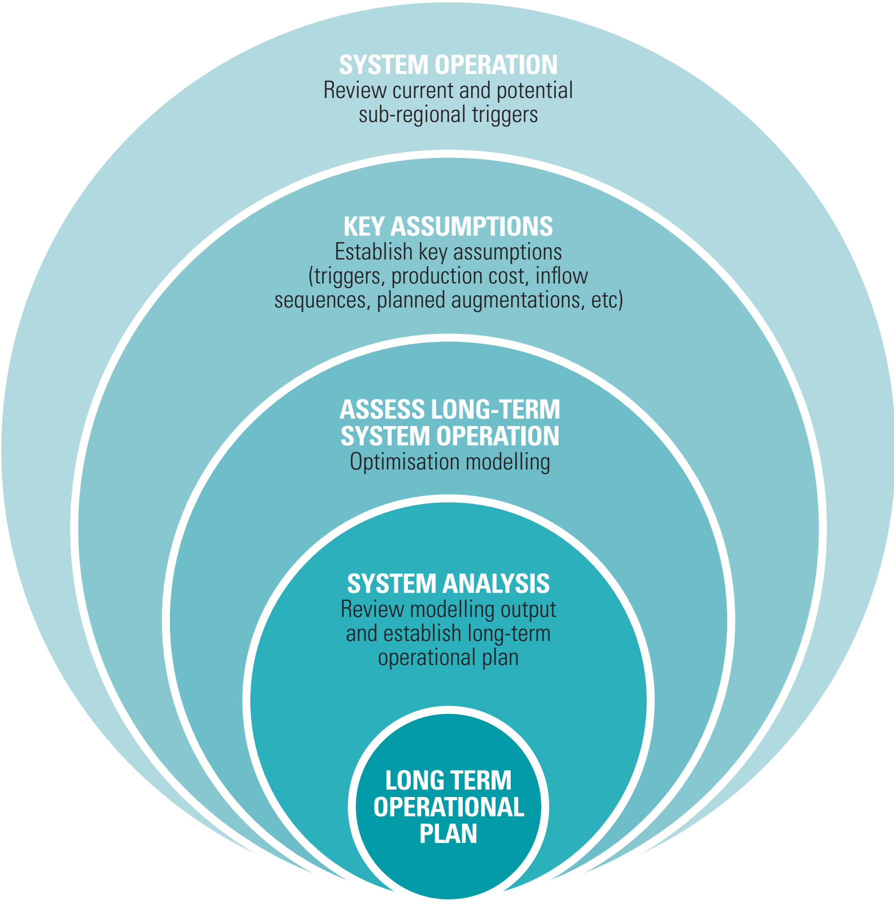


Figure H-4 Long-term (30-year) operational planning process

Appendix I: Drought response modelling

This appendix provides detail on the drought response modelling for drought response trigger development, sensitivity analysis and LOS compliance.

DROUGHT TRIGGER DEVELOPMENT MODELLING

There are many triggers required in a drought response approach, particularly when considering the three levers of supply, demand and system operation as integrated options. Given this complexity it was necessary to establish a modelling process consisting of a number of components. The components of the modelling fed the outputs from one component into another component as inputs. Modelling was a stepwise process to determine:

- essential minimum supply volume (EMSV):
  - EMSV restrictions trigger
  - EMSV supply with current infrastructure
  - temporary desalination plant capacity to meet future EMSV demands
- contingency infrastructure construction trigger
- demand management triggers
- triggers for climate resilient supply options:
  - Western Corridor Recycled Water Scheme (WCRWS) recommissioning
  - WCRWS operation
  - Gold Coast Desalination Plant operation.

Throughout this process a number of models and tools were used.

- The Regional Stochastic Model (RSM) was used to simulate the operation of the bulk water supply system to provide information such as the change in the probability of the storages reaching defined trigger levels over time and the average time spent at each restriction level. The RSM is also used to determine the LOS yield.
- The Strategic Portfolio Assessment Model (SPAM) uses the network operation data from the RSM such as pipeline transfer volumes, water treatment plant and climate-resilient water production volumes as well as duration spent under restrictions to calculate probabilistic net present value costs (NPV). The average or expected costs obtained from SPAM (as well as the bring-forward costs of augmentations to replace lost LOS yield where applicable) were used for the drought-response modelling to compare the cost implications of different scenarios.

Key modelling assumptions

The drought response modelling key assumptions include:

- current Seqwater infrastructure capabilities (including dams, climate-resilient water assets and water treatment plants)
- 2015 medium demand projection (refer Chapter 3 – Demand), including an allowance for all system losses
- demand management options and implementation costs from version 1 Water Security Program
- drought demand management societal economic impact based on external modelling
- contingency supply costs based on external investigations
- Seqwater operational costs
- Stochastic climate data based on historical rainfall and evaporation records as provided by the Queensland Government
- a drought lasting for 10 years
- drought response actions occur as detailed in the drought response approach, including the operation of climate-resilient water assets.

Modelling methodology

A broad outline of the methodology for each component of the modelling is given below.

Essential minimum supply volume (EMSV)

Establishing the optimum KBWS level at which EMSV restrictions will commence was the first step in the modelling to establish the version 2 drought response measures. This is because the KBWS level formed the basis of subsequent modelling including the EMSV supply capacity of current infrastructure, the contingency infrastructure required to meet future EMSV demands and the contingency construction trigger.

The choice of the KBWS trigger level for EMSV restrictions to commence was based on comparing the following information determined for a range of EMSV restriction levels:

- EMSV supply at each trigger level
- likelihood of reaching each trigger level
- implications of each trigger level.

The EMSV that can be supplied for each KBWS trigger level was determined using the Regional Stochastic Model (RSM) to simulate the operation of the bulk water supply system using the full stochastic climate data and with the KBWS starting at the EMSV restrictions trigger level. The EMSV supply equalled the maximum demand that could be met which satisfied a number of criteria, including no supply shortfalls within the first two years and no instances of the KBWS reaching minimum operating level (MOL) within five years.

This approach is conservative (in accordance with the DEWS guideline requirements) as it determines the volume of water that could be supplied should severe drought continue after the KBWS reach the EMSV restrictions level. A drought worse than in the stochastic record would need to have occurred to reach the EMSV restriction level. The risk profile of this approach is therefore less than 1:100,000.

Once the EMSV restrictions trigger and the yield with the current infrastructure were established, the temporary desalination plants required to meet future EMSV demands, were determined.

Construction of contingent infrastructure

The contingent infrastructure construction trigger is the KBWS level at which construction of temporary desalination plant(s) (identified to be required to meet the EMSV demand beyond 2026) has to commence. It is determined based on the trigger level that provides a 99.99% probability of the infrastructure being ready by the time the KBWS reach the EMSV restrictions level. This is with a construction time frame of approximately two years.

Demand management triggers

For the demand management trigger modelling, the assumptions concerning the EMSV restrictions trigger, contingency desalination requirements and the contingency construction trigger were as determined in the previous two modelling component steps.

The optimum level for introducing the medium level water restrictions (MLWR) trigger was determined on the basis of the LOS yield and average net present costs determined for varying MLWR trigger levels. The range of restriction levels modelled was 15–70% KBWS. The average net present costs include operational, demand management costs as well as the estimated cost of replacing lost LOS yield. The operational costs were determined for the 10-year period commencing in July 2026.

More severe (high level and emergency) water restrictions are introduced below the MLWR trigger level to help prevent the KBWS reaching the EMSV restrictions trigger and therefore minimum operating level (MOL). To demonstrate the benefit of having more severe measures commence at the 'safe minimum storage level', the impact of having no high or emergency level restrictions in place on the probability of the KBWS reaching 10% and 5% was determined.

To provide information on the optimum trigger for the 'safe minimum storage level' the probability of reaching possible triggers for these restrictions of 30%, 25% and 20% was determined as well as the earliest dates these triggers were reached.

Climate-resilient water supplies

The current climate-resilient water supplies are the Western Corridor Recycled Water Scheme (WCRWS) and the Gold Coast Desalination Plant (GCDP). A total production volume of 112,055 ML/annum can be provided by these supply sources. To demonstrate the benefits provided by these supplies to water security, the impact of having either no WCRWS or GCDP available on the probability of the KBWS reaching 5% and 20% and of the Gold Coast storages (Hinze and Little Nerang dams) reaching MOL over the next 10 years has been determined. The benefits provided by the climate-resilient supplies will increase with rising demand.

The modelling to establish the optimum triggers to increase to full production of the climate-resilient water supplies, including recommissioning of the WCRWS, utilised the triggers for EMSV restrictions, contingency construction and demand management measures determined in the previous modelling steps.

Both recommissioning and full production triggers for the WCRWS were developed for the drought response. For modelling purposes a KBWS volume of 40%, for full operation of the WCRWS, will be targeted. During a drought response the WCRWS may be operated regardless of whether recommissioning is complete before or after KBWS reach 40%. Post recommissioning a higher trigger for WCRWS full production will be adopted. This trigger will be determined in future versions of the Water Security Program.

As the WCRWS recommissioning trigger is dependent on the WCRWS full production trigger, the suitability of 40% KBWS for this trigger was established first. The modelling focussed on determining the level of water security provided by the current 40% trigger and any risks posed by lowering this trigger to 30%.

The KBWS levels considered as triggers for recommissioning the WCRWS were 60% and 70% only as these are higher than the optimum medium level water restriction trigger established in the earlier modelling. A recommissioning trigger higher than the medium level water restriction was considered appropriate so that Seqwater responds before restrictions are imposed on the community. Trigger levels higher than 70% would have required an almost immediate start of the recommissioning process which is not justified considering there is a very low probability (less than 0.5%) of the KBWS reaching 40% within the next five years.

To minimise the likelihood of reaching 40% prior to completion of recommissioning, full production of the GCDP will also commence at the recommissioning trigger.

The optimum recommissioning trigger for the WCRWS was established on the basis of comparing the following information determined for KBWS trigger levels of 60% and 70%.

- The probability of the KBWS reaching the WCRWS operational trigger of 40% within the recommissioning timeframe of 24 months starting from the recommissioning trigger. Figure I-1 illustrates how the probability increases over time after the recommissioning commences.
- The probability of reaching the recommissioning trigger within the next 10 years.
- The expected costs, including for operation and demand management, of adopting either recommissioning trigger. Costs were determined over the 10-year period commencing in May 2016.

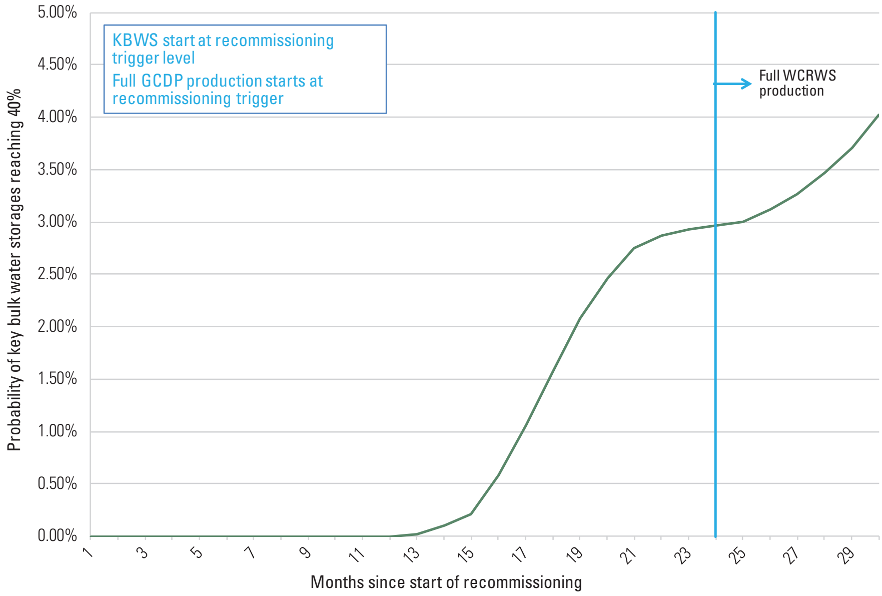


Figure I-1 Probability of KBWS reaching 40% starting from the recommissioning trigger

The trigger for full production from the GCDP is the same as the trigger for recommissioning the WCRWS. Modelling to support this mode of operation determined the differences in the probability of reaching defined trigger levels between the version 1 and version 2 modes of operation (see Table I-1 below). In addition, the impact of a higher trigger for full production from the GCDP on the probability of reaching the WCRWS recommissioning trigger was also considered.

MODELLING OUTCOMES

Some of the version 2 drought response triggers are different to the version 1 triggers based on the modelling outcomes. Table I-1 outlines the drought response triggers for versions 1 and 2.

Table I-1 Comparison of Version 1 and 2 drought response triggers

Drought response action	Version 1 KBWS trigger	Version 2 KBWS trigger
GCDP operation	60% (33% production) 40% (100% production)	60% (up to 100% production)
WCRWS recommissioning trigger	70%	60%
WCRWS operation trigger (post recommissioning)	To be assessed post recommissioning of WCRWS	To be assessed post recommissioning of WCRWS
Pre-drought messaging (target 150 L/p/d)	50%	60%
Medium Level Water Restrictions (target 140 L/p/d)	40%	50%
Western Corridor Recycled Water Scheme operation	40% (100% production)	
High Level Water Restrictions (target 120 L/p/d)	20%	25%
Commence contingency infrastructure construction	30%	20%
Emergency Level Water Restrictions (target 100 L/p/d)	10%	10%
EMSV	5%	5%

A broad overview of how the triggers were determined, based on the modelling outcomes and other considerations follows.

Essential minimum supply volume (EMSV)

For each EMSV trigger level assessed, Table I-2 below shows the EMSV yield of the bulk water supply system, the year the EMSV demand equals the yield and the probability of reaching the trigger level. As simulation of the system operation showed no instances of the triggers for EMSV restrictions being reached over the next 10 years, the probability of reaching the EMSV trigger levels over the next 10 years has been assessed on a qualitative basis considering a range of information such as the design drought drawdown and the drought response measures in place at each trigger level.

For example it is possible that the KBWS could reach 10% within the next 10 years as during the design drought drawdown the minimum storage level reached is close to 10%. However, if demands are higher or climate conditions are worse than those of the design drought the KBWS could reach 10%. Due to the more extreme demand management measures introduced at 10% and the high chance that the drought may be ending, it is highly unlikely that the KBWS would reach 5% within the next 10 years.

On the basis of these results, the optimum trigger for EMSV restrictions is 5% as supply of the EMSV demand can be met until 2026 but it is highly unlikely that the KBWS will reach 5% within at least the next 10 years.

Supply of the demand of 145,365 ML/annum was met from the volume remaining in the storages and the inflows into the storages, the GCDP which is assumed to be operating at full capacity, the WCRWS operating at a reduced capacity estimated to be 100 ML/day due to feed water limitations with EMSV restrictions in place, and use of North Stradbroke Island groundwater.

The 99.99th percentile exceedance curve, (minimum storage level curve), shows that with the 2026 EMSV demand of 145,365 ML/annum and the KBWS starting at 5%, the KBWS level did not reach minimum operating level and after the first two years eventually rose above 10% with slightly higher inflows (see Figure I-2).

Table I-2 EMSV yield and risk of triggering EMSV restrictions – variation with EMSV trigger level

EMSV trigger level	EMSV yield or maximum demand ML/annum	Year supply equals EMSV demand	Likelihood of reaching the triggers within the next 10 years
10%	186,158	2044	Possible
5%	145,365	2026	Highly unlikely
1.80%	<117,132	Before 2015	Extremely unlikely
1.30%	<117,132	Before 2015	Extremely unlikely

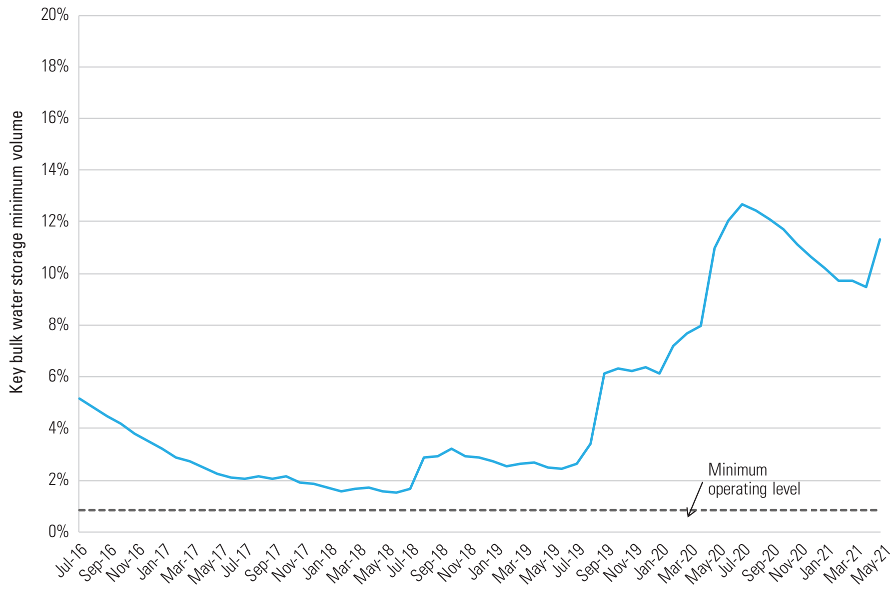


Figure I-2 KBWS minimum storage levels

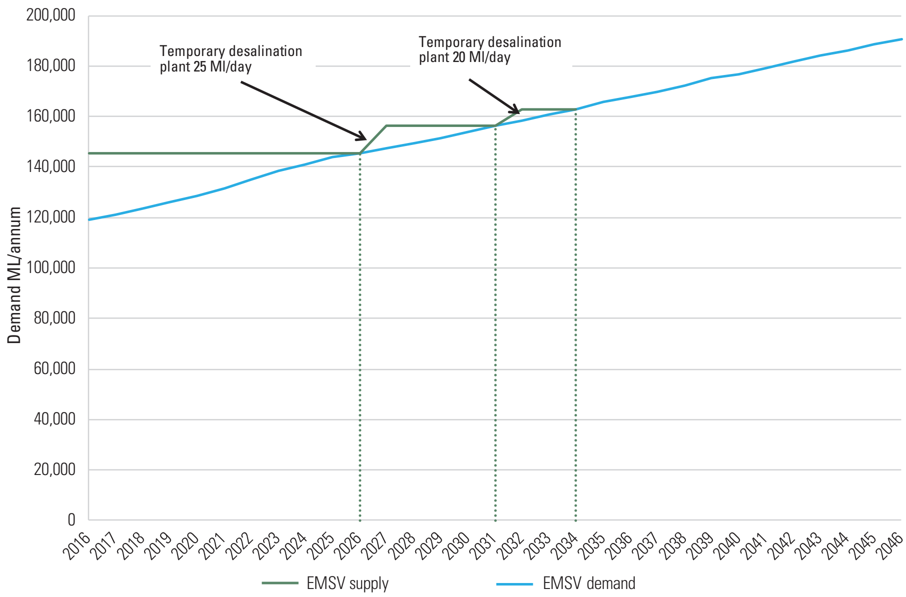


Figure I-3 EMSV supply demand balance

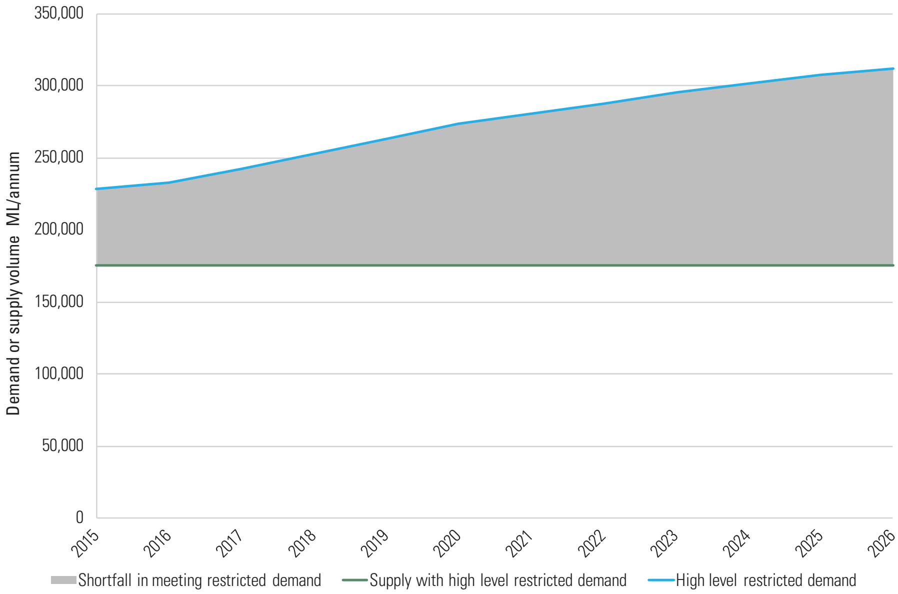


Figure I-4 Shortfall in meeting high level restricted demand

At EMSV demands higher than those for 2026, supply shortfalls occurred in the central region (due to the reduced WCRWS production volume caused by reduced feedwater) and the northern region (due to lack of climate-resilient water supplies). Preliminary modelling showed that with one 25 ML/day temporary desalination plant the EMSV demands could be met until 2031 and with an additional 20 ML/day temporary desalination plant the EMSV demands could be met until 2034. These are modelled examples only. The regional location of the temporary desalination plant will be determined during drought so that it can be sited to best support the area affected by supply shortfalls.

If the assumed inflows do not occur, the production capacity of the temporary desalination plant/s will be increased. Seqwater will commence pre-planning for an EMSV event when the KBWS reach 60% and will consider contingencies for managing an event more severe and of longer duration than has been modelled.

Figure I-3 shows the supply demand balance which compares the EMSV supply with the projected EMSV demand (prepared using the medium population projection and assuming a consumption rate of 100 L/p/d).

EMSV restrictions need to be in place when the KBWS reach 5% so that essential demands can be met for at least 12 months, allowing time for contingent infrastructure to be built. Modelling showed that if EMSV restrictions were delayed until the KBWS dropped below 5%, such as to 1.8% (1% above minimum operating level) or lower, the bulk water supply system with the current infrastructure could not meet the 2015 EMSV demand of 117,132 ML/annum.

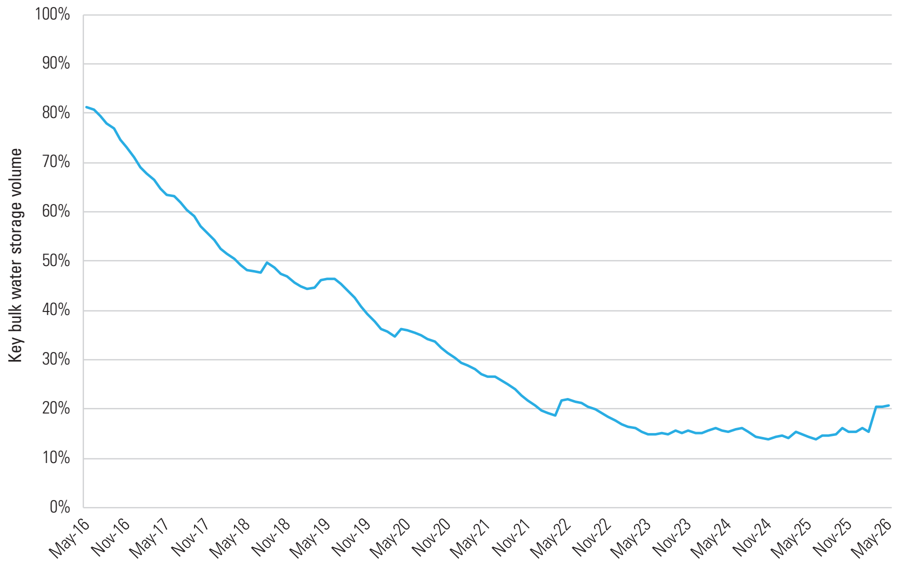


Figure I-5 Design drought drawdown with version 2 drought response measures

The KBWS reached minimum operating level during the first year of simulations. Furthermore, the supply capacity of the bulk water supply system – assuming the KBWS are at 5% and that only high level restrictions are in place – is well below the demand. Figure I-4 shows the difference between the restricted demand and the supply capacity, with only restricted demands in place. This supply capacity, is an optimistic estimate as it does not assume a reduction in the WCRWS production volume which occurs when EMSV restrictions are in place.

In planning for water security, one of Seqwater's objectives is for the minimum storage level reached by the KBWS during the design drought drawdown to be higher than the trigger for EMSV restrictions. As Figure I-5 shows, this criterion is met by the drought response. This, together with the LOS compliance assessment using the full stochastic data set for the current infrastructure, confirms that the likelihood of reaching the trigger for EMSV restrictions over the next 10 years is less than 1:10,000.

Where a drought more severe than the design drought occurred, further infrastructure may be required and will be planned for as an adaptive response.

Construction of contingent infrastructure

Contingent infrastructure utilises the supply lever to respond to drought, particularly temporary desalination facilities. The temporary desalination supply option is the least favourable on the basis of economic impacts so its use in drought response has been minimised.

A contingency trigger of 20% was found to provide a probability of less than, or equal to, 0.01% that the KBWS would reach 5% within the construction timeframe (i.e. supply would not be ready in time). Excluding any delays in construction there is therefore a 99.99% probability that the temporary desalination plant(s) will be ready when the KBWS reach 5%.

Demand management triggers

Drought demand management measures, including water restrictions, play a significant role in the drought response. A drop in consumption slows down the reduction in the KBWS levels significantly. Without demand management measures the water security of South East Queensland would be severely compromised (see Figure I-9). Prior to the implementation of drought water restrictions, a water-efficiency communication campaign will help prepare the community for drought.

Medium level water restrictions

Figure I-6 shows how the LOS yields and the average net present costs vary with the medium level water restrictions trigger.

Figure I-6 shows the optimal medium level water restrictions trigger is between 50% and 55% due to the high LOS yields achieved at these trigger levels and lower costs.

50% was the selected medium level water restrictions trigger as it has a similar cost and a lower probability of occurring than the 55% trigger.

- Triggers higher than 55% are more costly, placing a greater burden on the community through increased frequency of restrictions. It would also require bringing forward a future augmentation to comply with the LOS objectives and this would result in increased costs to consumers.
- Triggers lower than 50% do not achieve the same level of water security and are more costly.

Final selection of the 50% trigger for medium level water restrictions considered the modelling results as well as community and business impacts.

The medium level water restrictions target is 140L/p/d for residential consumers. This volume of water is planned to be supplied to residential consumer in addition to the non-residential demand and system losses. Non-residential demand is not reduced at the medium level water restriction trigger.

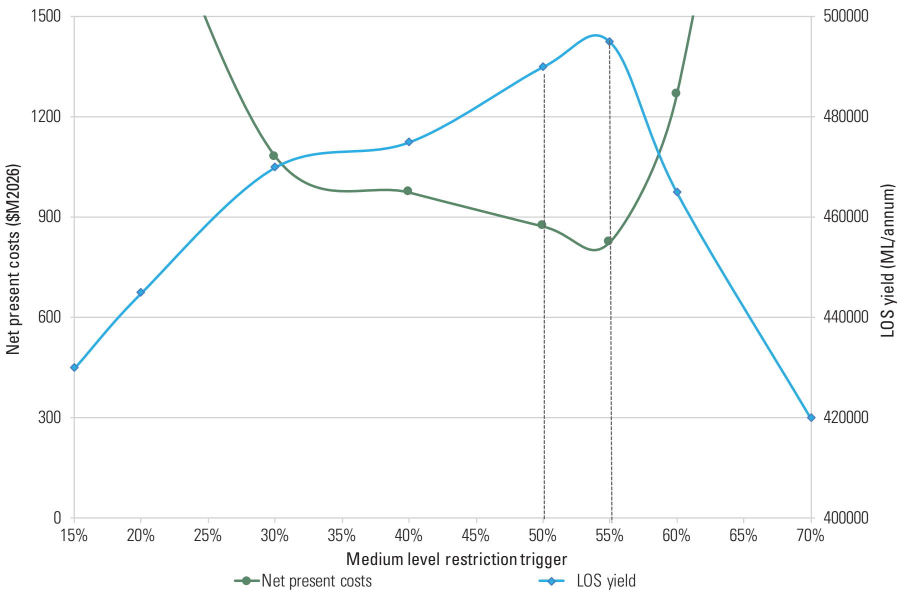


Figure I-6 Variation in LOS yield and net present costs with MLWR trigger

Demand management measures are deliberately staged requiring a number of trigger levels, with gradually reducing consumption targets, in between the medium level and EMSV restriction levels. Greater success of the demand management measures is likely by keeping the community informed and taking them on a journey of understanding as the drought becomes more severe. This was a learning from the Millennium Drought.

High level water restrictions

Without the high and emergency level water restrictions in place, the probability of the KBWS reaching 10% based on a full stochastic analysis increases and EMSV restrictions are triggered within 20 years. This is compared to not being triggered at all with high and emergency restrictions in place, demonstrating the benefit of these restrictions in preventing the KBWS reaching minimum operating level. Without high level water restrictions the LOS objectives would not be met for the current LOS yield demand of 440,000 ML/annum; there would be an increased chance of high cost contingency construction being triggered and EMSV occurring within the next 20 years; and the community may not reduce demand to necessary levels at EMSV, posing a severe risk of supplies reaching minimum operating level.

The KBWS level of 25% (note the version 1 KBWS level was 20%) was selected for the trigger for introducing high level restrictions for the following reasons:

- High level restrictions have a lower community cost than construction of contingent infrastructure.
- Triggering high level restrictions prior to contingent infrastructure would help delay the contingency construction trigger of 20%.

Trigger levels of 30% and 25% for high level restrictions were assessed and it was found that:

- the cost to the community would be less for the 25% trigger as there is a lower probability of reaching it
- there is approximately 10 months difference in reaching the 25% trigger compared to the 30% trigger (the probability of reaching 20% within 10 years was the same for both triggers).

The high level restrictions trigger of 25% KBWS allows for the drought response to be adapted if required. For example, it may need to be adapted if demand reductions have not been achieved.

Emergency level water restrictions

- The trigger for emergency level water restrictions remains 10% KBWS (the same as in version 1 of the Water Security Program). The trigger is:
  - high enough to assist in deferring EMSV restrictions as detailed
  - low enough to reduce the probability of it occurring thus avoiding potentially significant impacts on the community.

Without staged water restrictions in place, the community may not continue with demand management and therefore may not reduce demand to necessary levels at EMSV which would pose a severe risk of supplies reaching MOL.

Climate-resilient water supplies

Seqwater's current infrastructure includes two climate-resilient water supplies – the Western Corridor Recycled Water Scheme (WCRWS) and the Gold Coast Desalination Plant (GCDP). Utilising the operational lever includes varying the use of these supplies.

Benefits of the Western Corridor Recycled Water Scheme (WCRWS) and GCDP

Previous modelling has shown that the recommissioning and operation of the WCRWS is more cost effective than building a new water supply source. If the WCRWS was not used, a new climate-resilient water source would be required to replace the lost LOS yield. This would be a significant cost for the South East Queensland community.

- Without the WCRWS or the GCDP, the region would face significantly increased risk to water security as well as increased costs as the LOS yield would be reduced requiring much earlier augmentation at significant cost

- there would be an increased chance of EMSV occurring within the next 20 years
- when the WCRWS was not available for addition to Wivenhoe Dam as the KBWS reached 40%, contingency construction was triggered 10 months earlier. In addition, EMSV measures were triggered within 8 years; as compared to not being triggered at all when the WCRWS was available. (This is based on a full stochastic analysis).
- without the GCDP being at full production when KBWS reached 60%, the Gold Coast system storages reached minimum operating level within 12 years and the KBWS reached the trigger for contingency construction earlier.

Western Corridor Recycled Water Scheme operational target

For modelling purposes, the operational target for WCRWS remained at 40% KBWS. This operational target was carried over from version 1 of the Water Security Program and legacy Queensland Water Commission planning.

The target was maintained at 40% KBWS because it was found to be high enough to provide sufficient water supply security as demonstrated by the following:

- The LOS objectives compliance assessment (refer Chapter 6 – Planning for resilience)
- The KBWS level with the design drought inflows (refer Chapter 6 – Planning for resilience) does not reach 5% with the drought response measures.

The difference between a 40% and 30% WCRWS operational target would result in slightly higher probabilities of triggering more severe restrictions and contingency construction (see Table I-3).

A trigger of 30% does not reduce water supply security significantly however if a 30% trigger is targeted and a recommissioning trigger set accordingly, there is an increased likelihood that the WCRWS will not be available until the KBWS reach 20%. This would result in:

- higher costs due to the increased risk of triggering contingent infrastructure construction and more severe water restrictions
- a more significant risk to water supply security as the minimum storage level reached during the design drawdown decreases by 3%.

This target for commencing full WCRWS production is consistent with our drought response principle that existing infrastructure should be operational before the construction of new contingent infrastructure is commenced and more severe water restrictions are imposed to achieve the lowest community cost.

Western Corridor Recycled Water Scheme recommissioning trigger

The WCRWS recommissioning trigger was 70% KBWS in Version 1. In this version of the Water Security Program, a 60% trigger was adopted based on the modelling results summarised in Table I-4 The results showed that with a:

- 70% trigger for recommissioning and full GCDP production – the probability that the WCRWS will not be ready in time is very low but the expected costs are much higher as is the probability of reaching this trigger within the next 10 years.
- 60% trigger for recommissioning and full GCDP production – this would not have a significant impact on water security but if the WCRWS was not operational at 40% the likelihood of triggering contingent infrastructure and the likelihood of reaching lower KBWS levels would increase.

A recommissioning trigger that is lower than 60% is not considered acceptable as it would increase the risk of reaching the contingency construction trigger placing a significant cost burden on the community.

Table I-3 Probability of reaching target within 10 years as at April 2016

WCRWS full production target	Probability of reaching 30%	Probability of reaching 20%
40%	0.3%	<0.1%
30%	0.4%	<0.1%

Table I-4 Probability of reaching WCRWS recommissioning and full production triggers and expected costs as at April 2016

WCRWS Recommissioning trigger	GCDP full production trigger	Probability of reaching WCRWS recommissioning trigger within 10 years	Probability of reaching WCRWS 40% within 2 years from recommissioning trigger	Expected Cost ($M)
70%	70%	68%	<1%	551
60%	70%	26%	3%	509
60%	60%	31%	3%	498

Full production from the Gold Coast Desalination Plant

The trigger for GCDP full production of 60% was adopted for the following reasons.

- It would help delay the introduction of medium level water restrictions in line with the options analysis which shows system operation options are more favourable than demand management options when considering impact on the community
- It is more cost effective to have a single trigger for full production – updated operational costs indicate the production cost per megalitre is lower than assumed in version 1.
- It improves water security by reducing the probability:
  - of the KBWS reaching trigger levels over the next 10 years (Table I-5)
  - of the WCRWS not being commissioned in time (from 4.4% to 3%).

Is not necessary to raise the trigger for full production from the GCDP to 70%. This does not reduce the probability of reaching a WCRWS recommissioning trigger of 60% within 10 years by enough to justify the additional expected cost of increased GCDP operation (see Table I-4).

Importantly, as 60% is the trigger for the first drought response measure to commence, it constitutes the drought response level.

Table I-5 Comparison of the Version 1 and Version 2 probability of reaching trigger levels as at June 2016

KBWS trigger level (%)	Cumulative probability of KBWS reaching trigger levels within 10 years	
	Version 1	Version 2
GCDP one third production	60%	NA
GCDP full production	40%	60%
50%	12%	9%
40%	4%	2%
30%	<1%	<1%
20%	<0.1%	<0.1%

COMPARING THE DEMAND, SUPPLY AND SYSTEM OPERATION LEVERS

In preparing the drought response, Seqwater has compared each of the lever options – demand, supply and system operation – individually to determine the cost impact based on cost per megalitre. The system operation and supply costs include Seqwater capital and operational costs. The demand option costs include implementation costs and societal impacts. Demand options place a burden on the community and it is necessary to understand this impact when considering use of these options. In future versions other impacts will be considered across all levers.

In developing the drought response approach consideration has been given to available yield, economic impacts, the environment and resilience. People and place considerations will be assessed following community consultation about drought response.

Based on the assessment, system operations options (including GCDP and WCRWS) are shown to be more effective early drought response solutions. Drought demand management options provided the next most effective response when implemented in stepped progression as drought becomes more severe. Increased severity of water restrictions results in increased impact on the community and businesses. The supply option is the least favourable for this drought response due to the timeframe before the next supply augmentation and the significant cost. This option has been placed in the drought response to be triggered only when required and when pre-planning has been completed, allowing risk and costs to be minimised.

Each of the drought response options has been strategically placed in the drought response approach. Seqwater aims to optimise the bulk water supply system and provide best outcomes for the community by delaying the need for more severe water restrictions and potentially significant cost implications. If system operations and demand management options were not used early in the drought response there would be a higher risk of more severe water restrictions at higher KBWS triggers points.

This would significantly impact the community. It may also result in a larger temporary water supply solution being triggered earlier in the drought response, at an increased cost to the community.

A high-level indication of how each lever performs against each of the categories of water considerations for planning is outlined below.

Available yield

- System operation options are already available and able to provide significant yield.
- Drought demand management, where targeted demand reductions are achieved, provides a significant reduction in demand off-setting the need for additional yield.
- The supply option (temporary desalination) is only used at EMSV restrictions.

Economic

- Further investigation is required into the economic impact of each of the options.
- Given current information, including societal impact on drought demand management options only, system operation options provide the most cost-effective solution, followed by drought demand management and then supply.

Environment

- System operation options are already in place. While they require additional energy, some can reduce nutrients in waterways providing a positive environmental impact.
- Drought demand management options may have a significant environmental impact during a severe drought with harsher water restrictions. The earlier, less stringent restrictions may have environmental benefit due to water demand reductions from water-efficient behaviours and devices reducing demand. This can reduce greenhouse gases relating to water treatment and distribution and household water heating.
- The environmental impact of the drought demand management options has been assumed and requires further investigation in future drought response plans.
- The supply option needs to be constructed and commissioned in a short time period which may result in environmental impacts.

Resilience

- Generally system operation options can be operated in a reasonably short time period and provide climate-resilient sources of supply.
- The supply option of temporary desalination is also climate-resilient.
- Drought demand management options, whilst effective and adaptable, rely on community participation (as opposed to system operation and supply options which are able to perform as planned).

People and place

- This category of consideration has not been assessed as community engagement is required.

For the detailed analysis of the options within the levers refer to the respective chapters.

COMPARING WATER SECURITY BENEFITS OF VERSIONS 1 AND 2

A comparison of drought response approaches based on the probability of the KBWS reaching drought response trigger levels, demonstrates that the version 2 response provides better water security than version 1 (shown in Table I-6 and Figure I-7).

Table I-6 Probability of reaching drought response triggers – versions 1 and 2 compared as at June 2016

Drought response	Probability of reaching trigger within 10 years				
	60%	50%	40%	25%	20%
Version 1	32%	12%	4%	0.1%	<0.1%
Version 2	32%	9%	2%	0.1%	<0.1%

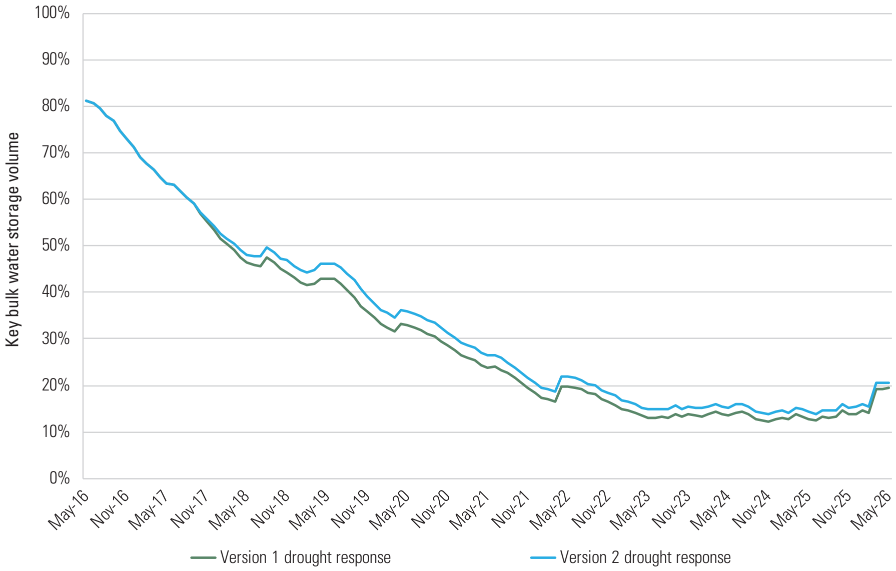


Figure I-7 Comparison of version 1 and version 2 drought response design drought drawdowns

SENSITIVITY ANALYSIS – POTENTIAL RISKS TO THE DROUGHT RESPONSE

There are a range of potential risks to the drought response approach. The design drought drawdown for the next 10 years shows that if all measures are implemented in accordance with the drought response approach, the minimum KBWS level reached is above 10%, thereby not reaching the EMSV restriction trigger. There is a risk that the minimum levels reached could be lower due to the modelled assumptions not being realised. Some examples include consumption increasing to higher than the assumed medium demand, drought response measures not being implemented according to plan, or changes in climate leading to conditions worse than in the design drought.

Potential risks have been assessed on the basis of the impact on the design drought drawdown and potential mitigation measures. In general, the sensitivity analysis indicates that the drought response triggers do not need to change. However, the triggers are likely to be reached earlier, with a higher risk of constructing contingent water supplies and with a greater cost to the community.

Climate change

- Risk – A change in climatic conditions may result in an increased probability of drought, or a more severe drought than the modelled design drought. Conversely, it may result in wetter conditions. The effects of climate change within the next 10 years are uncertain.
- Impact – Climate change has not been modelled specifically for this drought response as the model is for a 10-year period. The impacts of climate change are uncertain but they could include reduction in rainfall and increased evaporation, resulting in a higher probability of reaching the triggers.
- Possible mitigation measure – Review conditions and adapt drought response accordingly.

Increased water demand

- Risk – Water demand is higher than assumed in drought response modelling resulting in additional drought response actions being required.
- Impact – Sensitivity modelling (assuming the same demand reductions at each trigger level but a higher forecast demand) showed the KBWS level only drops just below 10% (see Figure I-8).
- Possible mitigation measure – Drought response will be closely monitored, and where demand reductions are not being met, further drought actions would be required. This may include the development of additional voluntary demand management options or more severe water restrictions at KBWS levels less than 25%, to meet a revised demand target. Noting that water restrictions will not exceed LOS requirements. Alternatively the construction of contingent infrastructure could be brought forward. This will be dependent on storage levels, demand, climatic and other conditions.

Ineffective demand management programs

- Risk – Demand management does not achieve assumed target reductions. With ongoing lower demands post Millennium Drought, it is unknown how effective the demand management programs will be in achieving the targeted demands.
- Impact – Figure I-9 highlights how important demand management is to the success of the drought response approach, based on a design drought scenario. If only 50% of the desired demand reduction targets were achieved, the severe emergency level water restrictions of target of 100 L/p/d (residential use only) would be triggered. If there was no demand management in place, South East Queensland would reach the EMSV restriction trigger. This would result in significant economic costs to the region with only 100 L/p/d able to be supplied, inclusive of residential and non-residential demands.
- Possible mitigation measure – Drought response will be closely monitored and where demand reductions are not being met, further drought actions would be required. This may include the development of additional voluntary demand management options or more severe water restrictions at KBWS levels less than 25%, to meet a revised demand target. Noting that water restrictions will not exceed LOS requirements. Alternatively the construction of contingent infrastructure could be brought forward. This will be dependent on storage levels, demand, climatic and other conditions.

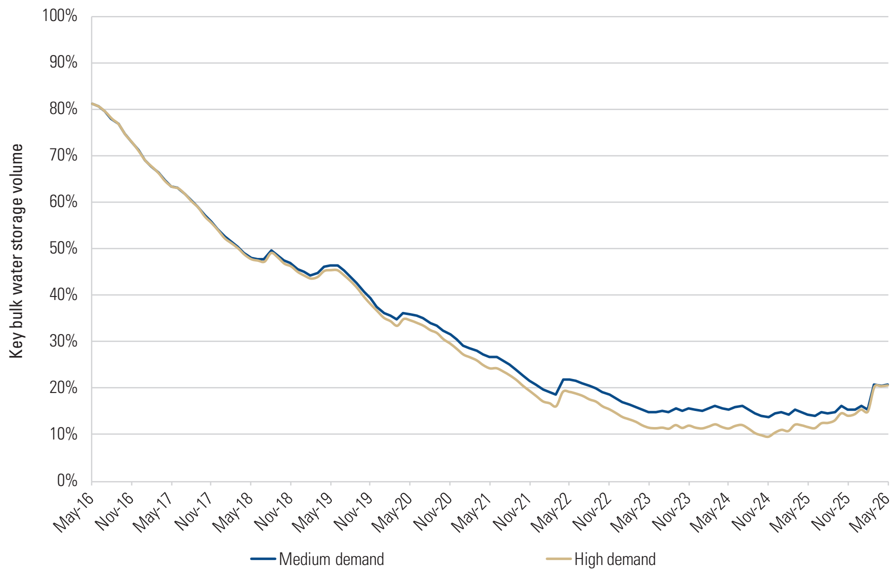


Figure I-8 Impact of higher demand on the version 2 drought response 1

Figure I-9 Impact of demand management on the version 2 drought response approach

WCRWS not operational by 40% KBWS

- Risk – WCRWS is not fully operational at the 40% KBWS modelling target. WCRWS is an integral part of the drought response approach and was built to secure water supplies during a severe drought. As detailed earlier, there is about a 3% chance of the WCRWS not being fully operational by the target 40% KBWS and a chance that it may not be operational until the KBWS reach 20%.
- Impact – When the WCRWS was not available until the KBWS reached 20%, the minimum storage level reached during the design drought drawdown decreased from 14% to 11%.
- Possible mitigation measure – Seqwater will regularly review the WCRWS readiness plan to monitor the risk of not being operational by 40% KBWS. If it is clear that WCRWS will not be operational at 40%, further drought actions would be required. This may include the development of additional voluntary demand management options or more severe water restrictions at KBWS levels less than 25%, to meet a revised demand target. Noting that water restrictions will not exceed LOS requirements. Alternatively the construction of contingent infrastructure could be brought forward. This will be dependent on storage levels, demand, climatic and other conditions.

Inability to use WCRWS

- Risk – WCRWS is not able to be used at all during the drought response.
- Impact – Figure I-10 shows that without the WCRWS, the KBWS could drop below 10% increasing the chance of EMSV restrictions being triggered.
- Possible mitigation measure – In the event that it is clear that WCRWS will not be operational, Seqwater would need to consider bringing forward significant water supply infrastructure in the central sub-region at a substantial cost to the community.

WCRWS does not receive the volume of anticipated feedwater at EMSV

- Risk – Where EMSV restrictions are triggered there will be less feedwater available and therefore reduced water production from WCRWS.
- Impact – A reduced ability to produce purified recycled water and meet the EMSV supply.
- Possible mitigation measure – Where feedwater volumes are not sufficient, the contingent infrastructure capacity would be increased. Seqwater will monitor the feedwater volumes throughout drought and the possible impacts of the demand reductions.

Figure I-10 Impact of WCRWS on the Version 2 drought response approach

LOS COMPLIANCE

Seqwater must operate the bulk water supply system to comply with the LOS objectives (refer Appendix A). The Regional Stochastic Model was used to determine how long the current operating strategy, with the drought response in place, could maintain compliance with the LOS objectives. Results of the assessment (shown in Table I-7 indicate that as the LOS yield of the current operating strategy is 440,000 ML/annum, compliance with the LOS objectives should be able to be maintained until 2031.LOS compliance for individual off-grid communities' is shown in Table I-8.

Table I-7 LOS compliance of current operating strategy and the drought response

LOS objective		**Current operating strategy and drought response**
LOS yield		**440,000 ML/annum**
Criteria	**Complying value criteria statistic**	**Value achieved**
Key bulk water storages reaching 50% (Medium level restrictions trigger)	less than once in every 10 years on average	Once in every 11 years on average
Key bulk water storages reaching 5% (Essential minimum supply volume trigger)	less than once in every 10,000 years on average	did not occur
Brisbane storages reaching minimum operating level	less than once in every 10,000 years on average	did not occur
Baroon Pocket Dam reaching minimum operating level	less than once in every 10,000 years on average	Once in every 12,333 on average
Gold Coast storages reaching minimum operating level	less than once in every 10,000 years on average	Once in every 110,987 on average
Average duration of medium level restrictions[1]	Less than or equal to 1 year on average	10 months on average

1 Average time KBWS remain below 50%

Table I-8 LOS compliance of current operating strategy and the drought response for individual off-grid communities

	Jimna	Linville	Somerset	Rathdowney	Kenilworth	Amity Point	Dunwich
LOS Yield (ML/annum)	20	35	40	80	180	200	500
Assessment method	Carting exceeds MDMM demand	Carting exceeds MDMM demand	Carting exceeds MDMM demand	Carting exceeds MDMM demand	Carting determines Average Day demand	Used the 2008 Groundwater Flow Model for North Stradbroke Island to assess impact with zero rainfall for 10 years, which demonstrated no supply issues for the three off-grid plants. Historical performance also indicates solid performance with no requirement for restrictions, hence restrictions will be grid based.	
Average supply capacity and determining factor	Entitlement of 20 ML/annum	Entitlement of 35 ML/annum	Entitlement of 40 ML/annum	Entitlement of 80 ML/annum	Entitlement of 220 ML/ annum	Entitlement of 200 ML/ annum	Entitlement of 500 ML/ annum
Frequency (Annual Recurrence Interval (ARI)) of restricted supply	as per grid	as per grid	as per grid	as per grid	as per grid	as per grid	as per grid
Average duration of restricted supply	as per grid	as per grid	as per grid	as per grid	as per grid	as per grid	as per grid
EMSV frequency (ARI)	as per grid	as per grid	as per grid	as per grid	as per grid	as per grid	as per grid
LOS determining factor	Entitlement	Entitlement	Entitlement	Entitlement	Average day demand carting capability (0.5 ML/day or 180 ML/ annum)	Entitlement	Entitlement

Communities									
	Point Lookout	Canungra	Kooralbyn	Dayboro	Esk	Boonah-Kalbar	Beaudesert	Kilcoy	Lowood
	750	170	450	270	380	1,000	2,500	1,400	12,700
	As per Amity Point and Dunwich Assessment Method.	10,000 year stochastic Goldsim model using daily demands and streamflow analysis	IQQM 10,000 year daily demand model shows that how water is extracted for Beaudesert and future Cedar Grove Weir will determine LOS characteristics	10,000 year stochastic Goldsim model using daily demands and streamflow/ groundwater analysis	Direct Supply from grid based storage	IQQM 10,000 year daily demand model	IQQM 10,000 year daily demand model	Direct Supply from grid based storage	Direct Supply from grid based storage
	Entitlement of 750 ML/ annum	Existing Entitlement 150 ML/ annum plus additional Entitlement from town water reserve equals 300 ML/annum	Entitlement of 450 ML/ annum	WTP (330 ML/ annum)	WTP (380 ML/ annum)	Entitlement of 1700 ML/ annum	Entitlement of 3165 ML/ annum	Entitlement of 1,520 ML/ annum	Proposed WTP (12,700 ML/ annum)
	as per grid	63	as per grid	63	as per grid	45	909 (grid)	as per grid	as per grid
	as per grid	as per grid	as per grid	as per grid	as per grid	< 12 months	< 12 months	as per grid	as per grid
	as per grid	10,000	as per grid	10,000	as per grid	10,000	10,000	as per grid	as per grid
	Entitlement	EMSV frequency	Entitlement	EMSV frequency	Current WTP capability	EMSV frequency	EMSV frequency	EMSV Carting capability (0.48 ML/day or 1,400 ML/ annum)	Proposed WTP capability

Appendix J: Drought risk

DROUGHT RISK PROFILE AND THE DESIGN DROUGHT

The choice of risk profile for the drought response measures considered to be applicable for a period of up to 10 years meets the LOS objectives and has been guided by:

- the compliance requirement that the Water Security Program should include a strategy for responding to a drought with a severity of at least 1:1,000 and consideration of a drought with a severity of 1:10,000
- the 10 year planning objective to avoid reaching the KBWS level of 5% at which EMSV restrictions will be introduced
- the experience and lessons learned from the Millennium Drought (including early planning and planning for a drought more severe than the worst on historical record).

Drought risk modelling was prepared in 2016 and updated in January 2017.

Modelled on a Millennium Drought drawdown with the drought response measures in place, the KBWS only drop to about 40% (Figure J-1).

The stochastic climate data consists of multiple inflows, rainfall and evaporation data sets possible within the bounds of the historical climate record but including droughts more severe than in this record. From these data sets the design drought was selected on the basis of the climate data that resulted in the minimum storage levels being reached over a 10 year period.

Using the design drought allows the drought response triggers and relevant actions to be more strategically considered. The modelling demonstrates that with these inflows and the drought response measures in place, the KBWS drop below 20% but do not reach 5% – the trigger for introduction of EMSV restrictions (See Figure J-1).

The regulated requirement is that the drought response measures should be able to withstand a drought with a severity of at least a one in 1,000 year occurrence and consideration should be given to a drought with a severity of a one in 10,000 year occurrence. Planning for the drought response approach is based on a very low risk profile as the design drought inflows are the worst in the stochastic climate data over a 10 year period and the chance of inflows similar to those of the design drought occurring is less than 1 in 100,000. The KBWS drawdown graph (Figure J-1) illustrates that the Design Drought is much worse than the Millennium Drought.

Using the design drought does not result in drought response measures that are more severe than are necessary, nor does it assume that this is the worst possible drought, more severe droughts could occur in the future. The design drought climate data was used in addition to the stochastic climate data which allows planning to be undertaken on the basis of probabilistic information.

SEQ REGIONAL DROUGHT RISK ASSESSMENT

The Regional Stochastic Model provides information on the statistics of operation of the bulk water supply system. This information is used to assess the levels of risk associated with drought occurring over the next 5, 10 and 20 years based on the existing system and its current operational strategy.

The level of risk posed by an event depends on the:

- likelihood of the event occurring and
- consequences of the event occurring.

The level of risk posed by drought to the bulk water supply system – and consequently the South East Queensland region – considering the current system capability, operating strategy and drought response approach, is assessed based on the following.

- Likelihood of a drought occurring as determined from the:
  - cumulative probability of reaching defined trigger levels
  - Millennium and design drought drawdowns
- Consequences for the community and water security implications of reaching defined trigger levels.

The risk level is assessed on a regional scale because region-wide drought response measures are triggered when the KBWS reach defined levels.

Modelling to ascertain the likelihood of a drought occurring, assumed the infrastructure capability as of 2016 and the drought response measures are implemented.

Table J-1 shows the cumulative probability of the KBWS reaching 60%, 50%, 40%, 25% and 20% over the next 20 years, assuming initial storage levels as of 24 June 2016 when the KBWS were at 83.1%. The probability of reaching the 60% trigger level over the next 10 years is quite high, however full GCDP production which commences at this trigger helps to reduce the probability of reaching 50% within 10 years to less than 10%. With medium level water restrictions being introduced at 50%, the probability of reaching 40% is less than 2% and there is an extremely low chance of the KBWS dropping to 25%.

Table J-1 Version 2 drought risk trigger cumulative probabilities*

Within (years)	Probability of reaching 60% KBWS	Probability of reaching 50% KBWS	Probability of reaching 40% KBWS	Probability of reaching 25% KBWS	Probability of reaching 20% KBWS
5	20%	4%	1%	<0.1%	<0.1%
10	35%	10%	2%	0.1%	<0.1%
15	50%	17%	5%	0.3%	0.1%
20	65%	27%	9%	0.5%	0.2%

** as at 5 January 2017*

Monitoring of storage levels against drought inflows illustrates that even though the cumulative probability of reaching drought response triggers may be low, preparations need to be in place as a drought can occur at any time resulting in the storages dropping to low levels.

Figure J-1 shows how the actual KBWS level is tracking against the drawdowns assuming either the Millennium Drought or design drought inflows starting with initial KBWS levels of 97.2% (22 June 2015). As the KBWS level is currently closer to that of the Millennium Drought drawdown, there is a very low chance that the KBWS would follow the design drought drawdown and reach levels close to 20% over the next 10 years.

SUB-REGIONAL DROUGHT RISK ASSESSMENT

An assessment of the sub-regional drought risk, as determined from comparisons between the regional and sub-regional risks and between sub-regions is provided below. The likelihood of the KBWS and the storages within each of the subregions reaching the defined trigger levels of 60%, 40% and 30% are used as a measure of the risk. These trigger levels have been selected only so comparisons can be made. Drought response actions are not necessarily instigated at these levels.

Information is provided for the following sub-regions and their storages:

- Southern – Gold Coast system storages of Hinze and Little Nerang dams
- Central – Brisbane system storages of Wivenhoe and Somerset dams
- Northern – Baroon Pocket dam

In Table J-2 to Table J-5 the cumulative probability of the KBWS and the sub-regions reaching 60%, 40% and 30% is compared. The probability of the Brisbane system storages and Baroon Pocket Dam reaching 60% over the next 10 years is high. For the Brisbane system storages this is likely to be due, in part, to the modelling assumption that these storages will remain temporarily lowered until January 2021 (as part of Seqwater's Dam Improvement Program). The probability of the sub-regional storages reaching 30% over 15 years is quite similar but Baroon Pocket Dam has a much higher probability of reaching 30% within 20 years. The Gold Coast system storages have the lowest probability of reaching all trigger levels over the 20 year period.

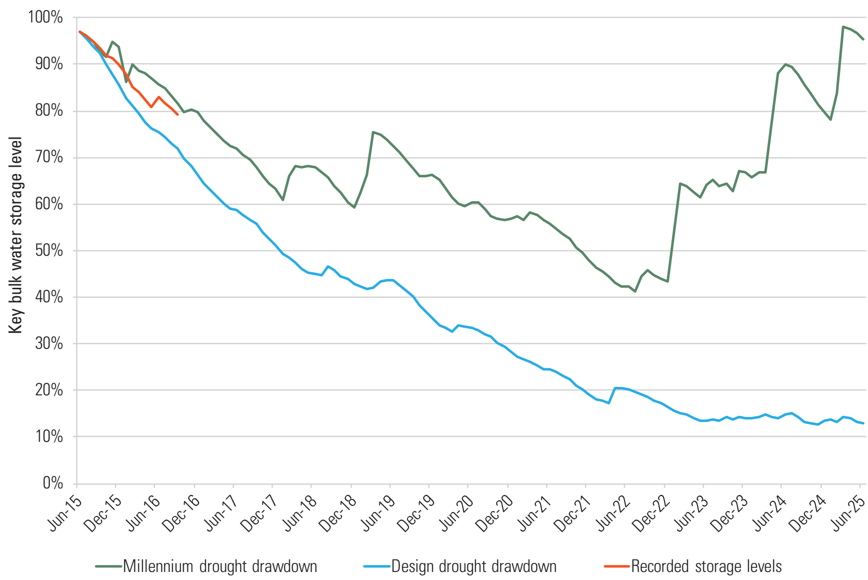


Figure J-1 Drought response drawdowns recorded and simulated with design and Millennium Drought inflows

Table J-2 Cumulative probability of the key bulk water storages reaching trigger levels*

Within (years)	Probability of reaching 60%	Probability of reaching 40%	Probability of reaching 30%
5	20%	0.6%	0.1%
10	35%	2.4%	0.26%
15	50%	4.7%	0.80%
20	65%	8.6%	1.61%

** as at 5 January 2017*

Table J-3 Cumulative probability of the Brisbane system storages reaching trigger levels*

Within (years)	Probability of reaching 60%	Probability of reaching 40%	Probability of reaching 30%
5	26%	1.0%	<0.1%
10	41%	3,8%	0.40%
15	56%	6.9%	1.20%
20	69%	12.3%	2.30%

** as at 5 January 2017*

Table J-4 Cumulative probability of the Gold Coast system storages reaching trigger levels*

Within (years)	Probability of reaching 60%	Probability of reaching 40%	Probability of reaching 30%
5	5%	0.2%	<0.1%
10	18%	1.0%	0.18%
15	38%	3.1%	0.80%
20	61%	9.2%	2.59%

** as at 5 January 2017*

Table J-5 Cumulative probability of Baroon Pocket Dam reaching trigger levels*

Within (years)	Probability of reaching 60%	Probability of reaching 40%	Probability of reaching 30%
5	60%	1.6%	<0.1%
10	71%	4.4%	0.47%
15	82%	10.5%	1.85%
20	90%	19.4%	4.40%

** as at 5 January 2017*

Appendix K: **Modelling summary**

MODELLING FRAMEWORK

The Water Security Program modelling framework provides guidance and a structure for the assessment of water security options and drought response planning, in order to meet the various objectives (LOS objectives and planning criteria) and assess other considerations and trade-offs.

The development of this version of the Water Security Program expanded on the extensive modelling completed for version 1, providing input to the following five components.

1. Demand forecasting and management component that identifies demand forecasts and assesses demand management options during normal operations and demand reductions from under restrictions – used as an input for the system operations, integrated planning and drought response components.
2. System operation component that identifies the optimal strategy to operate infrastructure (bulk supply point service specification) and determines when the current system and operational capacity is reached – used for consideration in the integrated planning and drought response components.
3. Drought response component that identifies triggers for new infrastructure needs, changes to system operation and demand management measures leading up to, during and exiting a drought.
4. Supply component that assesses the existing system capacity and contribution of new supply options including augmentations to existing assets – used as an input for the integrated planning and drought response components.
5. Integrated planning component that identifies water security option needs (new supply options, and augmentation of existing assets, and demand management options) including capacity, location and timing to determine investment needs – a set of options to meet water security objectives over the 30-year planning period.

Figure K-1 shows an overview of the modelling functions and corresponding information flows related to these five components.

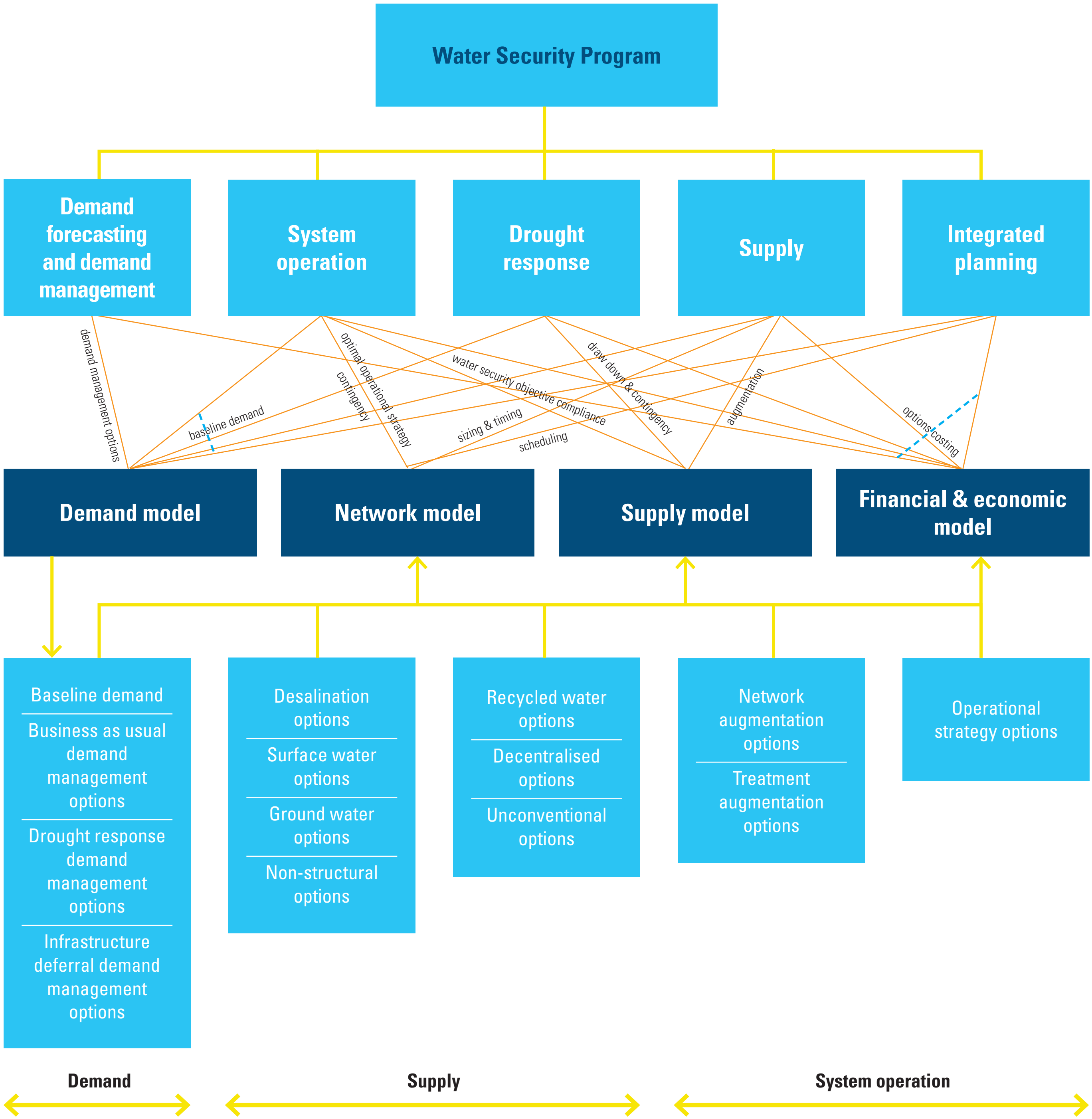


Figure K-1 Seqwater Water Security Program system modelling overview

Approach

The modelling framework was developed to provide information for options assessment and drought response planning. Considerations for the development of the modelling framework included:

- The ability to demonstrate compliance with the mandatory objectives of the Water Security Program for level of service (LOS) and planning criteria.
- The ability to compare how well the mandatory objectives are achieved with various operating strategies, infrastructure augmentation, demand management and supply options selected from the available options.

- The ability to determine the system performance and economic costs of options either singly or in combination, then use this information to assess the trade-offs. For example, better water security outcomes may be associated with higher costs. These trade-off outcomes need to be understood when assessing the value they provide to the community. Some option characteristics are assessed outside of the modelling framework because they are not monetised. Examples are environmental performance and impacts on people and place.

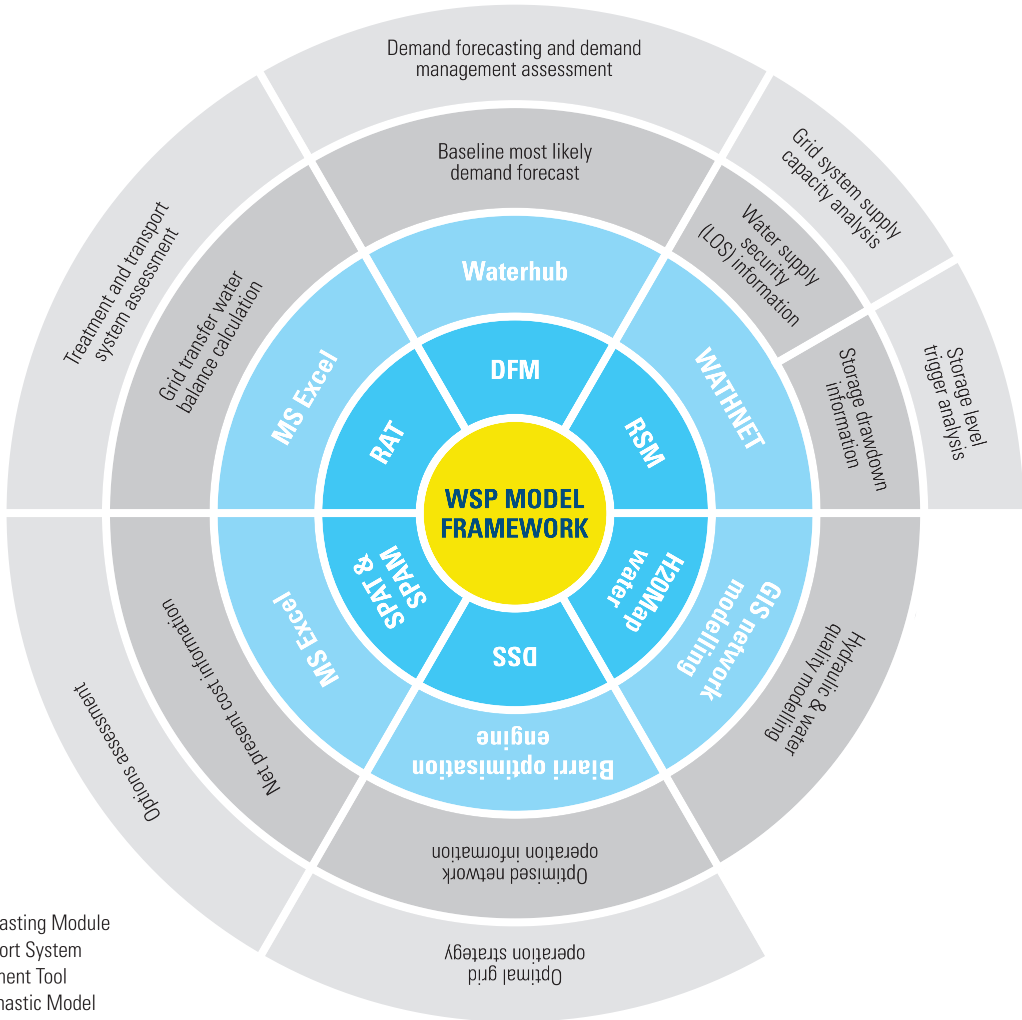
Seqwater has completed extensive modelling to develop the Water Security Program. The methodology adopted simulates the full water supply balance, network operation and economic efficiency and is complex and interactive. This approach provides a mechanism for continuous interaction with the decision-maker in the search for solutions that best meet the objectives.

The base system characteristics used for supply and network modelling, including LOS Yield Assessments, are as per Appendix D.

MODELLING TOOLS

Seqwater has used seven main models to complete the modelling assessments, as highlighted in Figure K-2 below. This figure presents layered rings showing each model name (e.g. DFM), the platform supporting the model (e.g. Waterhub), the model information generated and the outer ring shows what elements of the assessment the information was used to support.

The seven main models used for the completion of the modelling assessments, including their inputs and outputs, are outlined in Table K-1.



Acronym

DFM	Demand Forecasting Module
DSS	Decision Support System
RAT	Rapid Assessment Tool
RSM	Regional Stochastic Model
H20Map	H20Map Water
SPAT	Strategic Portfolio Assessment Tool
SPAM	Stochastic Portfolio Assessment Model

Figure K-2 Seqwater water security modelling framework

Table K-1 Summary of modelling tools

Model name	Main inputs	Main outputs
Demand Forecasting Model (DFM)	• Population projections • Future land use development information • Historical consumption information • Historical water treatment plant production information • Climatic information – historical and forecast rainfall data • Non-revenue water information • Historical season consumption patterns • Water demand management programs and policies	• Fit-for-purpose regional water demand forecasts • Climatic responsive monthly local government areas demand forecasts • Demand sensitivity and risk analysis comparative impact information • Mean day maximum month (MDMM) peak demand projections • Possible effective savings of demand management options
Regional Stochastic Model (RSM)	• Storage information (full supply capacity volume, dead volume and storage characteristic curves) • Climatic information (historical and stochastically generated storage inflow data) • Bulk supply system network characteristics (storage extraction capacities, water treatment plant capacities and bulk pipeline capacities) • Network operational rules (restriction trigger levels, manufactured water introduction rules, irrigator supply rules) • Storage levels • Demand forecast projection and seasonal patterns	• LOS yield information • Statistics of volumetric data (i.e. demand shortfalls, storage extractions and grid system transfer volumes) • Probabilities of reaching specified storage trigger levels • Predicted monthly storage volumes used to create future storage drawdown graphs
Decision Support System (DSS)	• Storage information as per RSM • Climatic information as per RSM • Bulk supply system network characteristics as per RSM • Demand forecast and seasonal patterns • Network operational rules as per RSM • MDMM peak demand forecasts • Operating costs of water treatment plants and pump stations	• Optimal grid operating strategy (cost and security outcome • Optimal water treatment plant production and bulk water transport pipeline flows to meet demand • Impacts of changes to available bulk supply network infrastructure
H2OMap – Network Model	• Bulk supply network characteristics as per RSM plus main local government supply mains and reservoirs • Storage information as per RSM • Demand forecast and diurnal consumption profiles	• Hydraulic and water quality data (i.e. reservoir tank water levels, pipe flow information (velocity and head loss), pump flow and head gain, system demand, node pressure and water age in the network)
Pricing Model	• Infrastructure and system operational cost information • Discrete optimal system operation under a given future investment pathway	• Discrete economic assessment information – long term bulk price impact • Financial sustainability
Strategic Portfolio Assessment Model (SPAM)	• Water security options cost information – capital, fixed and variable • Water security option implementation timing • Infrastructure volumetric and frequency of operation statistics as per RSM forecast run output • Supply shortfall information as per RSM forecast run output	• Comparative financial and economic assessment information – net present cost • Probabilistic distribution of costs representing the RSM sample set
Rapid Assessment Tool (RAT)	• Bulk water network demands distributed at a sub-regional level • All key water treatment and transport facilities maximum and minimum capabilities (aligned with the Seqwater asset capability statements) • Major facilities unitised variable operating costs ($/ML) • Additional or upgraded infrastructure in line with potential augmentation programs	• Information about minimum cost operating strategies based on whole-of-system operating modes • An overall schematic version of the operating modes in nominated 5-year planning intervals

Appendix L: **Scenario analysis**

OVERVIEW

The scenario analysis carried out for this version of the Water Security Program focused on testing how the two illustrative investment pathways respond to changes to the predominant influences of demand, climate change and operational changes to bulk water storage levels. The scenarios hold the underlying investment strategy static, assume the planned base case is implemented for all investment strategies, and demonstrates how the strategy would perform in meeting LOS requirements with regard to the applicable scenario.

Future versions of the Water Security Program will review a broader range of scenarios and sensitivities to better understand how the different investment strategies respond to changing conditions, including influences on demand and system operating strategies.

APPROACH TO SCENARIO ANALYSIS

Demand

Demand is influenced by many factors including:

- end-user behaviour
- population growth
- demographics and housing characteristics
- distribution
- adoption of water saving technologies
- agricultural land use
- energy demand and the energy supply mix (fossil fuel-based sources require more water to produce electricity than renewable based energy sources such as solar power)
- changes to industrial and commercial growth/activity
- broader economic factors (i.e. lower exchange rates may increase tourism in the region and thus water consumption).

The key demand influences assessed through the scenario analysis were per capita consumption of water and population growth. While the medium demand forecasts were incorporated into the base case analysis, high and low demand forecasts were used for testing investment strategies and the associated changes to system performance.

The high and low demand forecasts are based on differing assumptions regarding the per capita consumption of water and population growth, providing plausible upper and lower bounds respectively.

Climate change

Climate change affects both the quality and quantity of raw water available for use, particularly from surface water sources, in addition to demand for water driven by changes to temperature and evaporation. The timing, frequency and duration of extreme weather events can be influenced by climate change and may compel investment where additional resilience is required within the supply system. This impact can range from changes to the frequency of peak demand days, influencing supply, treatment and transport capacity requirements, through to increased rainfall and run-off, which influence the extent to which the system is required to treat either poorer quality water or source water from climate-resilient sources.

The potential impact of climate change on the water grid yield was tested by altering the evaporation and storage water inflow data used as input factors to the bulk water supply system yield model. The possible impacts of global warming were considered in water supply modelling using stochastic climate data adjusted to account for impacts expected to occur by either 2030 or 2045.The stepped approach undertaken is noted in Figure L-1.

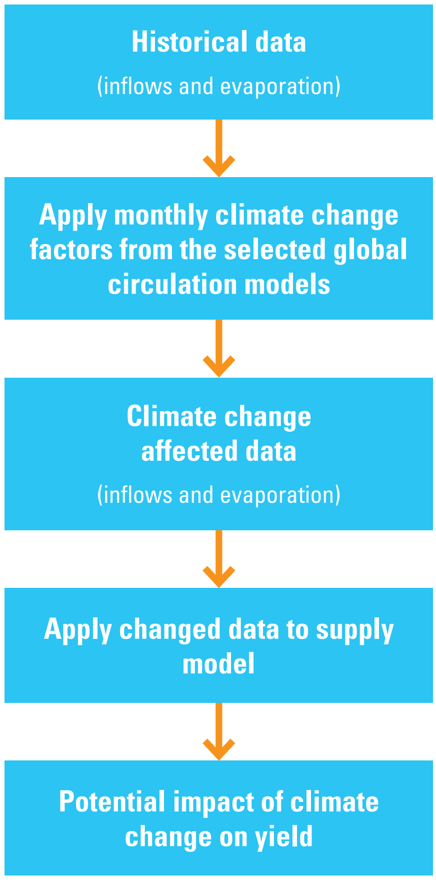


Figure L-1 Approach to estimate climate change impact

Lowering of key storage capacity

In the first quarter of 2016, water levels at the key storages of Somerset and Wivenhoe were lowered to 80% and 90% of their normal drinking water capacities respectively as part of Seqwater's Dam Improvement Program. Drinking water levels of the dams were temporarily lowered to allow us to manage the safety of both dams, while the detailed scope and design of improvements required at Somerset Dam is undertaken.

To demonstrate the potential impact of ongoing key bulk water storage level reductions through continual dam safety improvement programs, a scenario has been developed. It illustrates what is conceivably the lowest level of storage reduction at the key storages of Somerset and Wivenhoe (without substantially impacting water security).

This scenario involves:

- permanently lowering Somerset's full supply level to 80%; and
- permanently lowering Wivenhoe's full supply level to 70%.

Although only a hypothetical case, this scenario does effectively examine lost storage capacity in these dams and may be applicable to situations such as excessive sedimentation build up.

RESULTS

Scenario analysis

The LOS yield achieved at the end of each illustrative investment pathways is as follows:

- Illustrative investment pathway 1 – centralised: 575,000 ML/annum
- Illustrative investment pathway 2 – decentralised: 550,000 ML/annum

Each illustrative investment pathway incorporated the planned base case and was tested against the scenarios to determine the scenario's impact. The analysis demonstrated that, to achieve robustness against climate change and high demand, more climate-resilient sources would be required. For instance, the high demand/climate change scenario results in each investment pathway incurring an LOS failure at least one decade earlier than under the base case.

The results of the scenario analyses are summarised in Table L-1. Figure L-2 to Figure L-11 demonstrate the performance of each illustrative investment pathway.

Table L-1 Scenario analysis outcomes

Scenario		After implementation of Investment strategy 1		After implementation of Investment strategy 2	
	Earliest LOS augmentation* (for either Investment Strategy)	Year the LOS yield requires augmenting	Years differential to base scenario	Year the LOS yield requires augmenting	Years differential to base scenario
Base scenario	2040	2054	-	2054	-
Low demand	2055	>2056	At least + 2 years	>2056	At least + 2 years
High demand	2032	2039	-15	2038	-16
Climate change	2033	2044	-10	2045	-9
High demand and climate change	2029	2034	-20	2032	-22
Somerset and Wivenhoe temporary lowering	2040	2045	-9	2045	-9

** The earlies LOS augmentation date after the planned base case has been implemented*

LOS assessment results – investment strategy 1

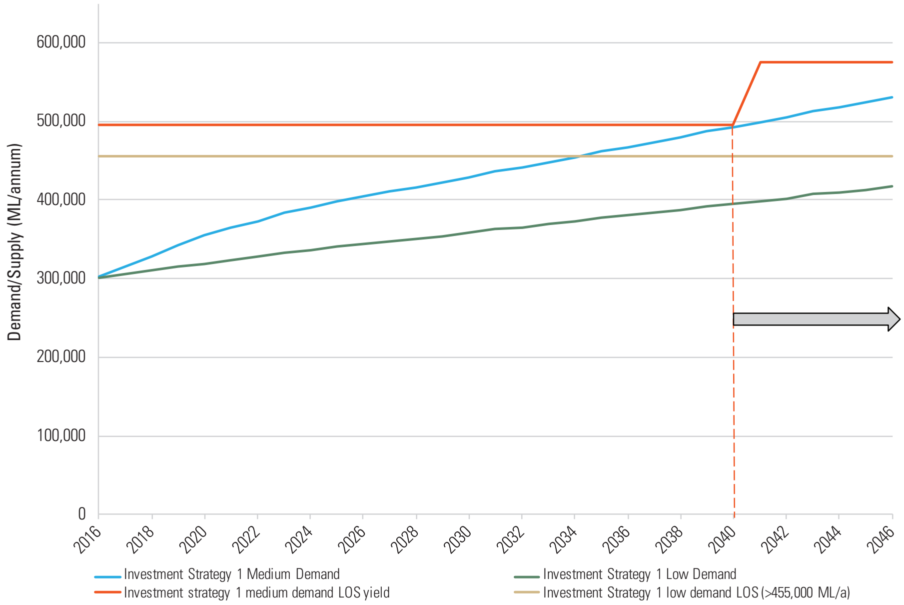


Figure L-2 Investment strategy 1 – low demand scenario supply/demand balance

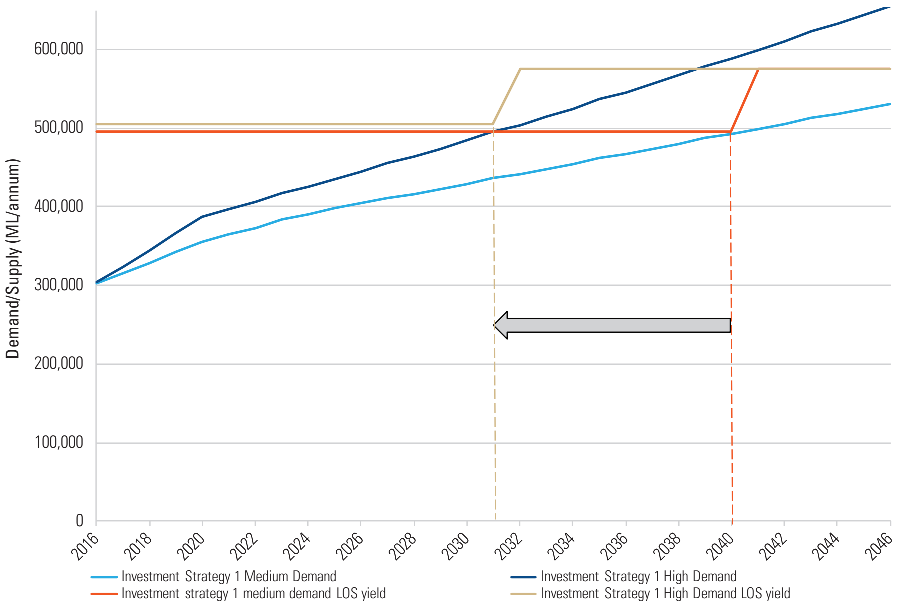


Figure L-3 Investment strategy 1 – high demand scenario supply/demand balance

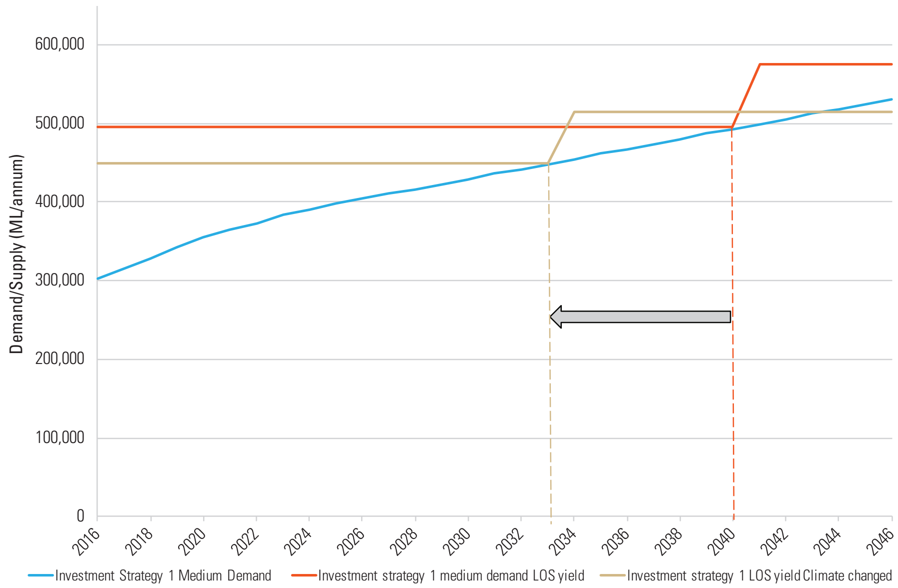


Figure L-4 Investment strategy 1 – climate change scenario supply/demand balance

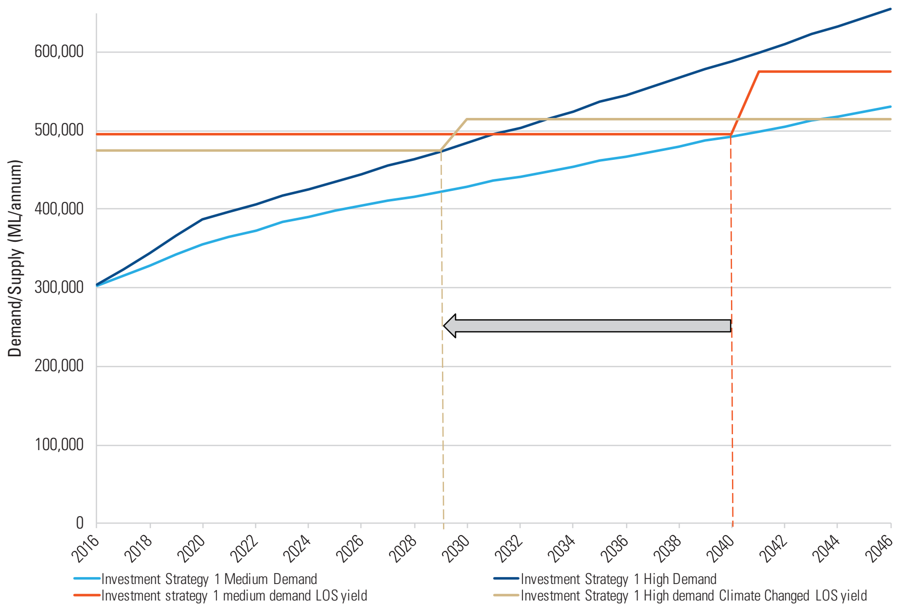


Figure L-5 Investment strategy 1 – high demand and climate change scenario supply/demand balance

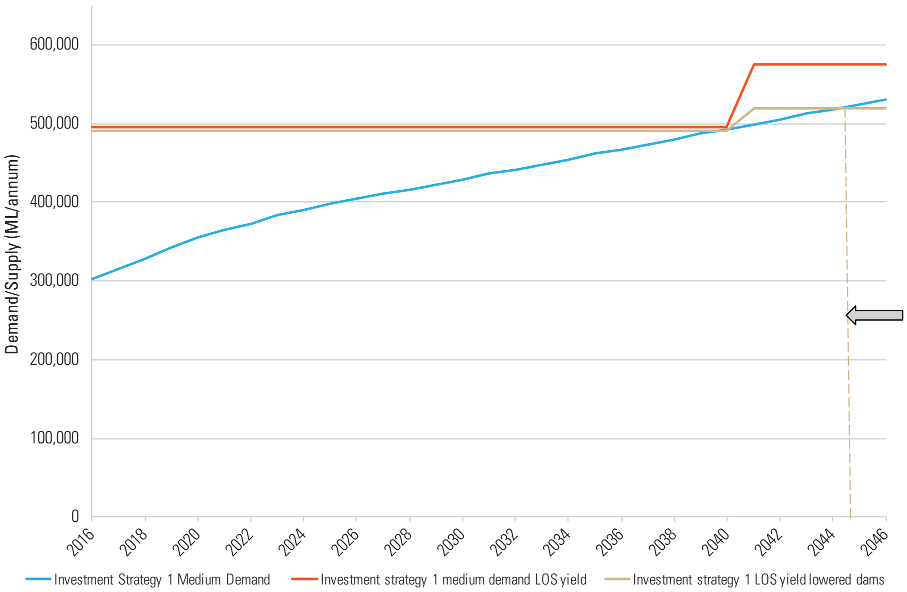


Figure L-6 Investment strategy 1 – permanent Somerset and Wivenhoe dam lowering scenario supply/demand balance

LOS assessment results – investment strategy 2

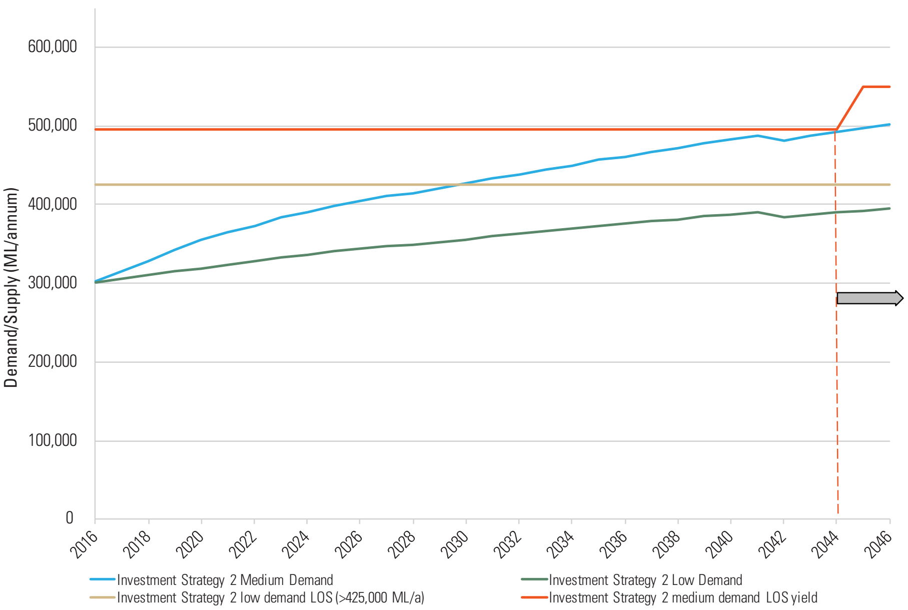


Figure L-7 Investment strategy 2 – low demand scenario supply/demand balance

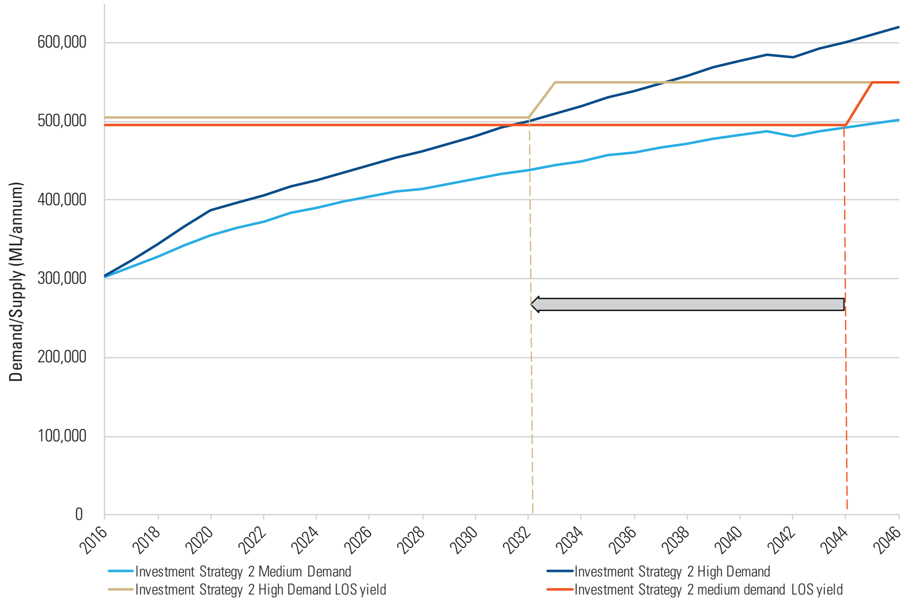


Figure L-8 Investment strategy 2 – high demand scenario supply/demand balance

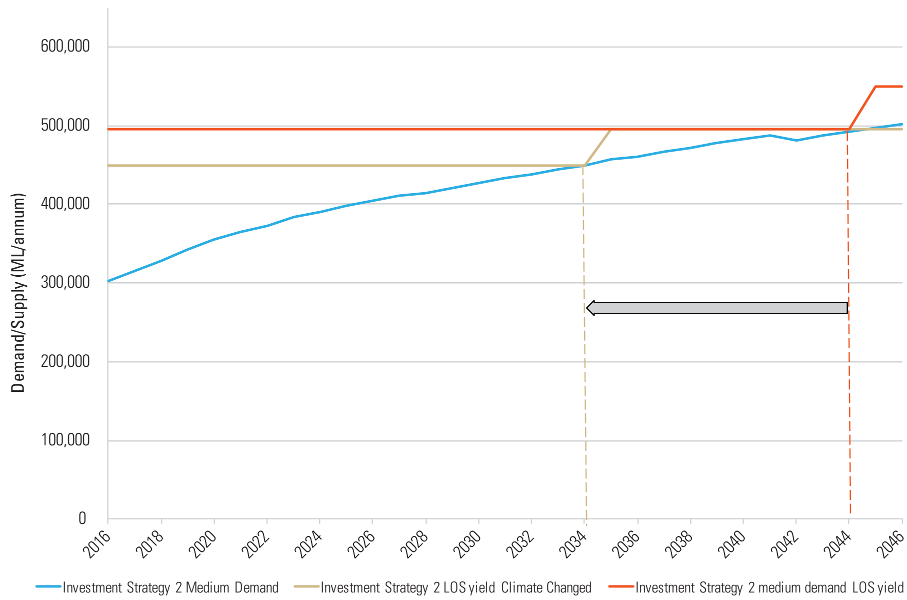


Figure L-9 Investment strategy 2 – climate changed scenario supply/demand balance

Future Scenario analysis

Version 3 of the Water Security Program may consider inclusion of a much broader range of changes to influences in the development of scenarios, testing all supply, demand and system operation levers. Considerations may include factors such as changing catchment conditions, broader ranges of impacts from climate change, changing technology, the degree of decentralisation, and the degree of integration of planning with other government agencies and sectors.

Future versions will also consider the impact of major system shocks, such as failure of a major Water Treatment Plant or Dam. This will inform the planning for a more resilient water supply for South East Queensland.

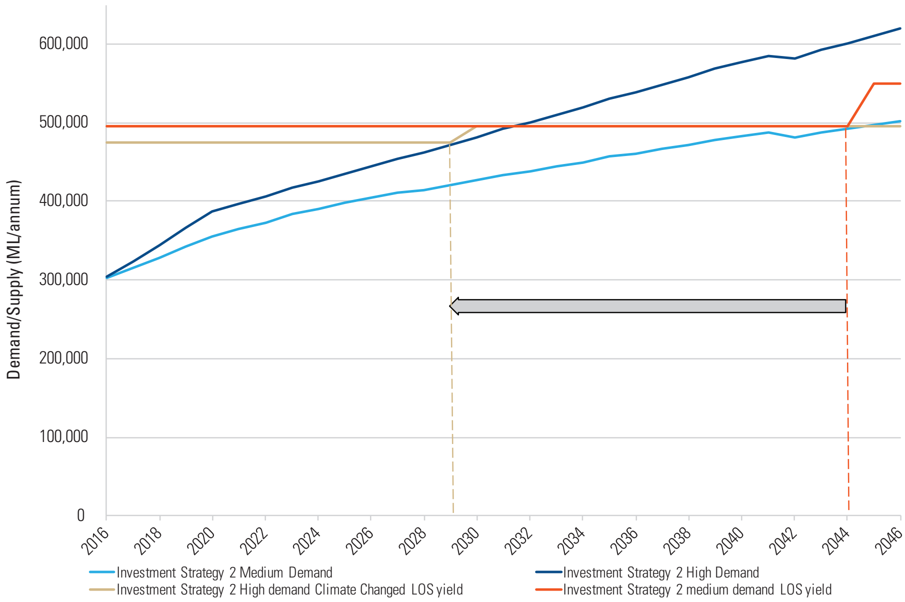


Figure L-10 Investment strategy 2 – high demand and climate changed scenario supply/demand balance

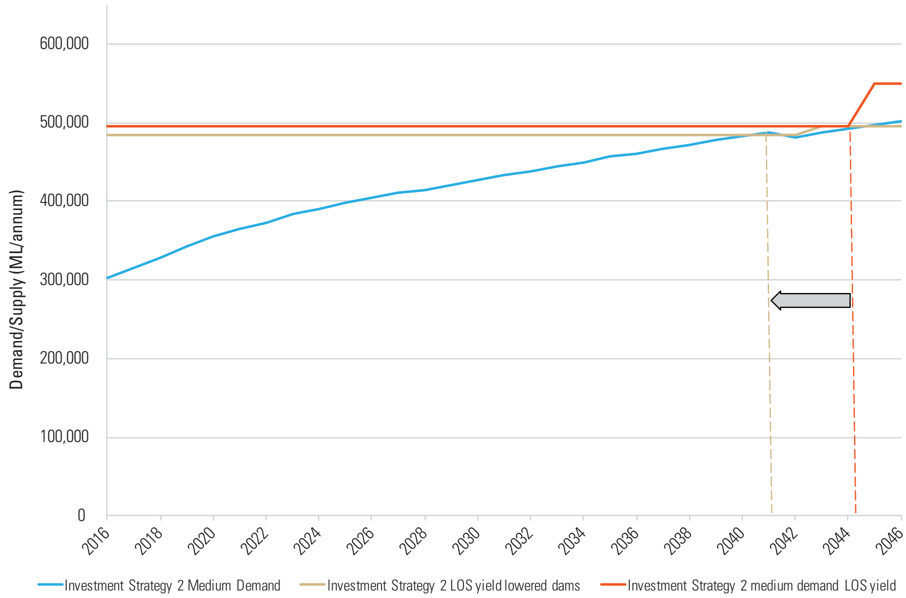


Figure L-11 Investment strategy 2 – Somerset and Wivenhoe lowering scenario supply/demand balance

Appendix M: Options assessment methodology

OVERVIEW

The investment pathway formation methodology for this version of the Water Security Program, was designed with the constraints of time, information availability and current Seqwater modelling capability in mind. A multi-criteria decision analysis (MCDA) approach was employed to develop the options assessment method. This approach provides a structured means of incorporating quantitative and qualitative impacts.

The investment pathway formation process, shown in Figure M-1, is iterative. It provides a step by step approach to building up the investment pathway for the investment strategy and established failure type.

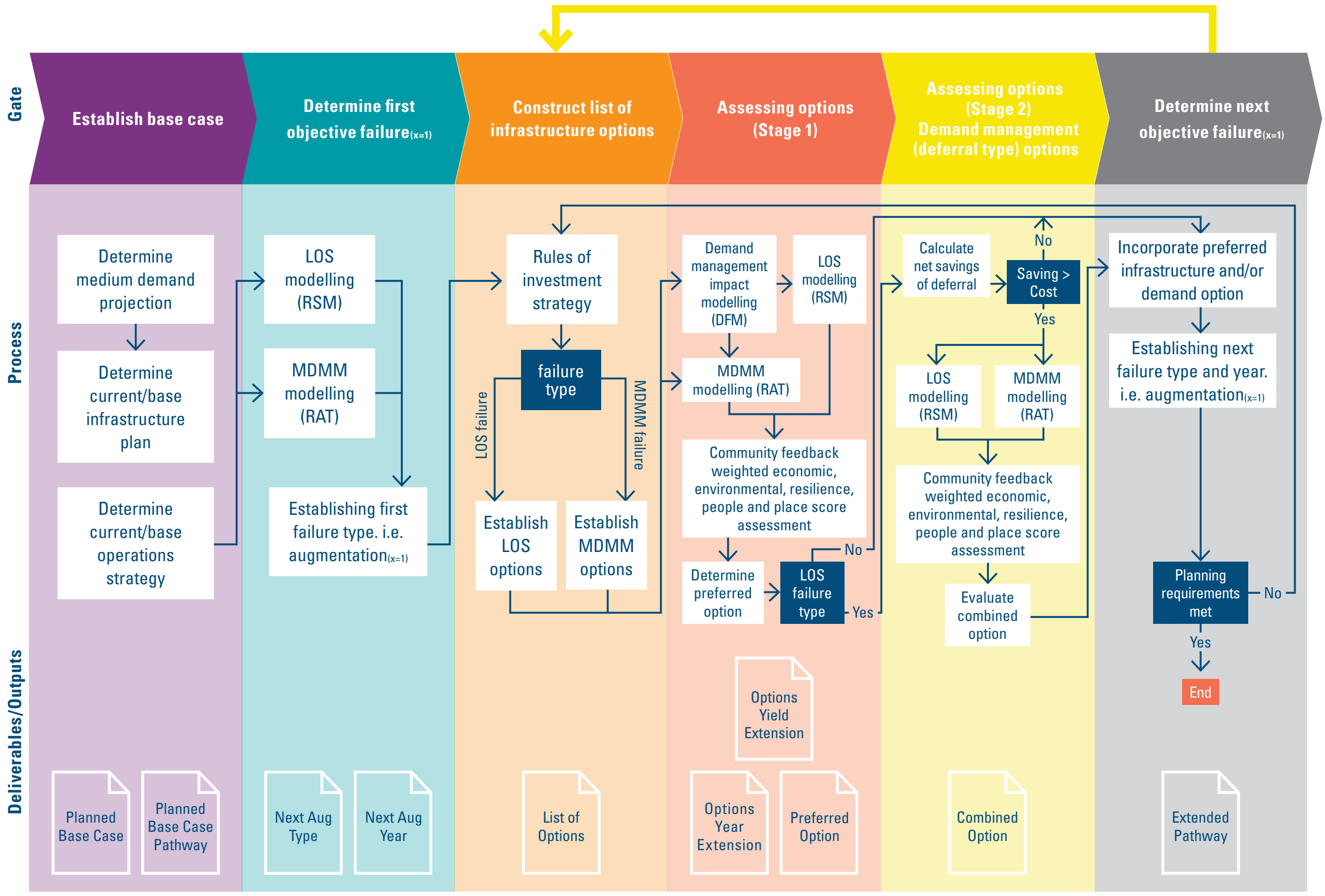


Figure M-1 Option assessment methodology process overview

The process consisted of the following six gates:

Gate 1 – Establishing base case

Using the medium demand forecast, the current base infrastructure and base operation strategy is determined, establishing the planned base case pathway.

Gate 2 – Determining first objectives failure

An LOS and a peak demand model run are then completed using planned base case infrastructure. The modelling results determine the type and timing of the first system failure (peak demand or LOS).

Gate 3 – Constructing a list of infrastructure options

A list of options for solutions to this failure is collated based on the rules of the investment strategy and the established failure type.

Due to current modelling limitations in establishing the peak demand impact from options to defer infrastructure, these options were not included in the options list for peak demand failures.

Gate 4 – Assessing options (Stage 1)

LOS and peak demand model runs are completed for each of the options. An economic score, environmental score, people and place score and resilience score are derived for each of the options. The options were scored by Seqwater for each consideration against a qualitative scoring matrix. Weightings based on community feedback were applied to the scores.

The option with the highest total score is considered to be the preferable option for selection.

Gate 5 – Assessing options to defer infrastructure (Stage 2)

When assessing options to defer infrastructure an economic score cannot necessarily be derived as there may be no actual LOS benefit as the option's design purpose is simply to push out the timing of the next objective's failure. The LOS yield is based on the long-term contribution to supply. If infrastructure for LOS augmentation is still required during the assessment period, there will be no change to LOS yield. Therefore an alternative assessment approach is adopted for this type of option.

Options to defer LOS driven infrastructure are assessed using a two-step process.

1. Use the existing process to assess the most favourable infrastructure option available.
2. Assess whether there is benefit in deferring this infrastructure option by employing an option to defer infrastructure first.

   This is done by calculating the net savings generated from deferring the infrastructure (by investing in the demand management options to defer infrastructure). The levelised cost is calculated based on the infrastructure cost per ML per year. If the cost of the demand management option is less than the savings generated (from deferring the infrastructure) then the economic, people and place, environmental and resilience scores for this combined option are derived and compared with the infrastructure only option. The result of the cost/benefit comparison determines if the demand management option will form part of the option combination for the given investment pathway, at the given system failure point.

Gate 6 – Determine next objectives failure

At Gate 6 the preferred option (or combination of options) that successfully passed Gate 5 is incorporated into underlying infrastructure planning and supply/demand balance modelling, expanding the investment pathway.

If the updated investment pathway addresses all system requirements (peak demand and LOS), at the end of the 30-year horizon, the investment pathway formation process is complete.

If the updated investment pathway is unable to address all system requirements, the established next system failure, failure type and timing, is then used as inputs back into gate 3 where the pathway formation process is repeated until the investment pathway fully addresses all system requirements.

Scenario analysis is then undertaken for each of the pathways to test the resilience of each pathway to shocks and trends, identifying triggers for implementation and review.

Appendix N: **Off-grid community fact sheets**

BEAUDESERT OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Beaudesert off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

Beaudesert is a town in the Scenic Rim region, located on the Mt Lindesay Highway, approximately 90 kilometres south of Brisbane. The town supports timber, cattle and dairy industries and, as recorded by the 2011 Census, a population of 6,000. Figure N-1 provides regional context on the location of the Beaudesert township and its water supply service area.

The township of Beaudesert is supplied with treated water from the Beaudesert water supply scheme. The scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for Beaudesert is sourced from the Logan River. The Logan River water supply scheme supplements the amount of water available to Beaudesert with infrastructure such as Maroon Dam and weirs along the Logan River. The Logan River also supports irrigation and other urban water uses and its catchment forms an important aspect of the drinking water supply chain. The characteristics of the catchment impacts raw water quality, which affects the ability of treatment assets to meet quality and capacity requirements.

Activities in the catchment that influence raw water quality include the level of degradation of the natural ecosystem, cattle grazing, intensive agriculture such as dairy and poultry production as well as horse industries. Other land uses in the area include urban developments, lifestyle blocks, industry and regional transport corridors. Natural areas in the catchment include the National Parks of Mt Tamborine, Mt Barney, Moogerah Peaks, Main Range and Lamington Plateau and numerous council-owned reserves and conservation areas.

Seqwater holds a high priority water entitlement of 3,165 ML in the Logan River water supply scheme that is used to supply Beaudesert with drinking water. A strategic reserve of 37,000 ML is also held in this water supply scheme for urban water supply purposes.

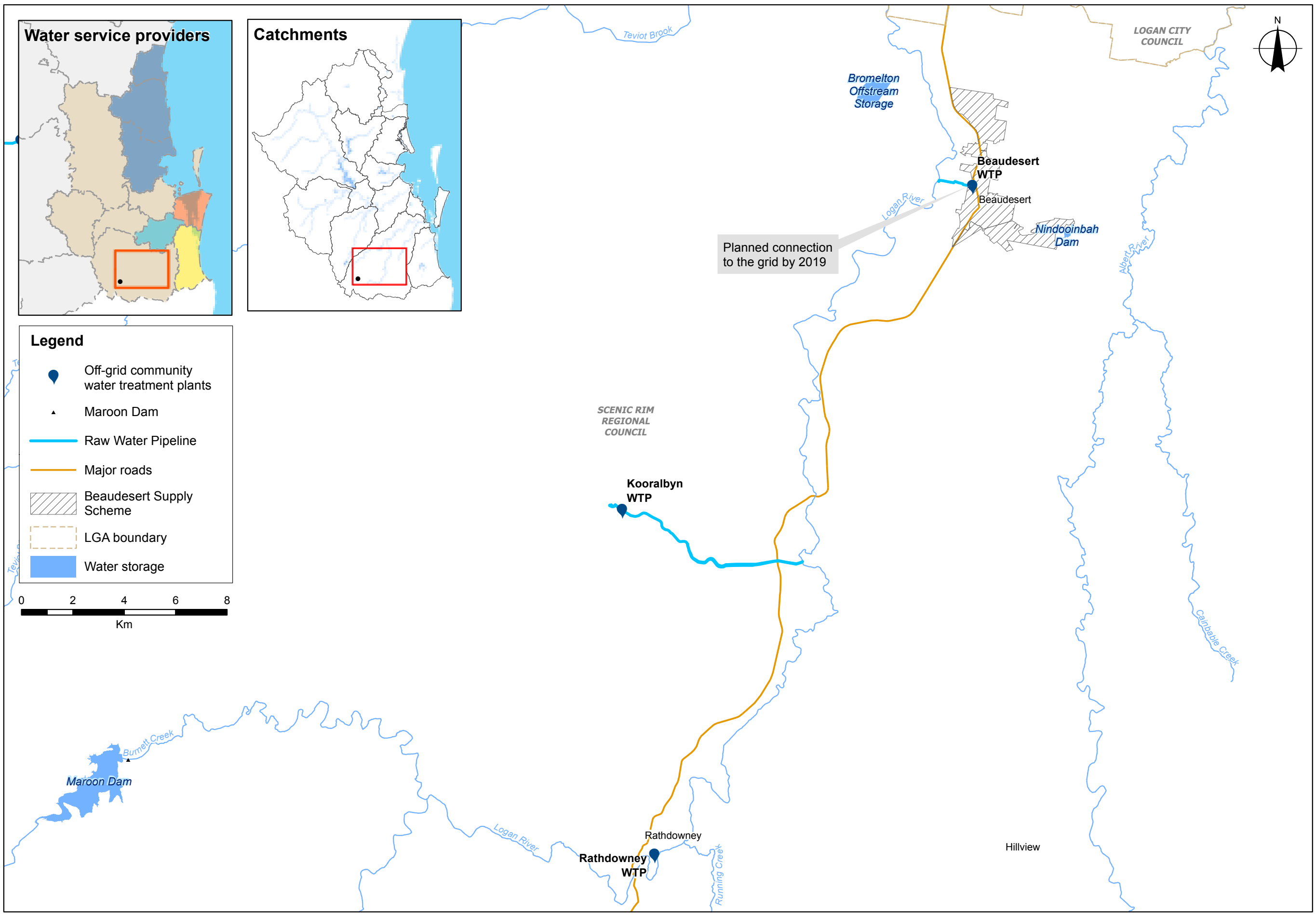


Figure N-1 Beaudesert water supply scheme

Raw water is released from Maroon Dam into the Logan River system to provide for environmental flows, irrigation, industrial activities and for urban water supply to the Rathdowney, Kooralbyn, and Beaudesert off-grid communities. The quality of the raw water at Beaudesert varies depending on weather conditions such as drought or rain.

Raw water sourced from the Logan River at Beaudesert weir is treated to meet drinking water quality standards at Seqwater's local Beaudesert WTP. The bulk treated water produced at the plant is supplied to Queensland Urban Utilities (QUU) who own and operate the distribution network. QUU are responsible for the retail and distribution of water to the end water users.

Expected demand growth in Beaudesert will mean the existing system will not meet the LOS objectives in approximately 2032. Before then, an upgrade will be required to enable the scheme to supply the community's peak demand. Detailed planning to secure supply for this community is currently underway and the assumed outcome is a connection to the South East Queensland Water Grid. When this occurs, Beaudesert will no longer be an off-grid community. Any alternative to a grid connection will need to meet the LOS objectives to be considered viable.

A number of options for connecting Beaudesert to the water grid have been identified by Seqwater, QUU and Logan City Council. These options are currently being assessed to determine option costs and other benefits for end water users. The decision on the preferred option is expected to be made in 2017 using an assessment process in line with the options assessment framework. The implementation program will depend on the selected option but is likely to commence in 2018.

Table N-1 provides a summary of the government authorities and water service providers associated with the Beaudesert supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-1 Summary – Local government, service providers and bulk supply description

Beaudesert off-grid water supply	
Local government	Scenic Rim Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Beaudesert WTP is sourced from the Logan River.
Water entitlement	The entitlement associated with the supply to the Beaudesert township is 3,165 ML/annum.
Water treatment plant	Beaudesert WTP with an existing capacity of 3.5 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Beaudesert water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed until Beaudesert is connected to the water grid. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day demand (AD) and peak demand (MDMM) for the Beaudesert water supply scheme to 2046. The current average demand for Beaudesert is 690 ML/annum or an average of 1.9 ML/day. By 2046 it is expected that demand will increase to approximately 5,000 ML/annum or an average of 14 ML/day. The peak demand in 2046 is expected to be as high as 20 ML/day.

The demand will fluctuate over time due to many factors, including end use customer behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-2 shows Beaudesert's AD and MDMM demand for the next 30 years. From 2016 until 2046, population and water demand in Beaudesert is expected to increase in the order of seven-fold. This forecast is partially due to the upcoming industrial development within the Bromelton State Development Area, including a rail project connecting Bromelton to the Port of Brisbane and other areas.

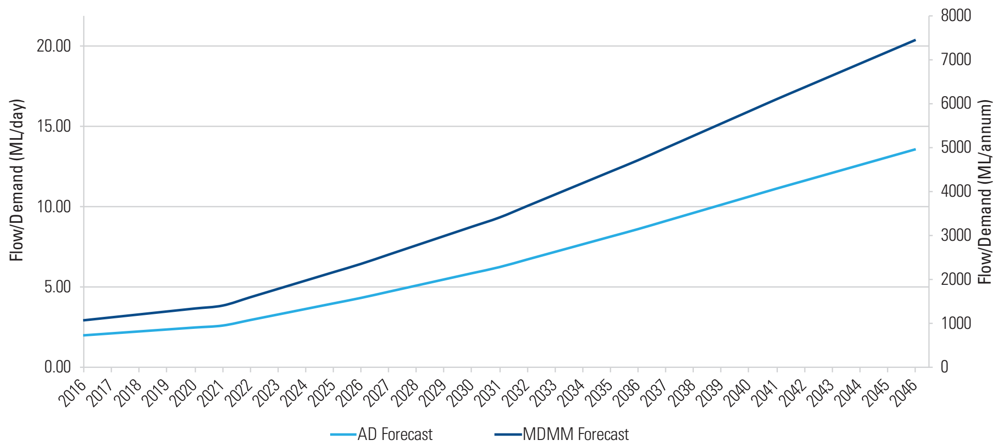


Figure N-2 Beaudesert Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For Beaudesert, the demand management options considered in the determination of the LOS performance are outlined in the Beaudesert drought response plan at the end of this fact sheet.

Supply

Supply is the primary lever used to determine LOS yield for the Beaudesert water supply scheme. Bulk supply options have been considered along with the capacity of water treatment infrastructure to effectively treat the required peak demands until 2019 when Beaudesert will be connected to the water grid.

Supply source

The supply source for Beaudesert is the Logan River. This raw water source is subject to a regulatory restriction in the form of a water entitlement equivalent to 3,165 ML/annum. The Beaudesert water supply system has an LOS yield of 2,500 ML/annum which has been determined by modelling the performance of the system using historical Logan River flows at Beaudesert as a model input. This assessment indicates that the regulated water entitlement is greater than the actual capacity of the system at the required LOS.

The assessed LOS yield of 2,500 ML/annum, however, exceeds the forecast average day demand until 2032 – sufficient to meet Beaudesert's needs until connected to the water grid in 2019. Beyond that, supply from the grid will be sufficient to meet LOS objectives for Beaudesert.

The LOS yield and annual demand forecast is summarised in Figure N-3.

LOS objectives also require contingency supply planning for a 1:10,000 year drought event. During a drought of this severity, Maroon Dam will be unable to maintain supply to Beaudesert. Contingent supply could consist of a pipeline from the water grid with capacity to supply the EMSV. This is estimated to be 2 ML/day. Contingency supply planning would be triggered when Maroon Dam reaches 10,000 ML (or 25% capacity), to allow for an 18 month construction period which is the minimum time required for implementing the pipeline.

Due to the size of the Beaudesert community, water carting from an alternative source is not a feasible alternative.

Water pumped from the Beaudesert weir is treated at the Beaudesert WTP at Helen Street, Beaudesert. This arrangement will continue until the Beaudesert supply area is connected to the water grid.

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-4 shows the 20 hour capacity of the current WTP and the peak demand up to 2019.

The existing rated capacity of the Beaudesert WTP is approximately 2.9 ML/day based on 20 hours of operation, or 3.5 ML/day based on 24 hour operation. The peak capacity achievable when raw water quality conditions permit is 4.0 ML/day over a 24 hour period.

Peak demand is expected to exceed the 24 hour production capacity of the WTP by approximately 2019. MDMM demand in 2019 is expected to be in the order of 3.53 ML/day. A connection to the grid is planned for completion in 2019. While a peak demand event is not something that occurs every summer, the following additional operational measures may be required to assist the local WTP before connection to the grid is complete.

- Maximising water supply network storage across Seqwater and QUU treated water reservoirs, as network storage can dampen peak demands on the WTP.
- Incorporating water carting during peak demand events to provide up to 0.5 ML/day to supplement supply from the Beaudesert WTP.

Further investigation, in conjunction with QUU, will be required to establish the feasibility of any operational measures.

Connection of the Beaudesert reservoir to the water grid will provide adequate capacity to meet peak demand to 2046.

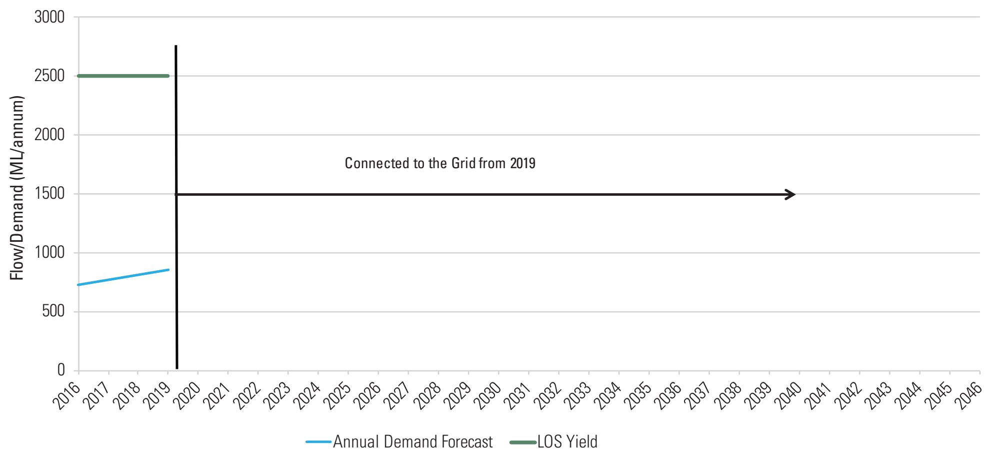


Figure N-3 Beaudesert annual demand forecast and LOS yield

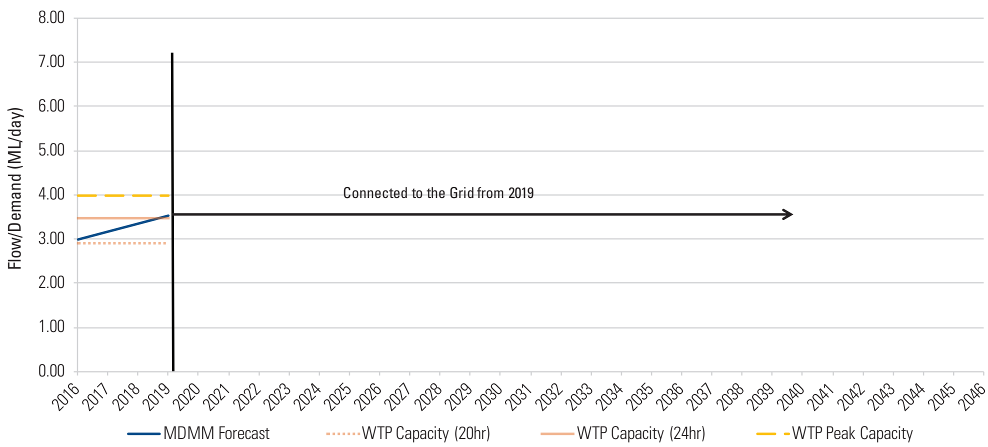


Figure N-4 Beaudesert peak demand (MDMM) forecast and treatment capacity

System operation

The system operation options available to supply water to Beaudesert include the following.

- Normal operation – Until 2019, the normal operation of this scheme is to extract water from the Logan River water supply scheme and treat it at the Beaudesert WTP. Assuming Beaudesert is connected to the water grid in 2019, it will cease to be an off-grid community. Water will then be supplied via the water grid and Beaudesert demand will be considered part of the grid-connected LOS and MDMM planning.
- Emergency operation – Until Beaudesert is connected to the grid, the plan to supply the Essential Minimum Supply Volume (EMSV) to the community will involve a contingent pipeline from the grid, sized to supply the EMSV. This plan ensures LOS objectives can be met until Beaudesert is connected to the grid. After grid connection, drought response actions will be taken in accordance with the South East Queensland drought response plan.

The trigger to initiate planning and construction of the contingency pipeline will be driven by the ability to supply the community with potable water. For drought conditions this should commence when Maroon Dam storage levels reach 10,000 ML or 25%, and will provide a minimum 18-month planning and construction period.

Beaudesert water future

Table N-2 provides a summary of the three levers and how they will be managed to meet the LOS objectives for Beaudesert.

Table N-2 Demand, System Operations and Supply Lever Summary

Levers – demand, system operation and supply	
Demand	Demand is forecast to grow by 580% from 730 ML/annum to 4,900 ML/annum by 2046. The demand lever options for the Beaudesert off-grid community include all measures outlined within the Beaudesert drought response plan.
System Operations	The system operation options available to supply water to Beaudesert include: • Normal operation – Extraction from the Logan River and treatment at the local Beaudesert WTP. This will remain the normal scheme operation to 2019. The water entitlement associated with extraction from the Logan River is equivalent to 3,165 ML/annum. • Emergency operation – A contingent pipeline to address EMSV needs from the water grid may be required if EMSV conditions become evident before 2019. When Maroon Dam reaches 25% the planning and implementation of the EMSV pipeline would commence. This allows 18 months for implementation.
Supply	The LOS yield that can be achieved has been determined to be equivalent to 2,500 ML/annum, based on modelling of historical Logan River flows at Beaudesert. The existing Logan River supply will remain the dominant supply for the Beaudesert off-grid community out to 2019. In 2019, Beaudesert will be connected to the water grid and will no longer be an off-grid community. This will ensure water security beyond 2046 in line with the performance of the water grid.

Seqwater will monitor influences and trends in demand and supply which may adjust the timing of Beaudesert's connection to the water grid. The reassessment of the Beaudesert off-grid community's water security will be based on one of the following:

- A trigger for review based on Maroon Dam storage levels reaching 10,000 ML or 25%, to provide for a minimum 18-month construction period for contingency supplies.
- A trigger for review based on Average Day demand exceeding 2.3 ML/day (equivalent to Mean Day Maximum Month demand of 3.5 ML/day). This will provide a minimum of two years to accelerate the delivery of the pipeline connection.

BEAUDESERT DROUGHT RESPONSE – PLAN ON A PAGE

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	50% capacity Maroon Dam	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	25% capacity Maroon Dam	160 L/p/day residential	Implement communications plan, leak detection and repair	As per level 1 (S & QUU)
3. Voluntary conservation, restriction of standpipe and carting of water	15% capacity Maroon Dam	150 L/p/day residential	Standpipe restriction, communications plan and carting of water to supplement supply	As per level 1 but monitor daily (S & QUU)
4. Voluntary conservation, restrictions and the appropriate regulatory measures	10% capacity Maroon Dam	140 L/p/day residential	Impose water restrictions, communications plan, restrictions at standpipe	As per level 3 (S & QUU)
4a	7.5% capacity Maroon Dam	130 L/p/day residential	Impose further water restrictions, continue level 4 actions with increasing communications	As per level 4 (S & QUU)
Emergency Response	5% capacity Maroon Dam	Maximum reduction (100 L/p/day residential and non-residential combined)	Implement EMSV plans	As per level 4 (S & QUU) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Water supply level of a preceding drought response level and removal of the action is operationally appropriate	Maintain the target of the level implemented	Remove appropriate drought response actions	As per level 4 (S & QUU)
Complete drought exit	60% capacity Maroon Dam	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Contact Seqwater emergency response hotline (3270 4040) to close out incident as per ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	Advise Scenic Rim Regional Council (SRRC) and other major customers of the supply status (QUU)		Nil	Update DRP contact list and review actions (S)
	• As per level 1 (S & QUU) • Commence low level public communications (QUU)	Monitor standpipe use (QUU)	Nil	• Communications planning (QUU) • Make necessary arrangements for water carters to cart water to Beaudesert (S)
	• As per level 2 (S & QUU) • Increased communications (QUU)	Standpipe restriction (QUU)	Commence water carting (S)	• Communications planning (QUU) • Obtain approval to impose water restrictions schedule (QUU)
	As per level 3 (S & QUU)	• Standpipe restrictions (QUU) • Impose water restrictions on customers (QUU)	Continue water carting to supplement supply (S)	**Emergency response** • Communications planning (QUU) • Determine and prepare for emergency response (S&QUU) **Drought exit** • Communications planning (QUU)
	As per level 4 with increasing intensity (S & QUU)	• Increased water restrictions on customers (QUU) • Increased standpipe restrictions in line with community restrictions (QUU)	As per level 4 with increasing intensity (S & QUU)	As per level 4 with increasing intensity (S & QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain and possibly increase severity of water restrictions (QUU)	Implement appropriate EMSV plans (S&QUU)	Continue emergency response planning (S&QUU)
	As per level 4 (S & QUU)	• Standpipe remains restricted (QUU) • Retain restrictions (QUU)	As per level implemented (S&QUU)	**Emergency response** • Continue emergency response planning (S&QUU) **Drought exit/re-entry to other levels** • Communications planning (QUU)
	• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	• Re-open standpipe (QUU) • Revoke water restrictions (QUU)	**Water source** • Cease carting water (S)	• Review and debrief (S&QUU) • Update the Beaudesert Disruption Plan (S)

BOONAH-KALBAR OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Boonah-Kalbar off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

The Boonah-Kalbar water supply scheme services the rural townships of Kalbar, Boonah, Aratula and Mt Alford, which are all located within the Scenic Rim Regional Council area. The region's primary industries are agriculture and tourism. Boonah is the largest of the townships and is located in the Fassifern Valley, approximately 85km south-west of Brisbane.

The water treatment plant is located near Kalbar, a smaller neighbouring township in the Valley located near the Cunningham Highway, directly north of Mt French.

Figure N-5 shows the location of Boonah, Kalbar and neighbouring townships.

Water supply scheme

The Boonah-Kalbar water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for the scheme is sourced from Reynolds Creek within the Bremer River Catchment. The bulk raw water infrastructure of the Warrill Valley water supply scheme supplements the amount of water available to Boonah-Kalbar though infrastructure such as Moogerah Dam and weirs in the scheme. The Warrill Valley water supply scheme also supports irrigation uses in the area.

The catchment forms an important aspect of the drinking water supply chain. The characteristics of the catchment impacts raw water quality, which affects the ability of treatment assets to meet quality and capacity requirements. Activities in the catchment influencing the water quality include flood plain clearing for grazing and farming. This clearing, coupled with increased grazing pressure has caused loss of the riparian buffer zone and degradation along sections of Coulson Creek, Sandy Creek, the Upper and Lower Reynolds Creek and their associated tributaries.

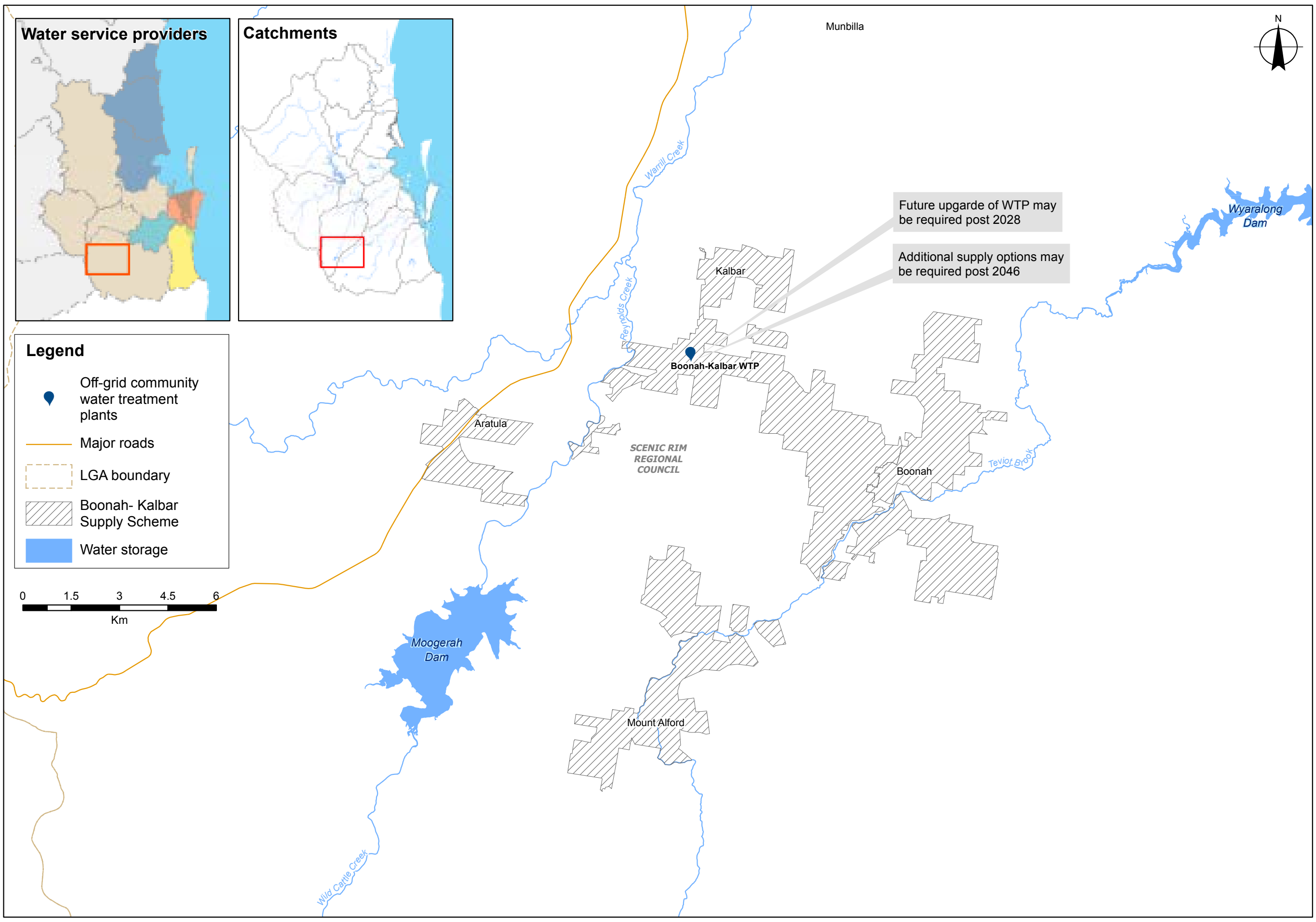


Figure N-5 Boonah-Kalbar water supply scheme

There is a high fire risk on the forested hills around Lake Moogerah and its tributaries. Fire can impact both raw water quality and the amount of water run-off into storages, impacting on yield. Rainfall events drive nutrient, sediment and pathogen runoff into the lake, which in turn contributes to algal blooms during the warmer months. There are also several onsite waste water systems and cattle grazing in close proximity to Lake Moogerah which can impact on raw water quality. The quality of the raw water from Moogerah Dam and Reynolds Creek varies depending on weather conditions such as drought or rain.

Due to the size of the community, carting of water in the event of any local source issues affecting water supply to Boonah-Kalbar is currently not possible. Therefore, water carting alone is not sufficient to address LOS objectives, but may assist to supplement existing sources.

Raw water from the Warrill Valley water supply scheme is taken from Reynolds Creek and treated to meet drinking water quality standards at Seqwater's Boonah-Kalbar WTP. The bulk treated water produced at the plant is supplied to Queensland Urban Utilities (QUU) who own and operate the distribution network. QUU are responsible for the retail and distribution of water to the end water users.

Table N-3 provides a summary of the government authorities and water service providers associated with the Boonah-Kalbar supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-3 Summary – Local government, service providers and bulk supply description

Boonah-Kalbar off-grid water supply	
Local government	Scenic Rim Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water supply to the Boonah-Kalbar is from Reynolds Creek supported by Moogerah Dam releases
Water entitlement	A water entitlement of 1,700 ML/annum from Moogerah Dam is applicable for Boonah-Kalbar
Water treatment plant	Boonah-Kalbar WTP with an existing capacity of 3.3 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Boonah-Kalbar water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operations.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak (MDMM) demands for the Boonah-Kalbar water supply scheme to 2046. The current average demand for the scheme is 500 ML/annum or an average of 1.4 ML/day. By 2046 it is expected that this demand will increase to 960 ML/annum or an average of 2.6 ML/day. During dry hot summer periods, peak demand is expected to be as high as 3.7 ML/day in 2046.

The demand will fluctuate over time due to many factors, including end use consumer behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-6 shows Boonah-Kalbar's AD and MDMM forecast demand for the next 30 years.

Demand is expected to increase into the future. Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

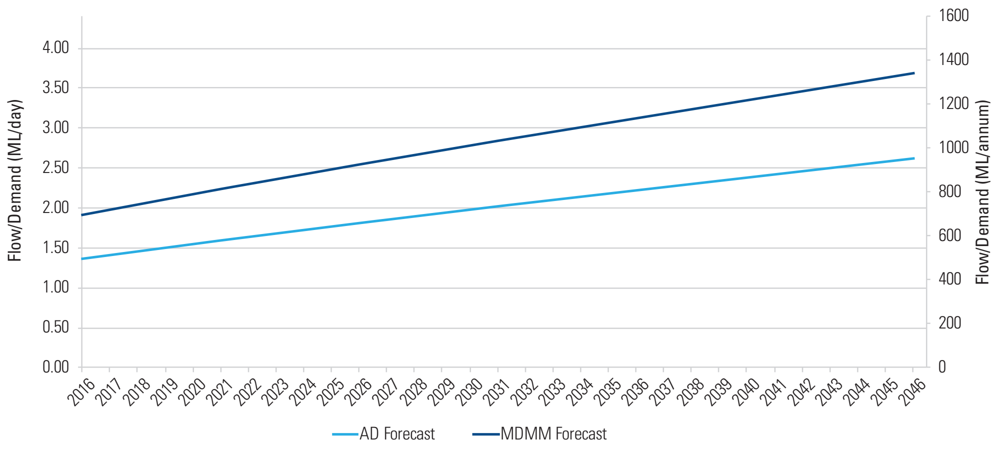


Figure N-6 Boonah-Kalbar Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For the Boonah-Kalbar water supply scheme, the demand management options considered in the determination of the LOS performance are outlined in the Boonah-Kalbar drought response plan at the end of this fact sheet.

Supply

Supply is the primary lever used to determine LOS yield for the Boonah-Kalbar water supply scheme. Consideration is therefore given to bulk supply options that could assist in supplying volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply source

There are two possible water sources for Boonah-Kalbar:

- Reynolds Creek – This source is run of the river supply supported by releases from Moogerah Dam. This raw water supply and associated infrastructure is part of the Warrill Valley Water Supply Scheme. This supply has a regulatory restriction in the form of a water entitlement equivalent to 1,700 ML/annum, which is sufficient to accommodate average day demand over the next 30 years. The average day demand in 2046 is forecast to be in the order of 960 ML/annum.
- Water carting – The alternative source of water for Boonah-Kalbar is carting potable water from other sources (i.e. SEQ water grid). The carting of water has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers etc). For Boonah-Kalbar the capability of water carting is estimated at 1.6 ML/day or 600 ML/annum, which is less than the forecast demand in 2046. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting (i.e. 1.6 ML/day) is sufficient to service average day demand out to 2021. Beyond this period carting will not be sufficient to service Boonah-Kalbar on its own out to 2046. Consequently, the ability to address LOS objectives will require consideration of the Reynolds Creek supply via Moogerah Dam, with possible supplementation through water carting if additional supply is necessary.

Seqwater has a high priority water entitlement of 1,700 ML from the Warrill Valley water supply scheme for supply to the Boonah-Kalbar water supply scheme. There are also approximately 20,158 ML of medium priority entitlements in the Warrill Valley water supply scheme, predominantly for irrigation. The ability to achieve LOS objectives for Boonah-Kalbar is influenced by the uptake of these medium priority entitlements which have historically been used at 0% to 40% of the maximum entitlement volume. Determination of LOS yield for the Boonah-Kalbar water scheme has therefore been based on modelling of historical inflows and a conservative assumption of 50% medium priority water usage.

For Essential Minimum Supply Volume (EMSV) it has been assumed that supply from Reynolds Creek and Moogerah Dam is not available.

The EMSV is determined based on an allowance of 100 L/person/day, which correlates to be 0.96 ML/day in 2046. Options available to address EMSV needs may include:

- Option 1 Water Carting – This option involves the carting of water from Beaudesert, Woodhill, Peak Crossing and Yamanto. The water would then be transferred to a local Boonah-Kalbar network reservoir (i.e. Templin Reservoir). Carting supply capability is estimated at 1.6 ML/day based on 15 hours per day operation.
- Option 2 Grid Connection – A temporary pipeline from Peak Crossing to the Boonah-Kalbar to supply at least 0.96 ML/day from the SEQ bulk water grid is proposed under this option to meet the EMSV supply requirements of the LOS objectives.

The above options should be considered when Moogerah Dam reaches 25% of its full supply level. This will provide a sufficient 18 month window at 2046 demands, to plan and implement the preferred option before Moogerah Dam reaches 7.5% of full supply level. An initial review has identified the following factors relevant to the selection of the preferred EMSV option:

- Cost – The carting of water to Boonah-Kalbar has been estimated to be in the order of $10,000/ ML, while the construction of a temporary EMSV pipeline would be in the order of $8 Million.
- Duration – Based on the cost of carting and pipeline, an EMSV event that lasts more than 2 to 2.5 years would result in a carting cost greater than the capital cost of a pipeline.
- Operational Constraints – An EMSV event for Boonah-Kalbar may coincide with other communities witnessing similar conditions. This may drive the need to consider a pipeline to address operational constraints for Boonah-Kalbar.
- Construction period – The construction period of the pipeline will need to be considered to confirm that the infrastructure can be put in place by the time Moogerah Dam reaches minimum operating level. Based on the pipeline being built above ground during an emergency, a six month construction window has been assumed for a temporary pipeline. Eighteen months has been allowed for planning and approvals.
- Water carting feasibility – The ability to cart the EMSV on a daily basis will need to be reviewed to confirm the feasibility at the time the option is required.

Based on the supply source information provided above, the LOS yield that can be achieved for Boonah-Kalbar is 1,000 ML/annum.

Figure N-7 demonstrates the ability of the LOS yield to securely supply Boonah-Kalbar demand and the ability of emergency supply options to achieve the required EMSV over the next 30 years.

The planning for bulk water sources for Boonah-Kalbar will be reviewed as part of the Water Security Program planning cycle, however early review will occur if:

- Average day demand for Boonah-Kalbar reaches 800 ML/annum (i.e. 80% of the LOS yield of 1,000 ML/annum).
- Moogerah Dam reaches 25% of its full supply level a review of EMSV needs and options should take place to establish the preferred option, and prepare for implementation when Moogerah Dam reaches 7.5% of full supply levels
- Medium priority entitlement usage exceeds 50% of announced medium priority entitlements associated with Moogerah Dam

Options that may be considered to increase the Boonah-Kalbar LOS yield include construction of new infrastructure, demand management and changes to system operations in the Warrill Creek. The preferred option will be selected using the option assessment framework in place at the decision time.

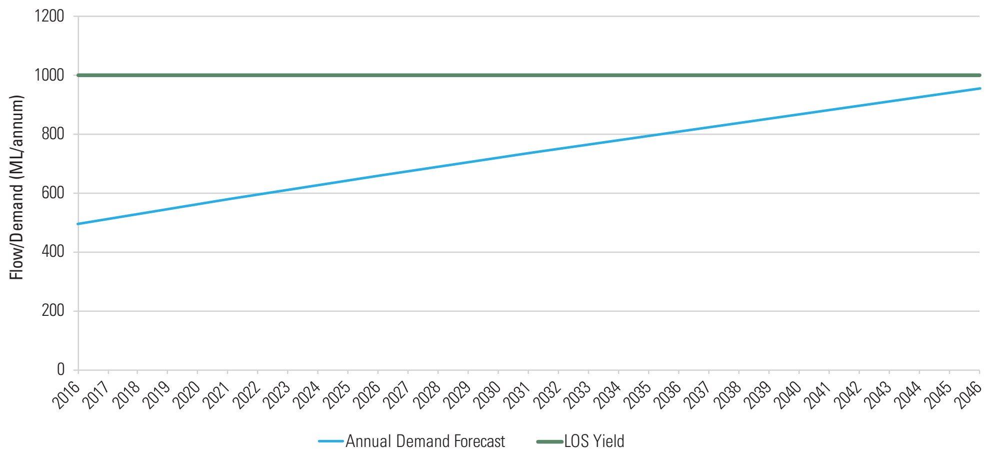


Figure N-7 Boonah-Kalbar annual demand forecast and LOS yield

Treatment Capacity

The current water source for the Boonah-Kalbar water supply scheme is the Reynolds Creek west of Kalbar. Water pumped from the creek is treated at the Boonah-Kalbar Water Treatment Plant at Kalbar.

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-8 shows the current WTP 20 hour capacity (i.e. 2.7 ML/day) and the MDMM demand over the next 30 years. Based on the current capacity it is expected that the MDMM demand will exceed the WTP 20 hour capacity by 2028 and the WTP will require an upgrade. According to the current projected peak demand the capacity would need to be approximately 3.7 ML/day based on a 20 hour operation.

The planning for bulk supply treatment infrastructure will be reviewed at regular intervals as part of the Seqwater planning cycle. However, the planning review will be brought forward if average day demand reaches 1.5 ML/day (i.e. MDMM demand of 2.2 ML/day) or if the demand is likely to exceed current 20hr capacity of the WTP within a two year period).

System operation

The system operation options available to supply water to Boonah-Kalbar include:

- Normal operation – extraction from the Reynolds Creek supported by Moogerah Dam releases within water entitlement limits and treatment at the Boonah-Kalbar water treatment plant is the normal operation for this scheme.
- Emergency operation – Water carting to meet future demand needs is a feasible solution to ensure supply for Boonah Kalbar out to 2028, when supply is not available under emergency conditions including drought.

However, in an EMSV event the supply can be sourced either through water carting or through the development of a temporary pipeline connected to the SEQ bulk supply grid to satisfy EMSV out to 2046.

The trigger to change from normal operation to water carting will be driven by the ability to supply the community with potable water. For drought conditions this operation would commence when the capacity of Moogerah Dam reaches lower levels with a review of EMSV operation to commence when Moogerah Dam reaches 25%. The trigger to select, plan and implement the EMSV supply option will be when Moogerah Dam reaches 25% of its full supply level to allow enough time for implementation and therefore to operate the EMSV supply when required.

Boonah-Kalbar water future

Table N-4 Table N-3 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Boonah-Kalbar. Based on this plan the LOS yield for the Boonah-Kalbar water supply scheme is 1,000 ML/annum.

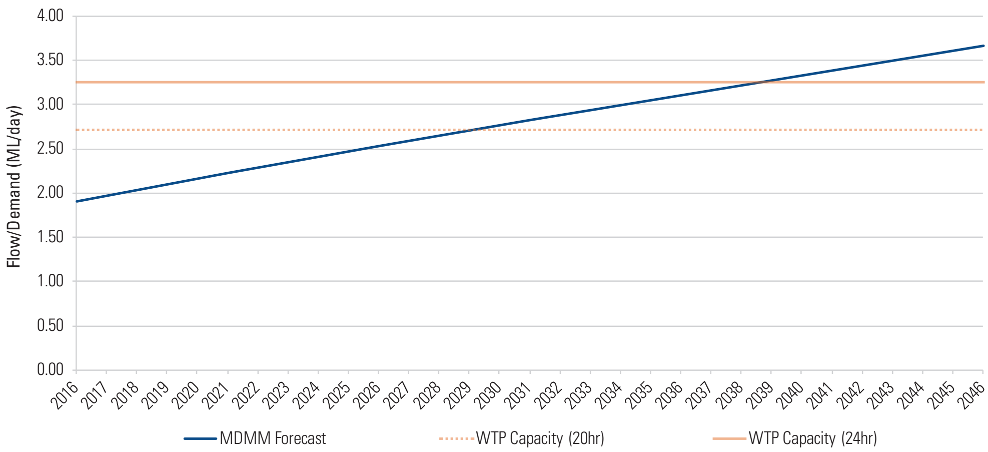


Figure N-8 Boonah-Kalbar MDMM demand forecast and treatment capacity

Table N-4 Demand, System Operations and Supply Lever Summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 92% from 500 ML/annum to 960 ML/annum. The demand lever options for the Boonah-Kalbar off-grid community include all measures outlined within the Boonah-Kalbar drought response plan.
System Operations	The system operation options available to supply water to Boonah-Kalbar include: • Normal operation – Extraction from the Reynolds Creek supported by Moogerah Dam releases and treatment at the Boonah-Kalbar WTP is the normal operation for this scheme. The water entitlement associated with extraction from the Warrill Valley water supply scheme is equivalent to 1,700 ML/annum. • Emergency operation – During an emergency water carting up to 1.6 ML/day is possible to meet average demand out to 2021. However, in an EMSV event emergency supply either through water carting or through an emergency pipeline to the Grid can address ESMV demand out to 2046.
Supply	The LOS yield that can be achieved has been determined to be 1,000 ML/annum. Moogerah Dam will remain the dominant supply source for the Boonah-Kalbar off-grid community out to 2046. This supply achieves LOS objectives relevant to the supply of average day demand and occurrence intervals relevant to medium level restrictions. No new sources are required although augmentations may be required to the Boonah-Kalbar WTP over the 30 year horizon. For the EMSV objectives, contingency solutions will be required in addition to the Moogerah Dam supply. Options include water carting or a pipeline connection to Peak Crossing (i.e. grid connected) to provide sufficient EMSV supply.

Boonah-Kalbar has sufficient water security for the 30-year planning horizon, however a WTP upgrade would be required in 2028 based on the current demand forecast. Seqwater will monitor influences and trends in demand and supply to provide adequate time to respond if required. This plan will be reviewed every five years or on any of the following triggers:

- The Average Annual demand exceeding 800 ML/annum
- The water level in Moogerah Dam falls to 25% of full supply.this will trigger a review of EMSV supply options will be considered along with other system operation triggers.
- Medium priority water usage in the Warrill Valley water supply scheme exceeds 50% of the medium priority entitlements.
- The average day demand exceeding 1.5 ML/day (equivalent to MDMM demand of 2.2 ML/day)

BOONAH-KALBAR DROUGHT RESPONSE PLAN – PLAN ON A PAGE

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	50% capacity Moogerah Dam	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	25% capacity Moogerah Dam	160 L/p/day residential demand	• Communications • Leak detection and repair	As per level 1 (S & QUU)
3. Voluntary conservation, restriction of standpipe and carting of water	15% capacity Moogerah Dam	150 L/p/day residential demand	Standpipe isolation and carting of water	As per level 1 but monitor daily (S & QUU)
4. Voluntary conservation, restrictions and the appropriate regulatory measures	10% capacity Moogerah Dam	140 L/p/day residential demand including isolation of standpipe	Continue to cart water and impose water restrictions	As per level 3 (S & QUU)
4a	7.5% capacity Moogerah Dam	130 L/p/day residential demand	Further water supply restrictions and continue to cart	As per level 3 (S & QUU)
Emergency Response	5% capacity Moogerah Dam	Maximum possible demand reduction	Implement EMSV plans	As per level 4 (S & QUU) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Water supply of a preceding drought response trigger and removal of the action is operationally appropriate	Maintain the target of the level implemented	Remove appropriate drought response actions	As per level 4 (S & QUU)
Complete drought exit	60% capacity Moogerah Dam	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM =Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Scenic Rim Regional Council (SRRC) and other major customers of the supply status (QUU) • Advise Irrigators of town actions if required (S)	Monitor standpipe use (QUU)	Nil	Update DRP contact list and review actions (S)
	• As per level 1 (S & QUU) • Commence low level public communications (QUU) • Advise standpipe users of restriction at next level (QUU)	Monitor standpipe use (QUU)		• Communications planning (QUU) • Make necessary arrangements for water carters to cart water to Kalbar (S)
	• As per level 2 (S & QUU) • Increased communications (QUU)	Standpipe restriction (QUU)	Commence water carting to supplement supply (S)	• Communications planning (QUU) • Obtain approval to impose water restrictions schedule (QUU)
	As per level 3 (S & QUU)	• Standpipe isolation (QUU) • Impose water restrictions on customers(QUU)	Continue and increase water carting (S)	**Emergency response** • Communications planning (QUU) • Determine and prepare for emergency response (S&QUU) **Drought exit** • Communications planning (QUU)
	As per level 3 (S & QUU)	Impose further water restrictions (QUU)	As per level 3 (S & QUU)	As per level 3 (S & QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain and possibly increase severity of water restrictions (QUU)	Implement appropriate EMSV plans (S&QUU)	Continue emergency response planning (S&QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain restrictions (QUU)	As per level implemented (S&QUU)	**Emergency response** • Continue emergency response planning (S&QUU) **Drought exit/re-entry to other levels** • Communications planning (QUU)
	• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	• Re-open standpipe (QUU) • Revoke water restrictions (QUU)	**Water source** • Cease carting water (S) • Remove sandbags (S) • Remove pumps and pipes from downstream (S)	• Review and debrief (S&QUU) • Update the Kalbar Disruption Plan (S)

CANUNGRA OFF-GRID COMMUNITY FACTS HEET

This fact sheet outlines Seqwater's plan for water security for the Canungra off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve the Level of Service (LOS) objectives and peak (MDMM) demand objectives over the 30-year planning period.

Canungra is a small rural township located in the Scenic Rim Regional Council local government area. Canungra, also called the "Valley of the Owls", is situated in the Gold Coast hinterland, 35 kilometres west of the Gold Coast and 90 kilometres south of Brisbane. The Canungra economy depends on tourism, being a popular destination for short drives from the Gold Coast and Brisbane.

At the 2011 census, Canungra had a population of 746. Figure N-9 shows the general location of Canungra and its water supply scheme service area.

Canungra water supply scheme

The Canungra water supply scheme supplies treated water to the township of Canungra. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant). The influences that impact on the performance of the schemes are outlined below

Raw water for the Canungra Water Treatment Plant (WTP) is sourced through run-of-river flows from Canungra Creek, in the Albert River catchment.

The catchment forms an important aspect of the drinking water supply chain. The characteristics of the catchment have an influence on the amount and quality of the raw water source, which has implications for the ability to treat and supply water of a suitable quality to meet the needs of the Canungra township. Activities and facilities in the catchment that may impact water quality (predominantly following high rainfall events) include agriculture, grazing, transport, recreation, onsite wastewater treatment systems, and Canungra showground. The quality of the raw water from the Canungra Creek varies depending on weather conditions such as drought, rain or flooding. Rainfall events can rapidly increase the turbidity of Canungra Creek, affecting water quality. However, suspension of raw water extractions for one to two days generally provides sufficient time to allow turbidity to return to normal background levels so that water can be treated.

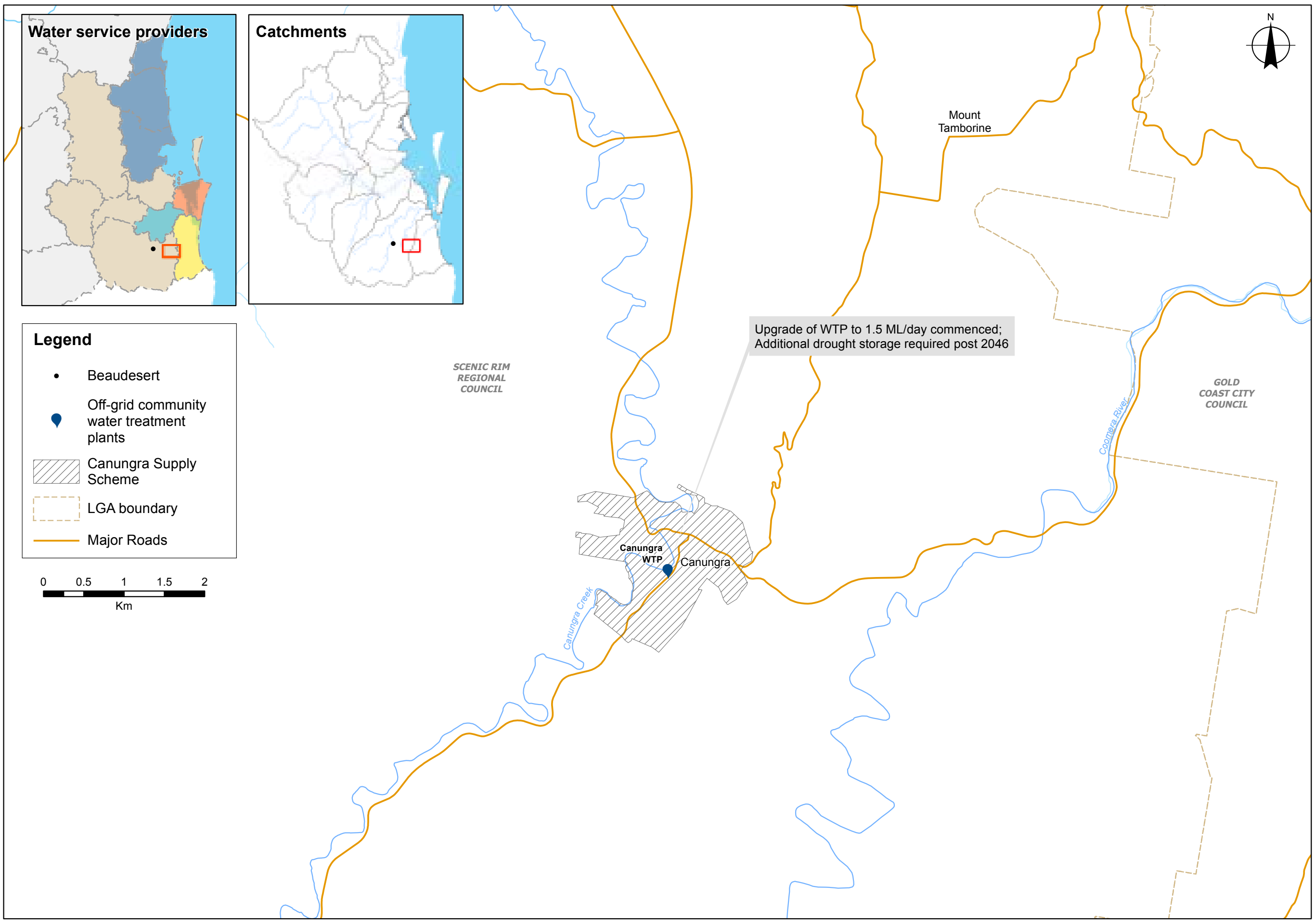


Figure N-9 Canungra – Existing and proposed water supply scheme

Due to the small size of the community, treated water can be carted in from an alternative source in the event of any local source issues affecting potable water supply to the Canungra community. When supplemented with carting, the Canungra Creek provides the level of reliability required to meet LOS objectives for Canungra.

Raw water drawn from Canungra Creek is treated to meet drinking water quality standards at Seqwater's Canungra Water Treatment Plant (WTP). The bulk treated water produced at the plant is supplied to Queensland Urban Utilities (QUU) who own and operate the distribution network. QUU have the responsibility for the retail and distribution of water to the end water users in the Canungra service area, which is generally restricted to the township.

The Canungra Creek is subject to short term low flows during extended dry periods and supply is maintained by carting water from Beaudesert and/or the grid. This has been successfully employed in the past in line with the community's drought response plan.

The Canungra water supply scheme was identified in version 1 of the Water Security Program as a scheme with a high priority for intervention due to peak demand levels approaching the existing water treatment plant capacity. Significant demand growth was projected within the service area due to land zoning and subdivision approval. Recent revised demand forecasts have since shown a reduced growth profile with proposed developments occurring later than originally anticipated.

Table N-5 provides a summary of the government authorities and water service providers associated with the Canungra supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-5 Summary – Local government, service providers and bulk supply description

Canungra off-grid water supply	
Local government	Scenic Rim Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Canungra WTP is sourced from Canungra Creek.
Water entitlement	The entitlement associated with the supply to the Canungra township is 150 ML/annum.
Water treatment plant	Canungra WTP with an existing capacity of 0.40 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines. A scheduled upgrade will increase the capacity of this WTP to 1.5 ML/day[1] from 2017.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Canungra water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak demands for the Canungra water supply scheme to 2046. Forecasts are based on equivalent populations (EP) provided by QUU. Equivalent populations take into account the contribution from non-residential customers and translate this to demand for an equivalent number of people. This forecast takes into account the following two demand scenarios.

- Medium demand forecast, which estimate an increase of population to 1,152 EP by 2046 – this is used for planning.
- High demand forecast, which consider higher growth to 3,000 EP by 2036 – this is used for scenario analysis so we can develop a plan which can adapt to higher growth should this occur.

As approved subdivisions are developed, growth may occur at double or triple the rate of current projections so an alternative higher demand projection is considered. Historical demand trends align with the medium demand forecast, and therefore assessment of LOS performance is based on medium demand forecast.
To account for the possibility of higher growth, however, infrastructure requirements for the high demand scenario have also been considered. This means we have a plan which can adapt to changing demand.

Under the medium demand forecast, the average demand for the scheme is 100 ML/annum or an average of 0.28 ML/day. By 2046 it is expected that this average demand will increase to 120 ML/annum or 0.32 ML/day. The peak (MDMM) demand in 2046 is expected to be as high as 0.45 ML/day. The forecast demand considers both local and tourist-driven demand.

Under the high demand forecast scenario, it is anticipated that average demand may increase to 400 ML/annum or 1.1 ML/day by 2046. The MDMM demand under this scenario would be as high as 1.5 ML/day.

Demand will fluctuate over time due to many factors, some of which may include end use customer behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-10 shows Canungra's historical average day (and associated MDMM) production, and forecast average day and MDMM demand for the next 30 years for both medium and alternative (higher) demand forecast. The medium demand forecast has been adopted for assessment of LOS performance, as this scenario aligns best with historical demand trends, however Seqwater will monitor demand and review bulk water supply planning should demand approach 80% of LOS yield or drive the need for additional infrastructure to achieve LOS objectives.

In the future, water may not be used the same way as we do today and demands may be lower or higher than projected. Demand management options, including water supply restrictions are essential to a well-managed water supply during droughts and periods of reduced water security. These options are listed within Canungra's drought response plan below and discussed in further detail in the System Operation section below.

Demand Options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For Canungra, the demand management options considered in the determination of the LOS performance are outlined in the Canungra drought response plan at the end of this fact sheet.

Supply

Supply is the primary lever used to determine LOS yield for the Canungra water supply scheme. Consideration is therefore given to bulk supply options that could assist in supplying volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply Source

There are two possible supply sources for the Canungra water supply scheme:

- Canungra Creek – has a regulatory restriction in the form of a water entitlement equivalent to 150 ML/annum, which is sufficient to accommodate average day demand over the next 30 years. The average day demand in 2046 is currently forecast to be in the order of 120 ML/annum. There is also availability of unallocated water reserved for town water supply of an additional 150 ML/annum to bring the total water entitlement to 300 ML/annum and meet additional future growth if required. However, on six occurrences in the past 41 years Canungra Creek has run dry, indicating the scheme is non-compliant with the LOS objectives if not supplemented with an alternative supply.

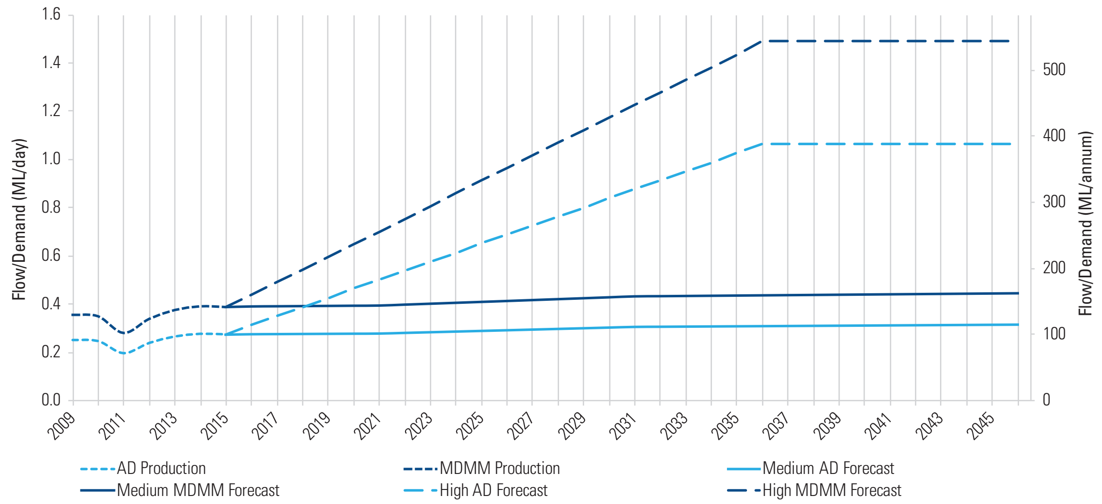


Figure N-10 Canungra average day (AD) and peak demand (MDMM) production and forecast demand

- Water carting – limited by the maximum hours of operation, the distance from the alternative source and available resources (e.g. tankers). For the Canungra off-grid community, the capability of water carting from the water grid is estimated at a maximum of 0.43 ML/day or 160 ML/annum, which is greater than the medium demand forecast at 2046. Water carting for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community. Carting has been used in the past to maintain supply when Canungra Creek has run dry.

To determine the LOS yield, a stochastic 10,000 year stream flow model was developed for Canungra based on historic Canungra Creek flows, carting, and demand restrictions. Based on current knowledge of the existing reservoir storage (1.2 ML) and demand restrictions outlined in the Canungra drought response plan, the LOS yield of the current system is 170 ML/annum. Because the LOS yield is greater than the medium demand forecast (120 ML/annum in 2046) the Canungra water supply is LOS compliant over the 30-year planning horizon. This assessment includes water carting as a supplementary water source when the Canungra Creek runs dry. Additional supply options or augmentations will therefore not be required and the off-stream storage proposed in version 1 of the Water Security Program is no longer required.

Figure N-11 demonstrates the ability of the 170 ML/annum LOS yield to securely supply the current forecast demand for Canungra over the next 30 years.

It is recognised that growth for Canungra may exceed current demand forecasts, in which case an off-stream storage may be necessary. The volume of off-stream storage required will depend upon demand, and the level of water carting acceptable, to supplement supply at times when the Canungra Creek supply is disrupted. To explore potential options for off-stream storage volumes for Canungra, three water carting scenarios (normal carting 0.43 ML/day, moderate carting 0.25 ML/day, and no carting except for essential minimum supply volume (EMSV)) were assessed against medium (1,152 EP in 2046) and high (3,000 EP by 2046) demand forecasts. These conditions were assessed using the stochastic 10,000 year flow model, to provide a preliminary estimate of off-stream storage requirements for each case.

Results of this assessment are shown in Figure N-12, and indicate that:

- Under medium demand forecast (1,152 EP by 2046, average day demand 0.45 ML/day) the existing 1.2 ML network storage is sufficient to secure supply if supplemented by moderate or normal carting at times when Canungra Creek supply is disrupted. If no carting is desired (except for EMSV), an off-stream storage of approximately 10 ML would be required to secure supply.
- Under the high demand forecast (3,000 EP by 2046, average day demand 1.1 ML/day), an off-stream storage of 20 ML would be required to secure supply if supplemented by normal carting at times when Canungra Creek supply is disrupted. If supplemented by moderate carting, an off-stream storage of approximately 35 ML would be required, and if no carting was desired (except for EMSV) an off-stream storage of approximately 85 ML would be required to secure supply.

These results provide an indicative range of off-stream storage requirements under a range of conditions. As long-term demand forecasts are uncertain, a staged approach may present a suitable alternative for Canungra. For example, preliminary estimates indicate that an off-stream storage of 10 ML would secure supplies with no water carting (except for EMSV) for the current demand forecast to 2046 (demand 0.32 ML/day). If demand increased according to the high demand forecast, however, the same 10 ML off-stream storage would be sufficient to secure supplies until 2031 (demand 0.89 ML/day) if supplemented by normal carting, at which time additional off-stream storage could be considered.

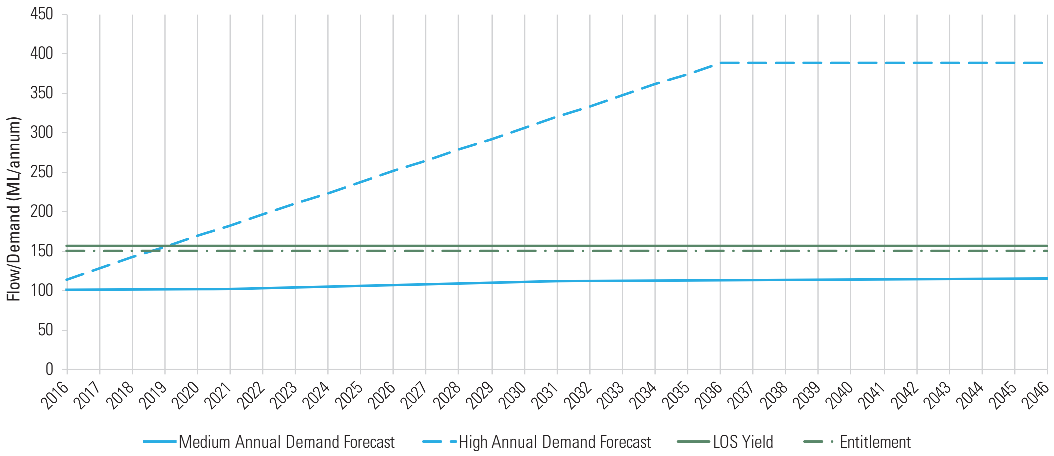


Figure N-11 Canungra annual demand forecast and LOS yield

The Canungra water supply is LOS compliant for the current demand forecast over the 30-year planning horizon, and off-stream storage is not required to secure supply. However, the planning for bulk water sources (including off-stream storage requirements) will be reviewed as part of the Water Security Program planning cycle, and this review will be considered earlier if the average day demand for Canungra reaches 130 ML/annum (i.e. 80% of the LOS yield of 170 ML/annum).

Treatment capacity

The current water source for the Canungra water supply scheme is the Canungra Creek and it is treated at the Canungra WTP.

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-13 shows the 20 hour capacity of the current WTP and the MDMM demand over the next 30 years. In 2046 the medium MDMM forecast demand (0.39 ML/day) is greater than the Canungra WTP 20 hour operational capacity of 0.33 ML/day, however it is below the maximum 24 hour operational capacity (0.40 ML/day).

This means that at peak times there may be an operational shortfall due to water treatment plant capacity. Water carting can supplement supply during such peak demand events. As demand increases water carting will become more frequent. This is not considered an appropriate long-term arrangement and therefore additional treatment capacity is required.

Previous studies identified the need to upgrade the Canungra WTP to achieve the production capacity to meet MDMM demands. Consequently, the treatment plant upgrade process has commenced, with completion of a 1.5 ML/day capacity plant expected in 2017. The upgraded WTP capacity is sufficient to meet MDMM demand under the medium and high demand forecast profiles, but operationally the upgraded capacity will also assist in servicing additional demand on the system from commercial water carters servicing rural residential properties outside the water supply service area.

The planning for bulk supply treatment infrastructure will be reviewed at regular five year intervals as part of the Seqwater planning cycle. However, the planning review will be brought forward if average day demand reaches 0.86 ML/day (i.e. MDMM demand of 1.2 ML/day) or if the demand is likely to exceed the 20 hour capacity of the upgraded WTP within a two year period.

System operation

The system operation options available to supply water to Canungra include:

- Normal operation – extraction from Canungra Creek and treatment at the Canungra WTP.
- Emergency operation – water carting to meet future needs is a feasible solution to ensure supply for Canungra, when supply is disrupted under emergency conditions including drought.

The trigger to change from normal operation to water carting will be driven by the ability to supply the community with treated water. For drought conditions this operation would commence when the stream gauge at Main Road Bridge (Department of Natural Resources and Mines meter number 145107a) records no flow in Canungra Creek. Readings from this gauge are updated on an hourly basis.

Based on the current operation plan, Seqwater is capable of meeting all water demands of Canungra for the next 30 years using locally treated water and carting if/when required.

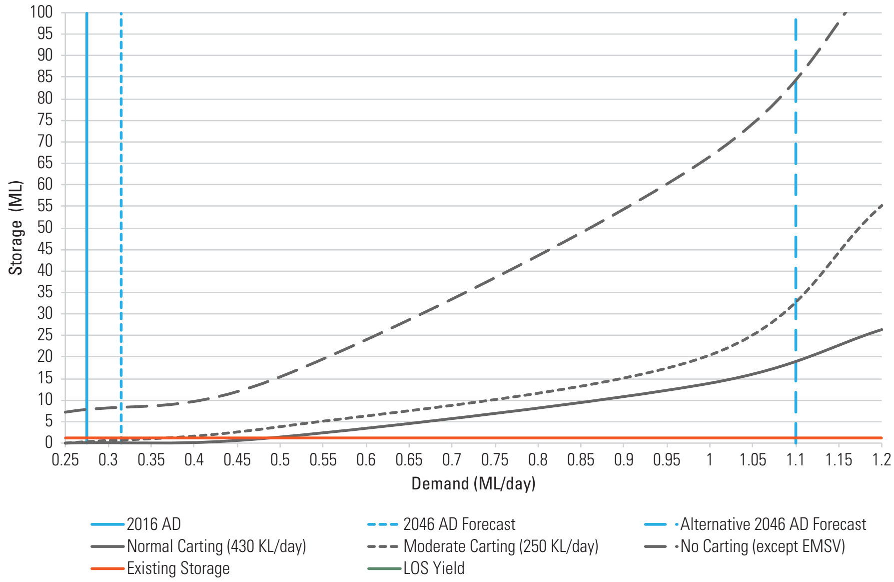


Figure N-12 Indicative Canungra Off-stream storage requirements based on average daily demand

Canungra water future

Table N-6 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Canungra. Based on this plan the LOS yield for the Canungra water supply scheme is 170 ML/annum.

Table N-6 Demand, System Operations and Supply Lever Summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 14% from 100 ML/annum to 120 ML/annum over the 30 year period. The demand lever options for the Canungra off-grid community include all measures outlined within the Canungra drought response plan.
System operation	The system operation options available to supply water to Canungra include: • Normal operation – Extraction from Canungra Creek and treatment at the local Canungra WTP. The water entitlement associated with extraction from Canungra Creek is equivalent to 150 ML/annum. • Emergency operation – Water carting to supply Canungra during emergency conditions, including drought. It is estimated that up to 0.43 ML/day could be sourced through carting if required. The triggers to change operations will be in accordance with the Canungra drought response plan.
Supply	The scheme LOS yield has been determined to be 170 ML/annum. This has been determined using a stochastic 10,000 year flow model based on Canungra Creek flows, carting, and the demand restrictions outlined in the drought response plan. The existing Canungra Creek supply will remain the dominant supply for the Canungra off-grid community out to 2046, with water carting potentially required to supplement supply at times of peak demand and drought. No new sources are required and it is not expected that any additional augmentations will be required over the 30 year horizon other than the upgrade to the Canungra WTP which is currently underway.

Canungra has sufficient water security for the 30 year planning horizon with no major activity planned for Canungra beyond the WTP upgrade due to be completed in 2017. Seqwater will monitor influences and trends in demand and supply. This plan will be reviewed every five years or on any of the following triggers:

- the average annual demand exceeding 130 ML/annum
- the Average Day demand exceeding 0.86 ML/day (equivalent to MDMM demand of 1.2 ML/day).

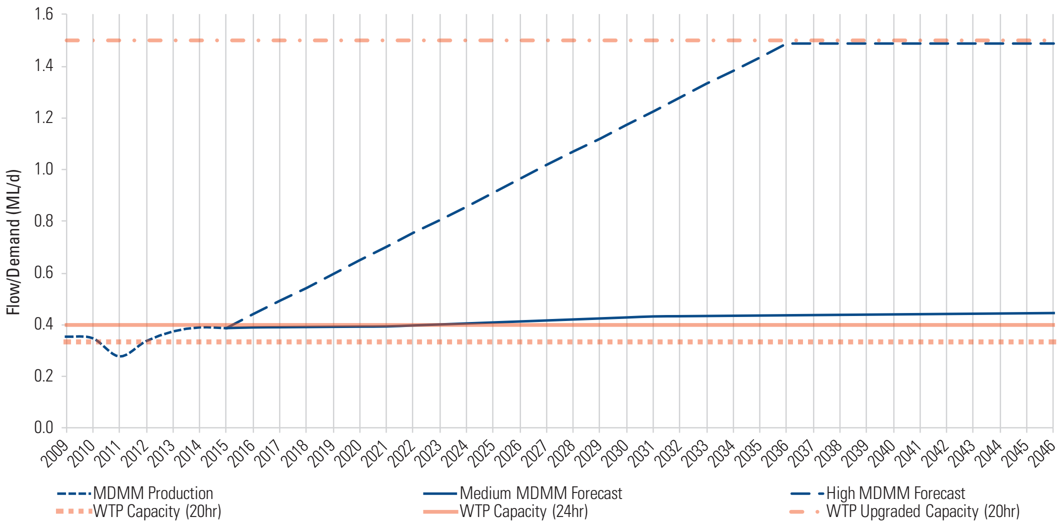


Figure N-13 Canungra MDMM demand forecast and treatment capacity

CANUNGRA DROUGHT RESPONSE PLAN

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	Flow falls to <7ML/day	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
1b. Drought alert, preparedness and monitoring	Flows fall to <1ML/day	Normal demand pattern (where there are no obvious leaks)		
2. Voluntary conservation	Flow falls to <0.5 ML/ day measured at Main Road Bridge Gauging Site #145107A	160 L/p/day residential demand	Sandbag downstream	As per level 1 (S & QUU)
3. Voluntary conservation, restriction of standpipe and carting of water	Pumping pool not overflowing and falling and/or Canungra Creek stopped flowing at Showground Road Crossing	150 L/p/day residential demand	Standpipe isolation and carting of water	As per level 1 but monitor daily (S & QUU)
4. Voluntary conservation, restrictions and the appropriate regulatory measures	Pumping pool continues to fall and reaches -300mm	140 L/p/day residential demand	Pump from downstream pools, continue to cart water and impose water restrictions	As per level 3 (S & QUU)
Emergency Response	Loss of supply continuity	Maximum possible demand reduction	Implement EMSV plans	As per level 4 (S & QUU) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Flow increases to those of a preceding drought response trigger and removal of the action is operationally appropriate.	Maintain the target of the level implemented	Remove appropriate drought response actions	As per level 4 (S & QUU)
Complete drought exit	Flow exceeds 250 ML/ day at Main Road Bridge Gauging Site #145107A.	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM =Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Scenic Rim Regional Council (SRRC) and other major customers of the supply status (QUU) • Advise Irrigators of town actions (S)	Monitor standpipe use (QUU)	Nil	Update DRP contact list and review actions (S)
				• Communications planning (S&QUU) • Check water carter availability and suitable access to draw points (S) • Approval to sandbag downstream (S)
	• As per level 1 (S & QUU) • Commence low level public communications (QUU) • Advise standpipe users of restriction at next level (QUU)	Monitor standpipe use (QUU)	Sandbag downstream of intake to provide pumping pool and protect from possible water quality issues. (S)	• Communications planning (QUU) • Make necessary arrangements for water carters to cart water to Canungra (S)
	• As per level 2 (S & QUU) • Increased communications (QUU)	Standpipe restriction (QUU)	• Retain sandbagging operation (S) • Commence water carting to minimise water loss in the pumping pool (S)	• Communications planning (QUU) • Obtain approval to pump water from downstream pools upstream (S) • Obtain approval to impose water restrictions schedule (QUU)
	As per level 3 (S & QUU)	• Standpipe isolation (QUU) • Impose water restrictions on customers(QUU)	• Retain sandbags (S) • Continue and increase water carting (S) • Commence pumping water from downstream pools (S)	**Emergency response** • Communications planning (QUU) • Determine and prepare for emergency response (S&QUU) **Drought exit** • Communications planning (QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain and possibly increase severity of water restrictions (QUU)	Implement appropriate EMSV plans (S&QUU)	Continue emergency response planning (S&QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain restrictions (QUU)	As per level implemented (S&QUU)	**Emergency response** • Continue emergency response planning (S&QUU) **Drought exit/re-entry to other levels** • Communications planning (QUU)
	• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	• Re-open standpipe (QUU) • Revoke water restrictions (QUU)	**Water source** • Cease carting water (S) • Remove sandbags (S) • Remove pumps and pipes from downstream (S)	• Review and debrief (S&QUU) • Update the Canungra Disruption Plan (S)

COMBINED NORTH STRADBROKE ISLAND OFF-GRID COMMUNITIES FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Amity Point, Dunwich and Point Lookout off-grid communities which are the three North Stradbroke Island (NSI) off-grid communities. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

The NSI off-grid communities are serviced by the NSI water supply scheme which is located approximately 30 km south east of Brisbane and east of Cleveland. The island contains mountain ranges, beaches and native forests making it a popular destination for camping, and walking. At 275 km^2, it is the second largest sand island in the world. The three communities are situated along the island's coastline.

Figure N-14 provides regional context on the location of the NSI combined water supply service area. Also on the island is the grid-connected NSI WTP supplying water to the mainland. The NSI WTP does not service NSI communities directly, but provides an alternative source via water carting in case of emergency.

NSI water supply schemes

The NSI water supply scheme supplies treated water to the townships of Amity Point, Point Lookout and Dunwich. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plants).

The raw water supply for NSI is sourced from the North Stradbroke Island Catchment, which is contained within island's aquifer system. The catchment forms an important aspect to the drinking water supply chain. The characteristics of the catchment impacts raw water quality, which affects the ability of treatment assets to meet quality and capacity requirements.

Activities in the catchment influencing the water quality include onsite wastewater treatment systems and sea water infiltration. The aquifers are well protected from human activities however, over-extraction of this source can lead to disruption of the natural filtration process which can impact on water quality. The quality of the raw water from NSI also varies depending on weather conditions such as drought or rain. Due to the size of the community, treated water can be carted in from an alternative source in the event of any local source issues affecting potable water supply to each of the NSI communities.

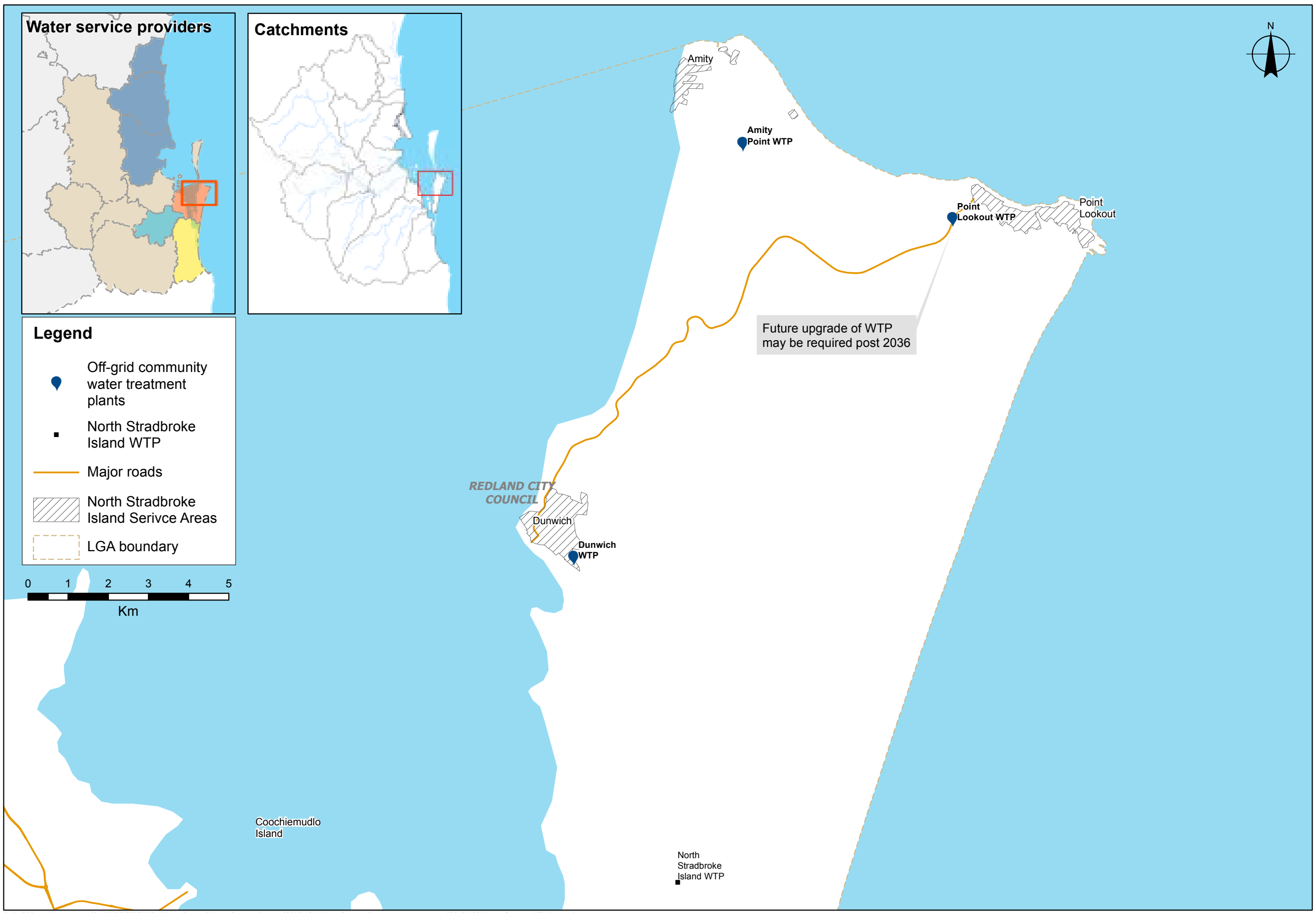


Figure N-14 North Stradbroke Island water supply schemes – Location and service areas

Water carting also provides a means to assist in meeting LOS objectives for each of the NSI communities.

Water sourced from the NSI aquifer system is treated to meet drinking water quality standards at Seqwater's Amity Point, Point Lookout and Dunwich Water Treatment Plants (WTPs). The aquifer also supplies the SEQ water grid through the NSI WTP via pipeline to Heinemann Rd reservoir on the mainland. Each of the three communities extracts their own groundwater at local bores. All the bores are relatively shallow; varying in depth between 9 m to 36 m. The ground water quality on North Stradbroke Island is consistently excellent, therefore the treatment steps required at the three WTPs to meet drinking water quality standards are less than is required at other Seqwater WTPs.

The bulk treated water produced at the NSI plants is supplied to Redland City Council who owns and operates the distribution network. Redland City Council has the responsibility for the retail and distribution of water to the end water users.

Table N-7 provides a summary of the government authorities and water service providers associated with the Amity Point, Point Lookout and Dunwich supplies along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-7 Summary – Local government, service providers and bulk supply description for NSI communities

Amity Point, Point Lookout, Dunwich off-grid water supply			
NSI community	**Amity Point**	**Point Lookout**	**Dunwich**
Local government	Redland City Council		
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups		
Bulk water service provider	Seqwater		
Local water service provider	Redland City Council		
Raw water source	Groundwater aquifer via 2 bore pumps	Groundwater aquifer via 4 bore pumps	Groundwater aquifer via 3 bore pumps
Water entitlement (for supply to township)	200 ML/annum	750 ML/annum	500 ML/annum
Water treatment plant	Existing capacity of 1.5 ML/day[1].	Existing capacity of 1.6 ML/day[1].	Existing capacity of 1.2 ML/day[1].

1 Rated capacity of the WTP over a 24 hour period.

Influence of Demand, Supply and System Operation

The NSI water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average demands and Peak (Mean Day Maximum Month (MDMM)) demands within the NSI water supply scheme out to 2046. These values can be seen in Table N-8.

Table N-8 Summary – Demand forecasts for NSI communities

Description	Amity Point	Point Lookout	Dunwich
Current 2016 average demand	100 ML/annum (0.28 ML/day)	280 ML/annum (0.77 ML/day)	160 ML/annum (0.43 ML/day)
Forecast average demand 2046	150 ML/annum (0.42 ML/day)	410 ML/annum (1.1 ML/day)	250 ML/annum (0.68 ML/day)
Forecast MDMM demand 2046	0.71 ML/day	2.0 ML/day	1.0 ML/day

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Demand is expected to increase into the future. Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

The following figures shows each community's AD and MDMM demand forecast for the next 30 years:

- Amity Point (Figure N-15)
- Point Lookout (Figure N-16)
- Dunwich (Figure N-17)

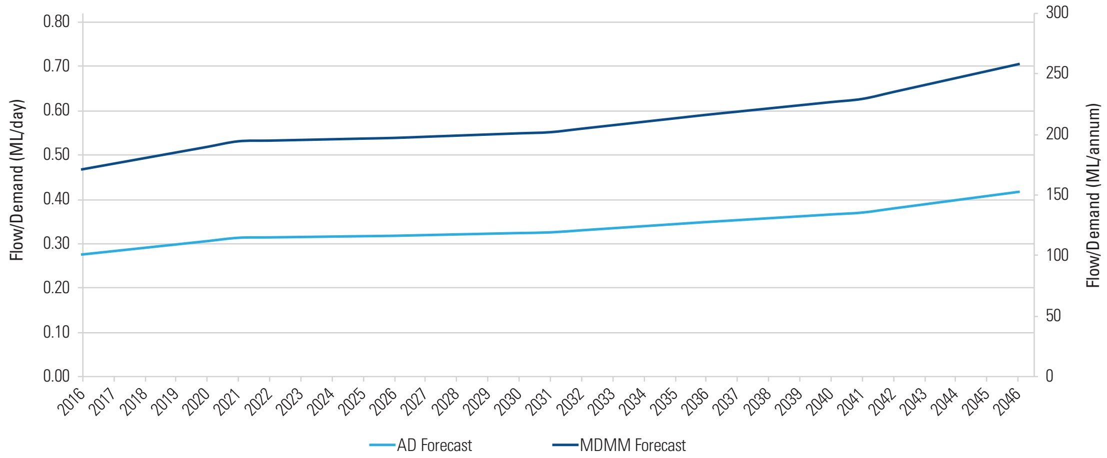


Figure N-15 Amity Point Average and Mean Day Maximum Month Demand Forecasts

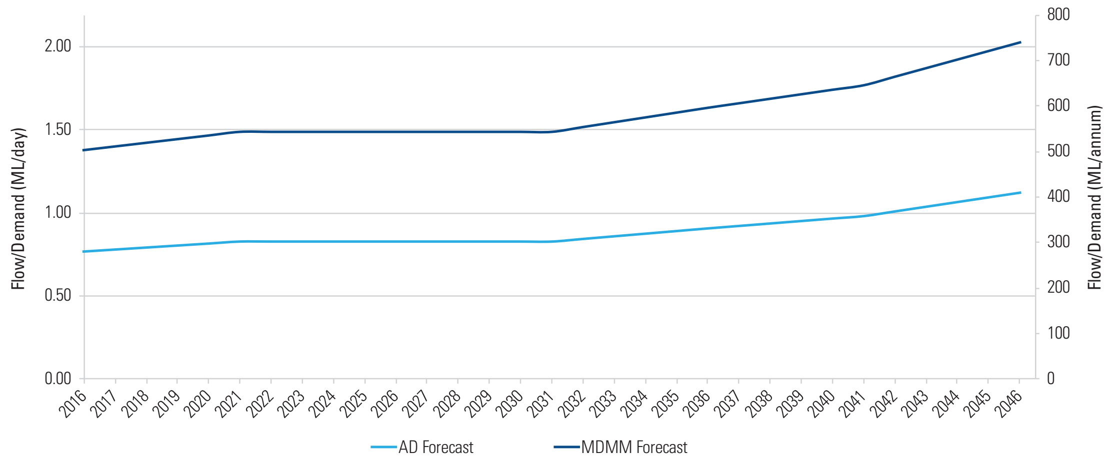


Figure N-16 Point Lookout Average and Mean Day Maximum Month Demand Forecasts

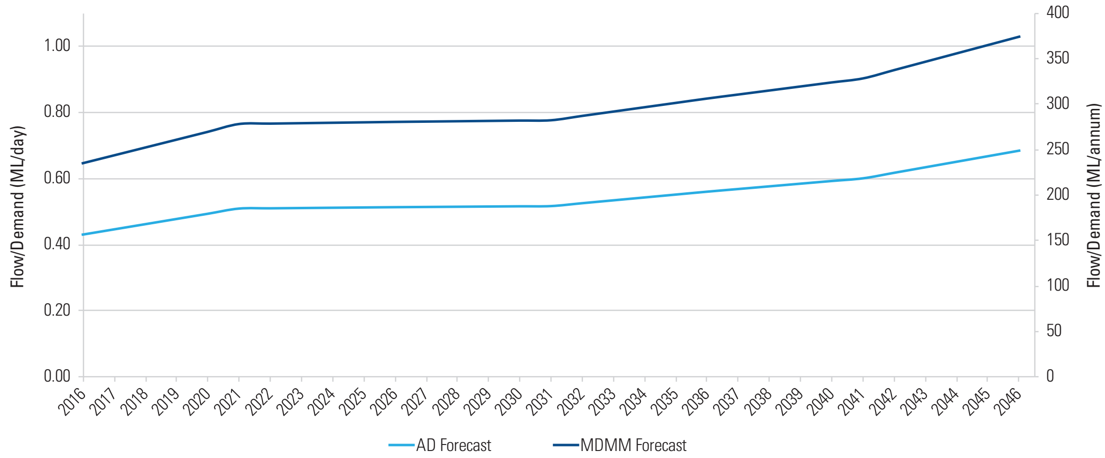


Figure N-17 Dunwich Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For NSI, the demand management options considered in the determination of the LOS performance are outlined in the NSI drought response plan at the end of this fact sheet.

Supply

Supply is the primary lever used to determine LOS yield for the NSI water supply scheme. Consideration is therefore given to bulk supply options that could assist in supplying volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply source

There are two possible water sources for NSI:

- NSI Aquifer – This supply has a regulatory restriction in the form of a water entitlement equivalent to 200 ML/annum for Amity Point, 750 ML/annum for Point Lookout and 500 ML/annum for Dunwich. These entitlements are sufficient to supply average demand over the next 30 years. The average demand in 2046 is forecast to be in the order of 150 ML/annum for Amity Point, 410 ML/annum for Point Lookout and 250 ML/annum for Dunwich.
- Water carting – An alternative source of water for the water supply scheme is water carting from other sources (one of the NSI townships or the NSI WTP). Water carting has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers etc.). The water carting capability and required operations for each community are shown in Table N-9. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Table N-9 Summary – Carting capability for NSI communities

Description	Amity Point	Point Lookout	Dunwich
Water Carting Capability	0.48 ML/day	0.48 ML/day	0.56 ML/day
Sufficient to supply forecast demand to 2046	Yes	No	No

Water carting is considered an emergency response to address severe drought and/or short term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the NSI Aquifer source and water carting sufficiently meet the demand of NSI to 2046, no additional bulk supply options are required for each of the three communities. The supply from the NSI Aquifer will continue to be the dominant source of supply for the NSI off-grid communities. The LOS yield for each off-grid community has been aligned to the maximum annual water entitlement from the NSI Aquifer as shown in Table N-10 below.

Table N-10 Summary – LOS Yield for NSI Communities

Description	Amity Point	Point Lookout	Dunwich
LOS Yield	200 ML/annum	750 ML/annum	500 ML/annum

The LOS yield and a comparison to the average demand is provided for the following communities:

- Amity Point (Figure N-18)
- Point Lookout (Figure N-19)
- Dunwich (Figure N-20)

This clearly demonstrates the ability to service the NSI communities in accordance with LOS objectives over the next 30 years.

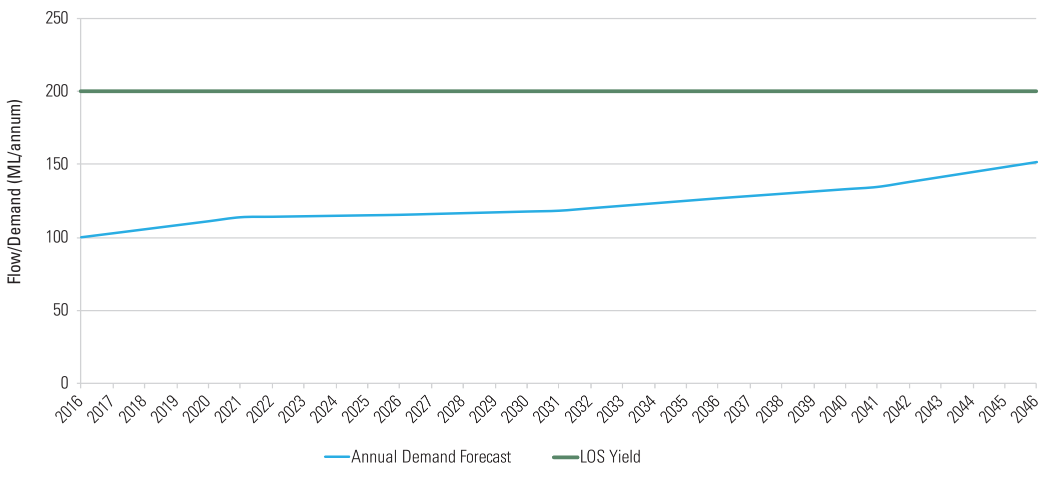


Figure N-18 Amity Point annual demand forecast and LOS yield

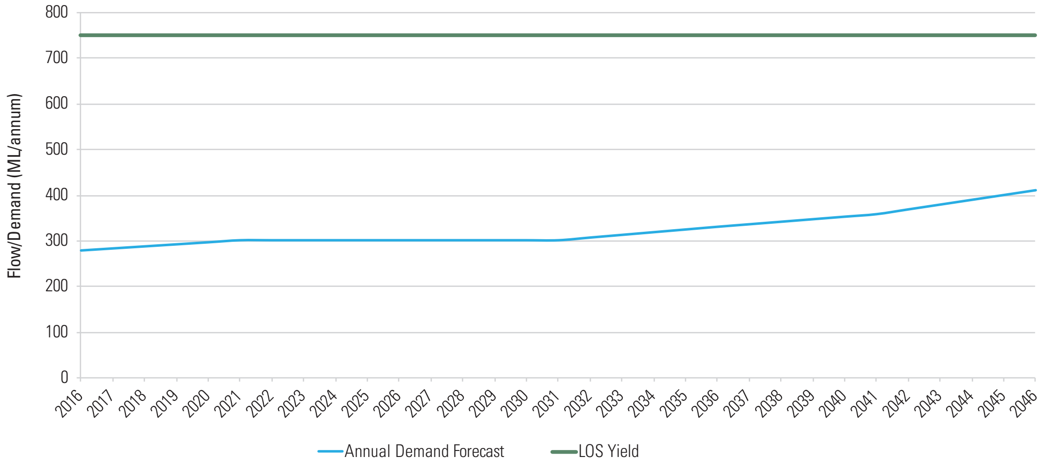


Figure N-19 Point Lookout annual demand forecast and LOS yield

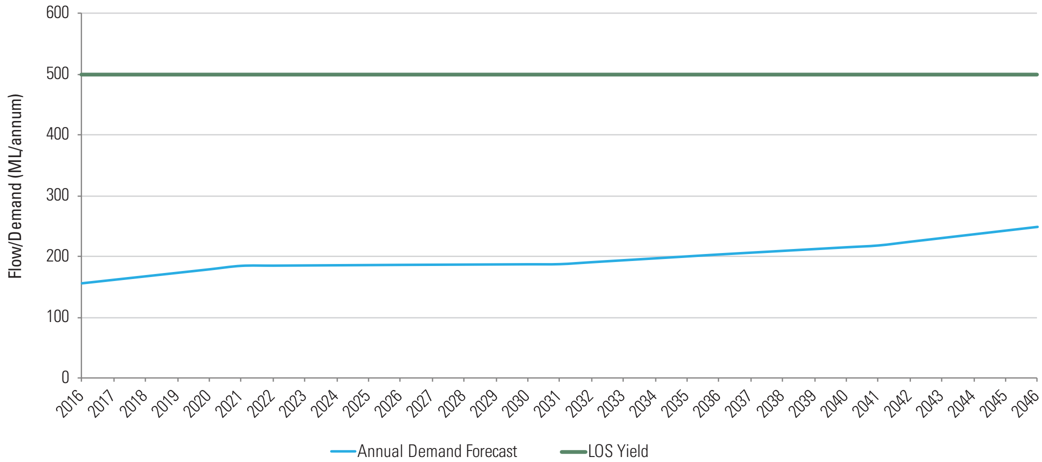


Figure N-20 Dunwich annual demand forecast and LOS yield

The planning for bulk water sources for NSI will be reviewed as part of the Water Security Program planning cycle, however early review will occur if average demand for each of the off-grid communities reach 80% of the LOS yield as shown below in Table N-11.

Table N-11 Summary – LOS Yield Review

Description	Amity Point	Point Lookout	Dunwich
Supply Source Review (80% of LOS Yield)	160 ML/annum	600 ML/annum	400 ML/annum

Treatment capacity

During normal operations water will be sourced from the NSI Aquifer and treated locally at each of the off-grid WTPs. Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

A comparison between WTP capacity and the peak (MDMM) demand forecast for each NSI Community is made in the following figures:

- Amity Point (Figure N-21)
- Point Lookout (Figure N-22)
- Dunwich (Figure N-23)

These comparisons show that Amity Point and Dunwich have sufficient WTP capacity over the 30 year period, but the WTP at Point Lookout has insufficient capacity with the demand likely to exceed capacity in 2037. Table N-12 provides a summary of the WTP capacity need assessment.

Table N-12 Summary – Treatment capacity NSI off-grid communities

Description	Amity Point	Point Lookout	Dunwich
MDMM Demand 2046	0.71 ML/day	2.0 ML/day	1.0 ML/day
20-hour operational capacity	1.5 ML/day	1.6 ML/day	1.2 ML/day
24-hour operational capacity	1.8 ML/day	2.0 ML/day	1.4 ML/day
Operational shortfall	No	Yes	No
Date WTP upgrade required by	>2046	2037	>2046

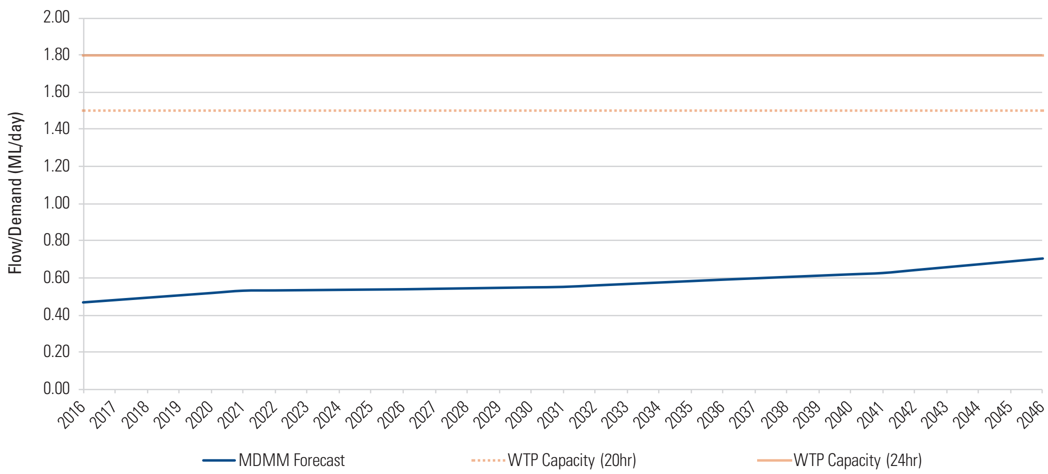


Figure N-21 Amity Point MDMM demand forecast and treatment capacity

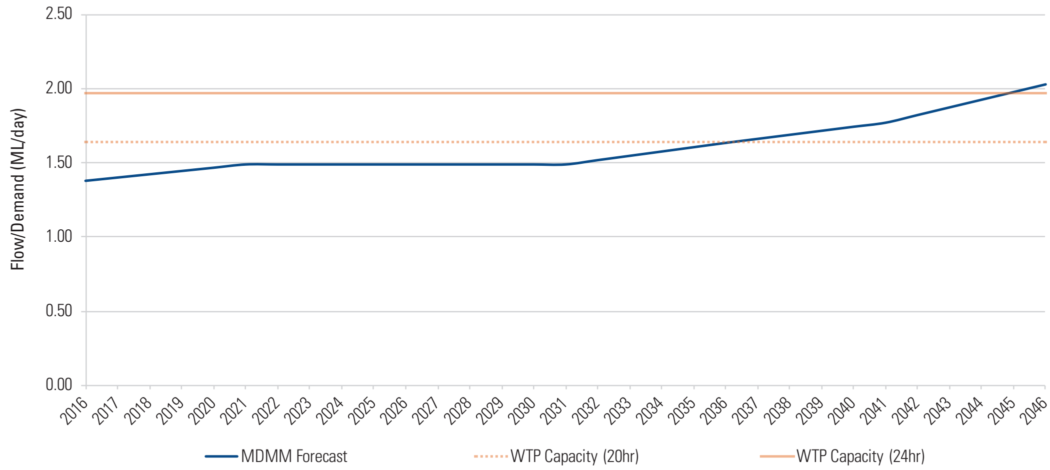


Figure N-22 Point Lookout MDMM demand forecast and treatment capacity

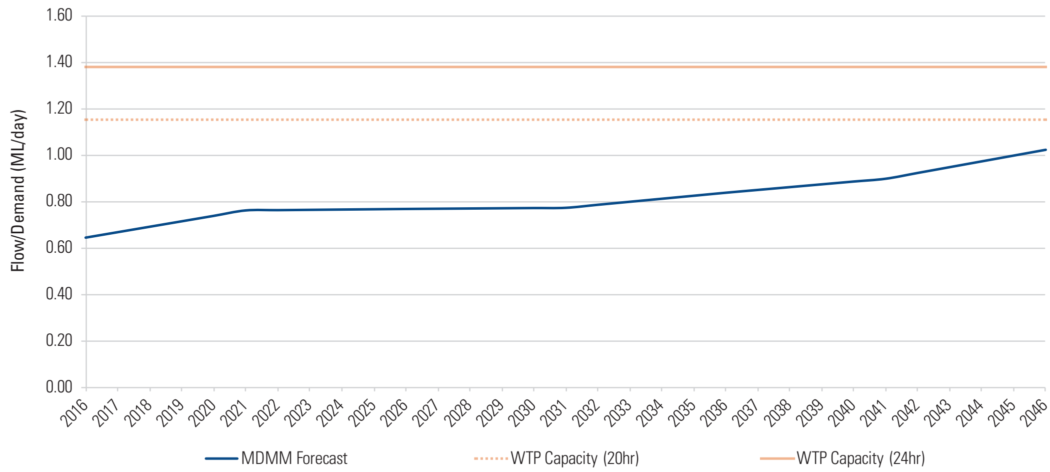


Figure N-23 Dunwich MDMM demand forecast and treatment capacity

The planning for bulk supply treatment infrastructure will be reviewed at regular intervals as part of the Seqwater planning cycle. However, the planning review will be brought forward if demands reach average demand trigger levels as identified in Table N-13 or if the demands are likely to exceed the 20 hour capacity of a WTP within a two year period.

Table N-13 Summary – Treatment capacity NSI off-grid communities

Description	Amity Point	Point Lookout	Dunwich
20-hour operational capacity	1.5 ML/day	1.6 ML/day	1.2 ML/day
Average demand trigger for review	0.71 ML/day	0.88 ML/day	0.61 ML/day
MDMM trigger for review	1.2 ML/day	1.3 ML/day	0.92 ML/day

System operation

The system operation options available to supply water to NSI include:

- Normal operation – Extraction from the NSI Aquifer within water entitlement limits and treatment at each of the three conventional water treatment plants
- Emergency operation – Water carting from alternative WTP on NSI is a feasible solution to ensure supply for each of the three communities when supply is not available under emergency conditions including drought.

The trigger to change from normal operation to water carting will be driven by the ability to supply the community with potable water. For drought conditions this operation would commence when supply is no longer available from the local Water Treatment Plant bores.

NSI water future

Table N-14 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for the three off-grid communities. Based on this plan the LOS yield for the NSI water supply scheme is 200, 750 and 500 ML/annum for Amity Point, Point Lookout and Dunwich respectively.

Table N-14 Demand, system operation and supply lever summary

<table>
<tr><th>Description</th><th>Amity Point</th><th>Point Lookout</th><th>Dunwich</th></tr>
<tr><td>Demand</td><td>Demand is forecasted to grow by 50% from 100 ML/annum to 150 ML/annum. The demand lever options for the Amity Point off-grid community include all measures outlined within the Amity Point drought response plan.</td><td>Demand is forecasted to grow by 46% from 280 ML/annum to 410 ML/annum. The demand lever options for the Point Lookout off-grid community include all measures outlined within the Point Lookout drought response plan.</td><td>Demand is forecasted to grow by 56% from 160 ML/annum to 250 ML/annum. The demand lever options for the Dunwich off-grid community include all measures outlined within the Dunwich drought response plan.</td></tr>
<tr><td rowspan="6">The system operations available to supply water to the NSI off-grid communities include:</td><td colspan="3">Normal operation – Extraction from the NSI Aquifer and treatment at the local WTP is the normal operation for this scheme.</td></tr>
<tr><td>The water entitlement associated with extraction from the NSI Aquifer is equivalent to 200 ML/annum.</td><td>The water entitlement associated with extraction from the NSI Aquifer is equivalent to 750 ML/annum</td><td>The water entitlement associated with extraction from the NSI Aquifer is equivalent to 500 ML/annum</td></tr>
<tr><td colspan="3">Emergency operation – Water carting to meet future demand needs is a feasible solution to provide supply for Amity Point, Point Lookout and Dunwich during emergency conditions including drought.</td></tr>
<tr><td>It is estimated that up to 0.48 ML/day could be sourced through carting if required</td><td>It is estimated that up to 0.48 ML/day could be sourced through carting if required</td><td>It is estimated that up to 0.56 ML/day could be sourced through carting if required</td></tr>
<tr><td colspan="3">For drought conditions the alternative emergency operation would commence if and when supply is no longer available from the local groundwater source.</td></tr>
<tr></tr>
<tr><td rowspan="2">Supply</td><td>The LOS yield that can be achieved has been determined to be equivalent to 200 ML/annum.</td><td>The LOS yield that can be achieved has been determined to be equivalent to 750 ML/annum.</td><td>The LOS yield that can be achieved has been determined to be equivalent to 500 ML/annum.</td></tr>
<tr><td colspan="3">This has been aligned to the maximum water entitlement available for each off-grid community.

The existing NSI Aquifer supply will remain the dominant supply for the each NSI off-grid community out to 2046, with water carting potentially required to supplement supply at times of peak demand. No new sources are required although augmentations may be required to the Point Lookout WTP over the 30 year horizon.</td></tr>
</table>

NSI has sufficient water security for the 30-year planning period, however a WTP upgrade would be required at Point Lookout in 2037 based on the current demand forecast. Seqwater will monitor influences and trends in demand and supply to provide adequate time to respond if required. The reassessment of the NSI off-grid community's water security will be based on one of the following triggers:

- General NSI review triggers:
  - A 5 yearly review period.
  - Significant changes to groundwater behaviour.
- Amity Point specific triggers:
  - A trigger for review based on Amity Point average demand exceeding 160 ML/annum for LOS and water entitlement considerations.
  - A trigger for review based on Amity Point average demand exceeding 0.71 ML/day (equivalent to MDMM demand of 1.2 ML/day) for WTP capacity consideration providing a minimum of two years to investigate WTP improvement/upgrade requirements.
- Point Lookout specific triggers:
  - A trigger for review based on Point Lookout average demand exceeding 600 ML/annum for LOS and water entitlement considerations.
  - A trigger for review based on Point Lookout average demand exceeding 0.73 ML/day (equivalent to MDMM demand of 1.3 ML/day) for WTP capacity consideration providing a minimum of two years to investigate WTP improvement/upgrade requirements.
- Dunwich specific triggers:
  - A trigger for review based on Dunwich average demand exceeding 400 ML/annum for LOS and water entitlement considerations. A trigger for review based on Dunwich average demand exceeding 0.61 ML/day (equivalent to MDMM demand of 0.92 ML/day) for WTP capacity consideration providing a minimum of two years to investigate WTP improvement/upgrade requirements.

NSI DROUGHT RESPONSE PLANS – AMITY POINT

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	Ground water (GW) observation bore 14400016 measures 15mAHD	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (Redland City Council) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	GW observation bore 14400016 measures 10mAHD OR GW observation bore 142634 measures 4mAHD	160 L/p/day residential demand		As per level 1 (S & Redland City Council)
3. Voluntary conservation, restriction of standpipe and carting of water	NA as carting is not a viable option and there are no standpipes on North Stradbroke Island			
4. Voluntary conservation, restrictions and the appropriate regulatory measures	GW observation bore 14400016 measures 4mAHD OR GW observation bore 142634 measures 2mAHD	140 L/p/day residential demand	Impose water restrictions	As per level 2 (S & RCC)
4a. Further water restrictions	GW observation bore 14400016 measures 3mAHD OR GW observation bore 142634 measures 1.5mAHD	130 L/p/day residential demand		
Emergency Response	Loss of supply continuity	Maximum possible demand reduction	Implement EMSV plans	As per level 4 (S & RCC) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	NA for North Stradbroke Island			
Complete drought exit	GW observation bore 14400016 measures 17mAHD OR GW observation bore 142634 measures 8mAHD	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & RCC) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, RCC = Redland City Council, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Redland City Council (RCC) and other major customers of the supply status (RCC)		Nil	Update DRP contact list and review actions (S)
	• As per level 1 (S & RCC) • Commence low level public communications (RCC) • Advise standpipe users of restriction at next level (RCC)			• Communications planning (RCC) • Make necessary arrangements for water carters to cart water (S)
	As per level 2 (S & RCC)	• Impose water restrictions on customers (RCC)		**Emergency response** • Communications planning (RCC) • Determine and prepare for emergency response (S& RCC) **Drought exit** • Communications planning (Redland City Council)
		• Increase water restrictions (RCC)		
	As per level 4 (S & RCC)	• Retain and possibly increase severity of water restrictions (RCC)	Implement appropriate EMSV plans (S& RCC)	Continue emergency response planning (S& RCC)
	• As per level 1 but advising of exit (S & RCC) • Drought exit communications (S)	• Revoke water restrictions (Redland City Council)	**Water source** • Cease carting water (S)	• Review and debrief (S& RCC) • Update the Disruption Plan (S)

NSI DROUGHT RESPONSE PLANS – POINT LOOKOUT

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	Ground water (GW) observation bore 14400016 measures 15mAHD	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (Redland City Council) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	GW observation bore 14400016 measures 10mAHD OR GW observation bore 14400056 measures 4mAHD	160 L/p/day residential demand		As per level 1 (S & Redland City Council)
3. Voluntary conservation, restriction of standpipe and carting of water	NA as carting is not a viable option and there are no standpipes on North Stradbroke Island			
4. Voluntary conservation, restrictions and the appropriate regulatory measures	GW observation bore 14400016 measures 4mAHD OR GW observation bore 14400056 measures 2mAHD	140 L/p/day residential demand	Impose water restrictions	As per level 2 (S & RCC)
4a. Further water restrictions	GW observation bore 14400016 measures 3mAHD OR GW observation bore 14400056 measures 1.5mAHD	130 L/p/day residential demand		
Emergency Response	Loss of supply continuity	Maximum possible demand reduction	Implement EMSV plans	As per level 4 (S & RCC) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	NA for North Stradbroke Island			
Complete drought exit	GW observation bore 14400016 measures 17mAHD OR GW observation bore 14400056 measures 8mAHD	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & RCC) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, RCC = Redland City Council, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Redland City Council (RCC) and other major customers of the supply status (RCC)		Nil	Update DRP contact list and review actions (S)
	• As per level 1 (S & RCC) • Commence low level public communications (RCC) • Advise standpipe users of restriction at next level (RCC)			• Communications planning (RCC) • Make necessary arrangements for water carters to cart water (S)
	As per level 2 (S & RCC)	Impose water restrictions on customers (RCC)		**Emergency response** • Communications planning (RCC) • Determine and prepare for emergency response (S& RCC) **Drought exit** • Communications planning (Redland City Council)
		Increase water restrictions (RCC)		
	As per level 4 (S & RCC)	Retain and possibly increase severity of water restrictions (RCC)	Implement appropriate EMSV plans (S& RCC)	Continue emergency response planning (S& RCC)
	• As per level 1 but advising of exit (S & RCC) • Drought exit communications (S)	Revoke water restrictions (Redland City Council)	**Water source** • Cease carting water (S)	• Review and debrief (S& RCC) • Update the Disruption Plan (S)

NSI DROUGHT RESPONSE PLANS – DUNWICH

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	Ground water (GW) observation bore 14400016 measures 15mAHD	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (Redland City Council) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	GW observation bore 14400016 measures 10mAHD OR GW observation bore 14400038 measures 4mAHD	160 L/p/day residential demand		As per level 1 (S & Redland City Council)
3. Voluntary conservation, restriction of standpipe and carting of water	NA as carting is not a viable option and there are no standpipes on North Stradbroke Island			
4. Voluntary conservation, restrictions and the appropriate regulatory measures	GW observation bore 14400016 measures 4mAHD OR GW observation bore 14400038 measures 2mAHD	140 L/p/day residential demand	Impose water restrictions	As per level 2 (S & RCC)
4a. Further water restrictions	GW observation bore 14400016 measures 3mAHD OR GW observation bore 14400038 measures 1.5mAHD	130 L/p/day residential demand		
Emergency Response	Loss of supply continuity	Maximum possible demand reduction	Implement EMSV plans	As per level 4 (S & RCC) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	NA for North Stradbroke Island			
Complete drought exit	GW observation bore 14400016 measures 17mAHD OR GW observation bore 14400038 measures 8mAHD	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & RCC) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, RCC = Redland City Council, EM = Emergency Manager

Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
• Advise Redland City Council (RCC) and other major customers of the supply status (RCC)		Nil	Update DRP contact list and review actions (S)
• As per level 1 (S & RCC) • Commence low level public communications (RCC) • Advise standpipe users of restriction at next level (RCC)			• Communications planning (RCC) • Make necessary arrangements for water carters to cart water (S)
As per level 2 (S & RCC)	• Impose water restrictions on customers (RCC)		**Emergency response** • Communications planning (RCC) • Determine and prepare for emergency response (S& RCC) **Drought exit** • Communications planning (Redland City Council)
	• Increase water restrictions (RCC)		
As per level 4 (S & RCC)	• Retain and possibly increase severity of water restrictions (RCC)	Implement appropriate EMSV plans (S& RCC)	Continue emergency response planning (S& RCC)
• As per level 1 but advising of exit (S & RCC) • Drought exit communications (S)	Revoke water restrictions (Redland City Council)	**Water source** • Cease carting water (S)	• Review and debrief (S& RCC) • Update the Disruption Plan (S)

DAYBORO OFF-GRID COMMUNITIES FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Dayboro off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve the Level of Service (LOS) objectives and peak (MDMM) demand objectives over the 30-year planning period.

The Dayboro water supply scheme services the regional community of Dayboro which is located approximately 46 km North West of Brisbane, west of the Sunshine Coast and behind the Blackall Ranges. The region supports farming, including pineapple and avocado plantations as well as dairy cattle.

Dayboro township is situated on Terrors Creek, upstream of the junction with North Pine River. Figure N-24 provides regional context on the location of the Dayboro township and its water supply service area.

The Dayboro water supply scheme supplies treated water to the township of Dayboro. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant). The influences that impact on the performance of the schemes are outlined below

The raw water supply for the Dayboro water supply scheme is sourced from the North Pine River Catchment. The catchment forms an important aspect of the drinking water supply chain.

The characteristics of the catchment have an influence on the amount and quality of the raw water source, which has implications for the ability to treat and supply water of a suitable quality to meet the needs of the supplied communities. Activities in the catchment that influence raw water quality include pastoral land for dairy cattle grazing, irrigated pasture, plantations and rural residential activities. Dayboro is the only major township located inside the catchment. The quality of the raw water from North Pine River also varies depending on weather conditions such as drought or rain.

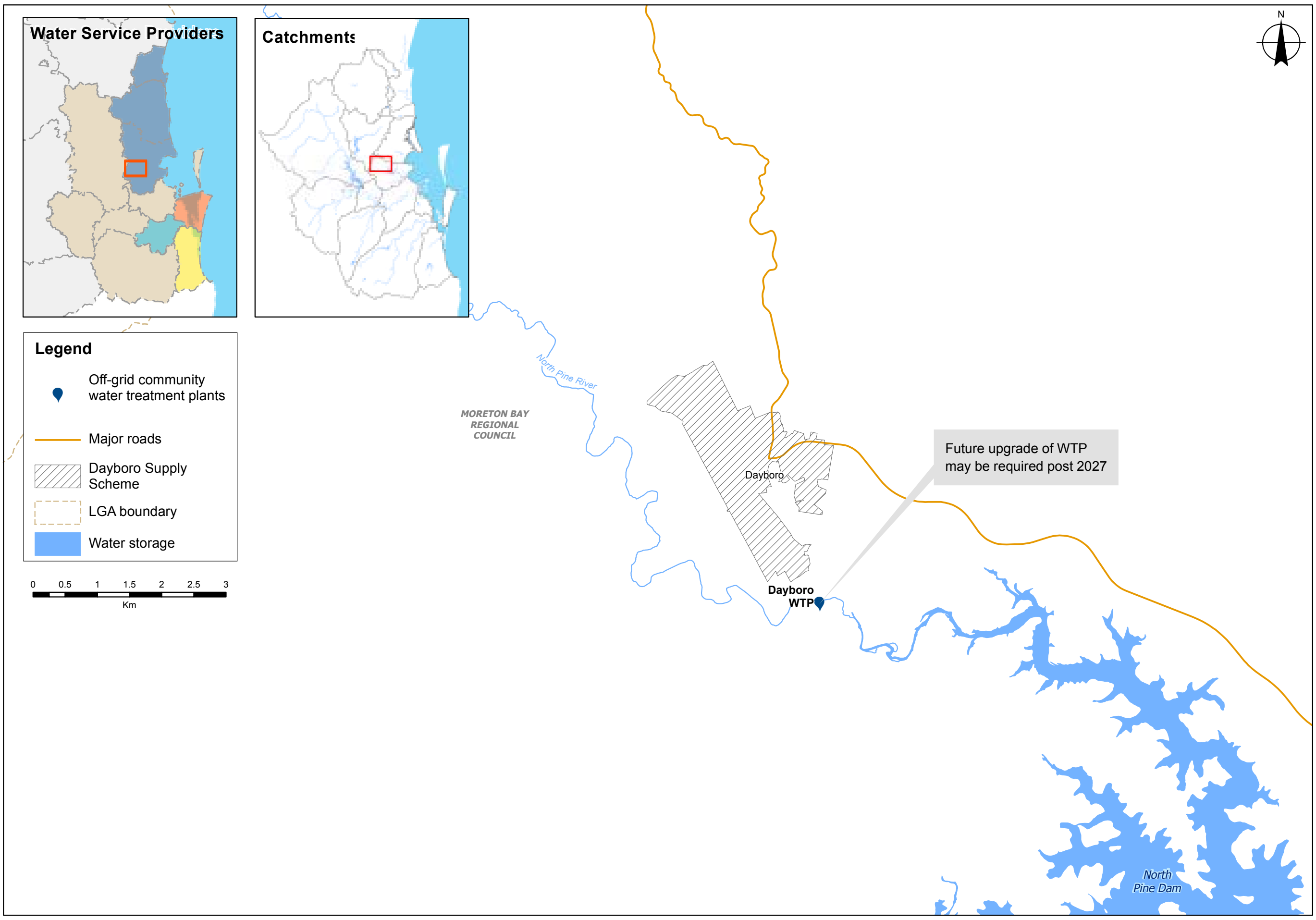


Figure N-24 Dayboro water supply scheme – Location and service area

Due to the size of the community, treated water can be carted in from an alternative source in the event of any local source issues affecting potable water supply to the Dayboro community. Water carting also provides a means to assist in meeting LOS objectives for the Dayboro township.

The Dayboro water supply scheme has a largely residential customer base.

Raw water is drawn from two wells alongside the North Pine River. During droughts, as North Pine River flow reduces, the performance of the wells also reduces and as such the alluvial aquifer provides some storage and delays the impact of a drought rather than providing an alternative source of water.

Treatment to meet drinking water quality standards is undertaken at Seqwater's local Dayboro WTP. The bulk treated water produced at the plant is supplied to Unitywater who own and operate the distribution network. Unitywater have the responsibility for the retail and distribution of water to the end water users.

The Dayboro water supply scheme was identified in Version 1 of the Water Security Program as a scheme to be investigated further because there was evidence that recent floods had modified the interaction between the surface water in the North Pine River and the aquifer. This impact has been included in recent model development. Work to improve the performance of the wells and to reduce river bed erosion is also required. Following this work, improved system knowledge will be incorporated in future system modelling.

Table N-15 provides a summary of the government authorities and water service providers associated with the Dayboro supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-15 Summary – Local government, service providers and bulk supply description

Dayboro off-grid water supply	
Local government	Moreton Bay Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups.
Bulk water service provider	Seqwater
Local water service provider	Unitywater
Raw water source	The raw water for the Dayboro WTP is sourced from the North Pine River.
Water entitlement	The entitlement associated with the supply to the Dayboro township is not defined.
Water treatment plant	Dayboro WTP with an existing capacity of 1.1 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of Demand, Supply and System Operation

The Dayboro water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for Average Day (AD) demands and Peak (Mean Day Maximum Month (MDMM) demands within the Dayboro water supply scheme out to 2046. The current average demand for the water supply scheme is 190 ML/annum or an average of 0.52 ML/day. By 2046 it is expected that this average demand will increase to approximately 250 ML/annum or an average of 0.68 ML/day. Subsequently the peak (MDMM) demand is expected to be as high as 4.9 ML/day by 2046.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-25 shows Dayboro's AD and MDMM forecast demand for the next 30 years.

Demand is expected to increase into the future. Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

In the future, water may not be used the same way as we do today and demands may be higher or lower than forecast. As such it is important not to build water supply infrastructure too small, too late, too big or too early. Demand management and water supply restrictions are also essential tools of a well-managed water supply during droughts and these are listed within Dayboro's drought response plan at the end of this fact sheet.

Demand management options offer an opportunity to influence demand outcomes and provide a basis to adjust to the LOS yield required to meet LOS objectives. Some typical demand management options may include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For Dayboro, the demand management options considered in the determination of the LOS performance are outlined in the Dayboro drought response plan which can be found at the end of this fact sheet.

Supply

Supply is the primary lever used to determine LOS yield for the Dayboro water supply scheme. Consideration is therefore given to bulk supply options that could assist in supplying volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply source

There are two possible water sources for Dayboro:

- North Pine River – One source of supply is the North Pine River, which allows for run of the river supply. The source water for the Dayboro WTP is extracted from shallow bores in proximity to the River. This supply has no regulatory restriction in the form of a water entitlement and is sufficient to accommodate average demand over the next 30 years. The average demand in 2046 is forecast to be in the order of 250 ML/annum.
- Water carting – An alternative source of water for the water supply scheme is the carting of potable water from other sources. The carting of water has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers etc.). For the Dayboro off-grid community the capability of water carting from the grid is estimated at 0.43 ML/day or 160 ML/annum, which is below the forecast demand in 2046. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting is considered an emergency response to address severe drought and/or short term operational needs. It is also a secure source and assists in achieving the required LOS performance. As the combination of the North Pine River source and water carting sufficiently meet the demand of Dayboro to 2046, no additional bulk supply options are required.

Historically, run of river flows have met supply requirements for Dayboro. During the Millennium Drought, supply from North Pine River was maintained. During periods of flooding however, supplementary treated water supplies have been required for Dayboro due to poor raw water quality in the North Pine River. This has been successfully achieved using water carting.

A stochastic 10,000 year flow model was developed for Dayboro based on North Pine River flows, bore performance, carting and demand restrictions to determine the LOS yield. Based on current knowledge of how the bores perform, existing reservoir storage and drought response plan, the current LOS yield is estimated to be 280 ML/annum.

The need for additional infrastructure (i.e. off-stream storage) has been mitigated by the use of water carting up to 0.43 ML/day. Figure N-26 provides an overview of the relationship between the need to have off-stream storage based on the level of water carting and demand.

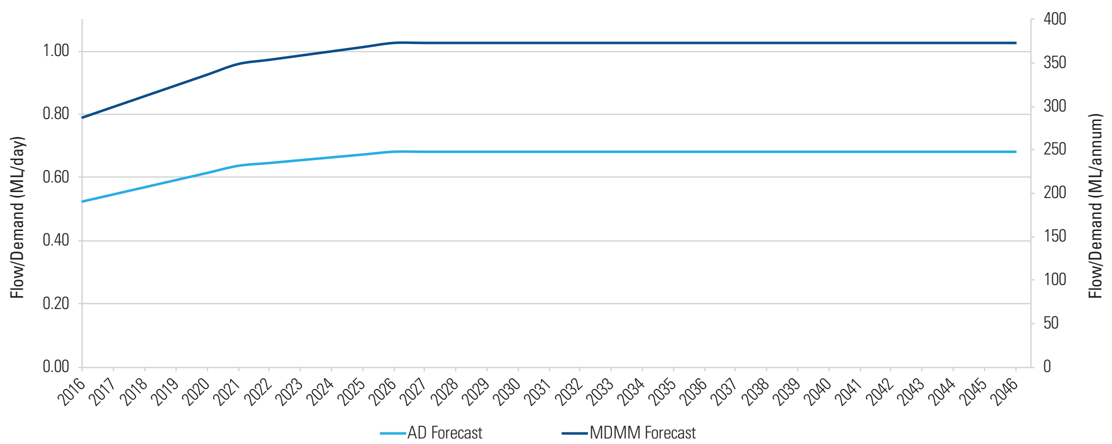


Figure N-25 Dayboro Average and Mean Day Maximum Month Demand Forecasts

The following can be deduced from this assessment:

- Reduced levels of water carting would require investment in off-stream storage. For the extreme case of no water carting an off-stream storage greater than 60 ML in volume would be required compared to no additional storage if the maximum carting capacity is assumed.
- Variation in demand may also induce the need to include off-stream storage, with average demand greater than 0.75 ML/day triggering the need to include additional storage even with maximum carting capacity in place.

For the purpose of determining Dayboro's LOS performance the ability to implement water carting in the order of 0.43 ML/day has been assumed. On this basis no additional storage is envisaged beyond what is already available within the water supply network.

The supply from the North Pine River will continue to be the dominant source of supply for the Dayboro off-grid community. This supply will be supplemented with water carting in times of drought. Using the alternative supply of carting, together with the local source, the Dayboro water supply is LOS compliant beyond 2046.

Additional supply options will be required when demand exceeds 280 ML/annum or if bore performance declines.

Figure N-27 demonstrates the ability of the 280 ML/annum LOS yield to securely supply Dayboro demand over the next 30 years.

The planning for bulk water sources for Dayboro will be reviewed as part of the Water Security Program planning cycle, however early review will occur if the average demand for Dayboro reach 220 ML/annum (i.e. 80% of the LOS yield of 280 ML/annum).

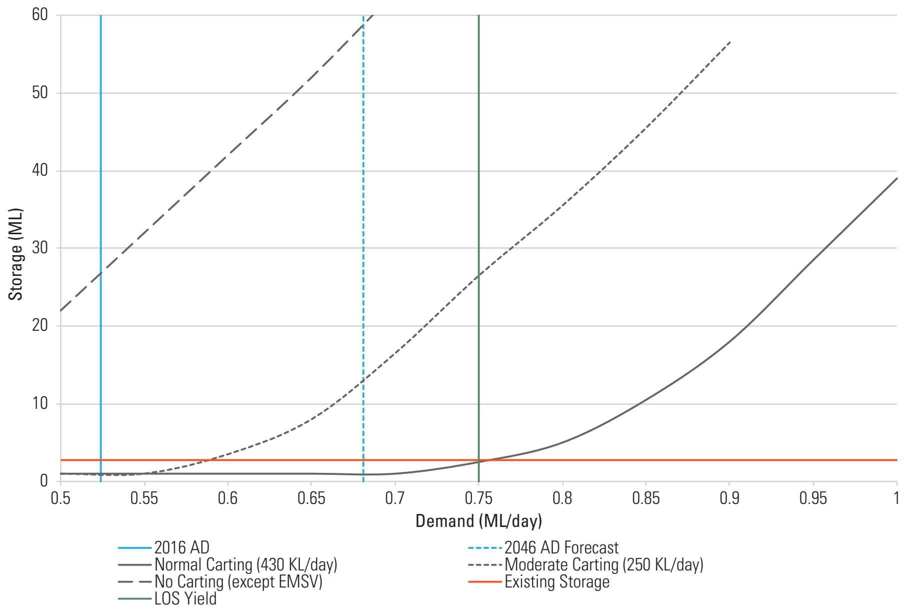


Figure N-26 Dayboro Indicative Off-Stream Storage requirements for different carting and demand scenarios

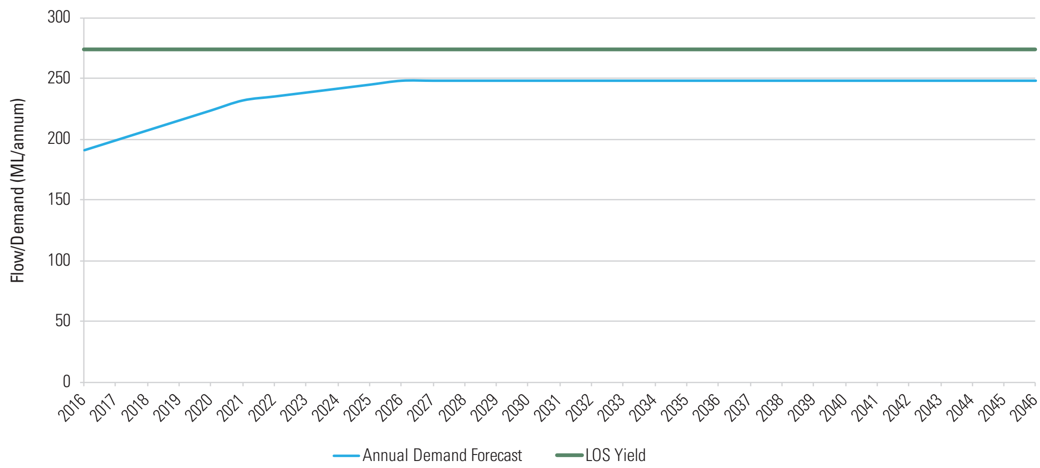


Figure N-27 Dayboro annual demand forecast and LOS yield

Treatment capacity

Water for the Dayboro supply scheme is currently sourced from the two bores adjacent to the North Pine River at the water treatment plant.

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-28 shows the 20 hour capacity of the current WTP and the peak (MDMM) demand over the next 30 years. The MDMM demand projection (1.0 ML/day) is above the 20 hour operational capacity (0.90 ML/day), however it is below the maximum 24 hour operational capacity (1.1 ML/day), indicating that at peak times there may be an operational shortfall. Water carting can supplement supply as required during such peak demand events.

Due to the envisaged WTP capacity exceedance in 2019, Seqwater will conduct planning to establish an MDMM capacity upgrade solution. Once the upgraded capacity is in place the triggers for future planning reviews will be established. These triggers will generally include:

- Intermediate planning reviews that would generally occur at a five year planning cycle
- When average demand results in an equivalent MDMM demand equivalent to 80% of the available capacity or when demand and its forecast indicates the need to upgrade capacity within a two year period.

System operations

The system operation options available to supply water to Dayboro include:

- Normal operation – Extraction from the two bores located alongside the North Pine River with treatment at the Dayboro conventional water treatment plant.
- Emergency operation – Water carting to meet future demand is a feasible solution to ensure supply for Dayboro, when supply is not available under emergency conditions including drought.

The trigger to change from normal operation to water carting will be driven by the ability to supply the community with potable water. For drought conditions this operation would commence when the standing level to both bores continues to fall below 40.7 mAHD or neither well is able to recharge.

Based on the current operation plan, Seqwater is capable of meeting all water demands of Dayboro for the next 30 years using the normal operations and carting.

Dayboro water future

Table N-16 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Dayboro. Based on this plan the LOS yield for the Dayboro water supply scheme is 280 ML/annum.

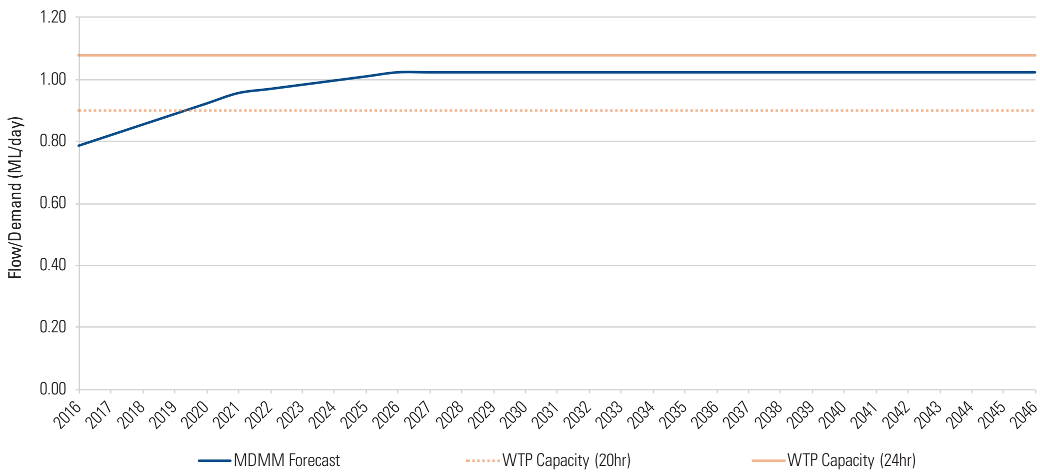


Figure N-28 Dayboro MDMM demand forecast and treatment capacity

Table N-16 Demand, system operation and supply lever summary

Levers – demand, system operation and supply	
Demand	Demand is forecasted to grow by 33% from 190 ML/annum to 250 ML/annum. The demand lever options for the Dayboro off-grid community include all measures outlined within the Dayboro drought response plan.
System Operations	The system operation options available to supply water to Dayboro include: • Normal operation – extraction from the two wells located alongside the North Pine River as well as treatment at the Dayboro conventional water treatment plant. The water entitlement associated with the supply to the Dayboro township is not defined. • Emergency operation – Water carting to meet future demand needs is a feasible solution to provide supply for Dayboro during emergency conditions including drought. It is estimated that up to 0.43 ML/day could be sourced through carting if required. Water carting to commence when the standing level to both bores continues to fall below 40.7mAHD or neither well is able to recharge.
Supply	The LOS yield that can be achieved has been determined to be equivalent to 280 ML/annum. This has been aligned to the equivalent maximum supply that can be sourced with consideration to local supply source and additional supply through water carting. The existing supply from the North Pine River will continue to be the dominant source of supply for the Dayboro off-grid community out to 2046. This supply will be supplemented with water carting in times of drought and/or peak demand. No new sources are required although augmentations may be required to the Dayboro WTP over the 30 year horizon.

Dayboro has sufficient water security for the 30 year planning horizon, however a WTP upgrade would be required in 2019 based on the current demand forecast. Seqwater will monitor influences and trends in demand and supply to provide adequate time to respond if required.

This plan will be reviewed every five years or on any other of the following triggers:

- The average annual demand exceeding 220 ML/annum
- The average daily demand exceeding 0.48 ML/day (equivalent to peak (MDMM) demand of 0.72 ML/day)

DAYBORO DROUGHT RESPONSE PLAN

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	Supply to the community being maintained, however experiencing problems with bores drawing down close to and/or tripping stop pump trigger, i.e. having to stop pumping to wait for recharge and pump again AND/OR Well No. 1 standing level falls below RL 40.70m AHD	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (UW) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	NA for Dayboro			
3. Voluntary conservation, restriction of standpipe and carting of water	River not running and standing level dropping AND/OR wells not recharging	150 L/p/day residential demand	Hydrant standpipe use prohibition and carting of water	As per level 1 but monitor daily (S & UW)
4. Voluntary conservation, restrictions and the appropriate regulatory measures	Wells not meeting demand	140 L/p/day residential demand	Continue to cart water and implement demand management	As per level 3 (S & UW)
Emergency Response	Water carting and wells not meeting demand AND/OR combined treated reservoir storage falls to less than 15%	Maximum possible demand reduction	Implement EMSV plans	As per level 4 (S & UW) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Bore levels increase to a preceding drought response trigger and removal of the action is appropriate.	Maintain the target of the level implemented	Remove appropriate drought response actions	As per level 4 (S & UW)
Complete drought exit	Well No.1 standing level above RL 41.0m AHD	Normal demand pattern (no obvious leaks)	Return to normal operations	• Completion of drought actions (S & UW) • Contact Seqwater emergency response hotline to close out (S)

S = Seqwater, UW = Unity Water, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	Advise Moreton Bay Regional Council (MBRC) and other major customers of the supply status (UW)	Monitor standpipe use (UW)	Nil	• Update DRP contact list and review actions (S) • Communications planning (S& UW) • Check water carter availability and suitable access to draw points (S)
	• As per level 2 (S & UW) • Increased communications (UW)	Standpipe restriction (UW)	Commence water carting to (S)	• Communications planning (UW) • Obtain approval to pump water from pooled areas near bore (if necessary) (S)
	As per level 3 (S & UW)	• Hydrant standpipe use prohibition • Implement targeted demand management (UW)	• Retain sandbags (S) • Continue and increase water carting (S)	**Emergency response** • Communications planning (Unitywater) • Determine and prepare for emergency response (S& UW) **Drought exit** • Communications planning (Unitywater)
	As per level 4 (S & UW)	• Standpipe remains isolated (UW) • Retain and possibly increase targeted demand management (UW)	Implement appropriate EMSV plans (S& UW)	Continue emergency response planning (S& UW)
	As per level 4 (S & UW)	• Standpipe remains isolated (UW) • Retain targeted demand management (UW)	As per level implemented (S& UW)	**Emergency response** • Continue emergency response planning (S& UW) **Drought exit/re-entry to other levels** • Communications planning (UW)
	• As per level 1 but advising of exit (S & UW) • Drought exit communications (S)	• Remove standpipe prohibition • Remove targeted demand management (UW)	**Water source** • Cease carting water (S)	• Review and debrief (S& UW) • Update the Dayboro Disruption Plan (S)

ESK OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Esk off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve the Level of Service (LOS) objectives and peak (MDMM) demand objectives over the 30-year planning period.

The Esk water supply scheme services the small township of Esk located approximately 100 km northwest of Brisbane in the Somerset Region, west of Lake Wivenhoe. The region supports farming and is an artistic centre with cafes, arts, crafts and antique stores in the heritage buildings that attract tourists. Figure N-29 provides regional context on the location of the Esk township and its water supply service area.

Esk water supply scheme

The Esk water supply scheme supplies treated water to the townships of Esk and Toogoolawah. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant). The influences that impact on the performance of the scheme are outlined below. The raw water supply for the Esk water supply scheme is sourced from Wivenhoe Dam within the Brisbane River Catchment.

The catchment forms an important aspect of the drinking water supply chain. The characteristics of the catchment have an influence on the amount and quality of the raw water source, which has implications for the ability to treat and supply water of a suitable quality to meet the needs of the Esk township and other towns drawing on Wivenhoe Dam as a source.

Activities in the catchment that can affect water quality include channel/gully erosion, cattle grazing, sewage treatment plant discharge, cropping, and intensive feedlots. There are also other townships within the catchment including Somerset, Woodford, Kilcoy, Linville, Toogoolawah, Cooyar, Yarraman, Crows Nest, Moore and Esk itself. Lake Wivenhoe is subject to periods of blooms of cyanobacteria, potential related toxins as well as taste and odour compounds. The lake provides a buffer to turbidity events that would normally be induced by runoff as a result of rainfall; however during intense flood events (such as January 2011) turbid water can be experienced at the off-take and can persist for extended periods (up to months). The quality of the raw water from the Wivenhoe Dam also varies depending on weather conditions such as drought, rain or flooding.

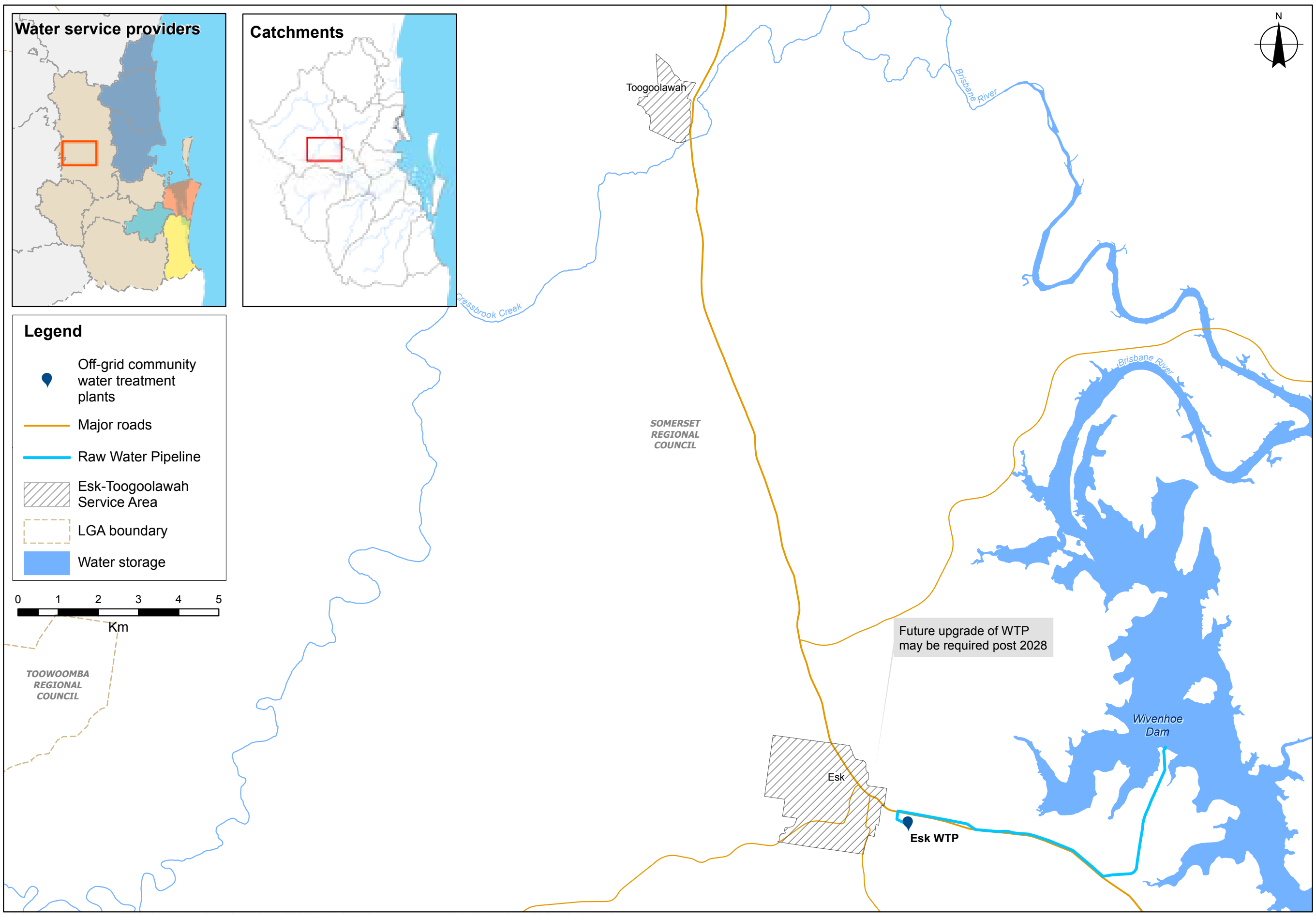


Figure N-29 Esk – existing and proposed water supply scheme and service area

Raw water pumps draw water from the end of a peninsula on Lake Wivenhoe which is then treated using conventional water treatment processes to meet drinking water quality standards at Seqwater's local Esk Water Treatment Plant (WTP). The bulk treated water produced at the plant is supplied to Queensland Urban Utilities (QUU) who own and operate the distribution network. QUU have the responsibility for the retail and distribution of water to the end water users.

Due to the small size of the community, treated water can be carted in from an alternative source in the event of any local source issues affecting potable water supply to the Esk community. When supplemented with carting, Wivenhoe Dam provides the level of reliability required to meet LOS objectives for Esk.

Table N-17 provides a summary of the government authorities and water service providers associated with the Esk supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Influence of demand, supply and system operation

The Esk water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Table N-17 Summary – Local government, service providers and bulk supply description

Esk off-grid water supply	
Local government	Somerset Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Esk WTP is sourced from Wivenhoe Dam.
Water entitlement	The entitlement for Esk forms part of much larger entitlements associated with Wivenhoe Dam (combined 24,899 ML/annum for all end water users around Wivenhoe Dam)
Water treatment plant	Esk WTP with an existing capacity of 1.3 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Demand forecast

A demand forecast has been developed providing an estimate for Average Day (AD) demands and Peak (Mean Day Maximum Month (MDMM) demands within the Esk water supply scheme out to 2046. The current average demand for the scheme is 220 ML/annum or an average of 0.6 ML/day. By 2046 it is expected that this demand will increase to 300 ML/annum or an average of 0.83 ML/day. During dry hot summer periods peak (MDMM) demand is expected to be as high as 1.3 ML/day in 2046.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-30 shows Esk AD and MDMM forecast demand for the next 30 years.

Demand is expected to increase into the future. Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For Esk, the demand management options considered in the determination of the LOS performance align with the Grid Drought Response Plan.

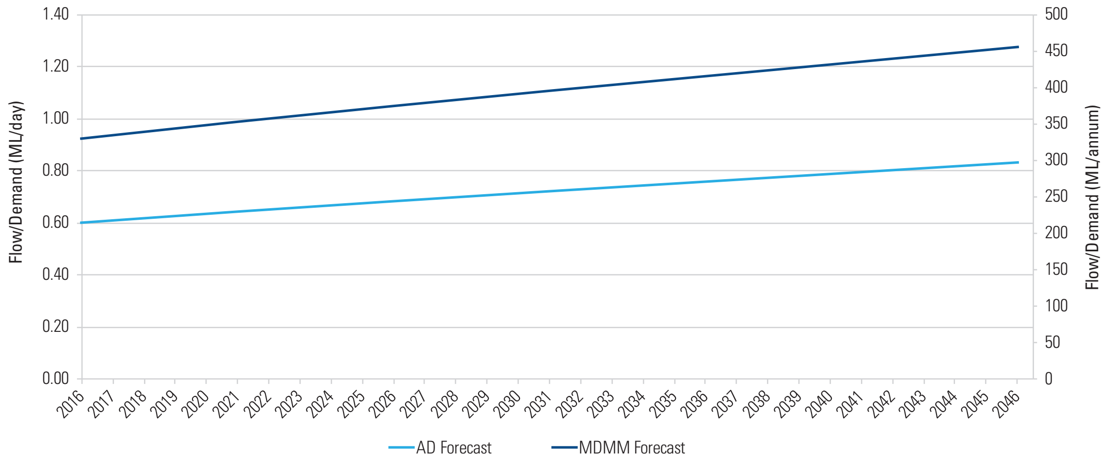


Figure N-30 Esk Average Day and Mean Day Maximum Month Forecasts

Supply

Supply is the primary lever used to determine LOS yield for the Esk water supply scheme. Consideration is therefore given to bulk supply options that could assist in supplying volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply source

There are two possible supply sources for Esk:

- Lake Wivenhoe –The existing water entitlement for Esk is defined as part of the combined 24,899 ML/annum allocated to end water users located around Lake Wivenhoe and is sufficient to meet forecast demand for Esk beyond 2046. As such, the entitlement is not a determining factor for LOS.
- Water carting – An alternative source of water for the water supply scheme is the carting of potable water from other sources. The carting of water has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers). For the Esk off-grid community the capability of water carting from the water grid is estimated at 0.43 ML/day or 160 ML/annum. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting is considered an emergency response to address short-term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Lake Wivenhoe source and water carting sufficiently meet the demand of Esk to 2046, no additional bulk supply options are required.

As Esk is dependent on Lake Wivenhoe, LOS compliance is determined based on how the bulk water supply is operated. As Lake Wivenhoe is a key component of the bulk water supply and will be operated to ensure continued supply, the Esk water supply is LOS compliant beyond 2046. In an essential minimum supply volume (EMSV) scenario, water would continue to be drawn from Lake Wivenhoe; however, in the unlikely case that water supply from Lake Wivenhoe was disrupted, the EMSV demand could be carted in from an alternative source. The current nominal LOS yield for Esk is therefore based on the ability to cart and meet the essential minimum supply volume, which is equivalent to an annual average demand of 380 ML/annum.

Figure N-31 demonstrates the ability of the 380 ML/annum LOS yield to securely supply Esk demand over the next 30 years.

Treatment capacity

The current water source for the Esk water supply scheme is Wivenhoe Dam. Water pumped from the Dam is treated at Seqwater's treatment plant at Esk.

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-32 shows the 20hr capacity of the current WTP and the peak (MDMM) demand over the next 30 years. In 2046 the forecast MDMM demand (1.3 ML/day) is above the 20hr operational capacity of 1.1 ML/day, however it is below the maximum 24hr operational capacity (1.3 ML/day), indicating that at peak times there may be an operational shortfall due to water treatment plant capacity. Water carting can supplement supply during such peak demand events. As demand increases however carting will become more frequent. This is therefore not considered an appropriate long-term solution and as such additional infrastructure is required.

WTP augmentations may be required in 2028 pending demands and assessed WTP capability at the time. With raw water quality management, demand management and reliability improvements, increased capacity may not be required or may be delayed.

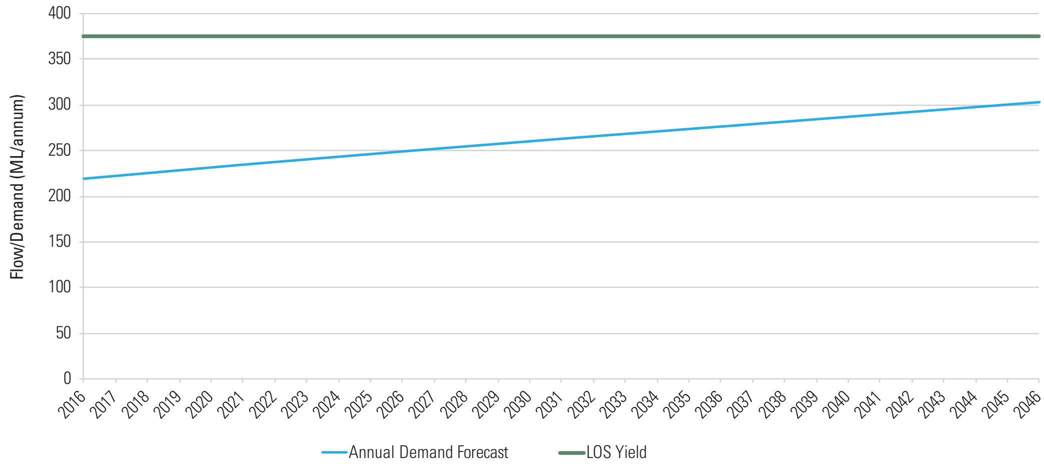


Figure N-31 Esk annual demand forecast and LOS yield

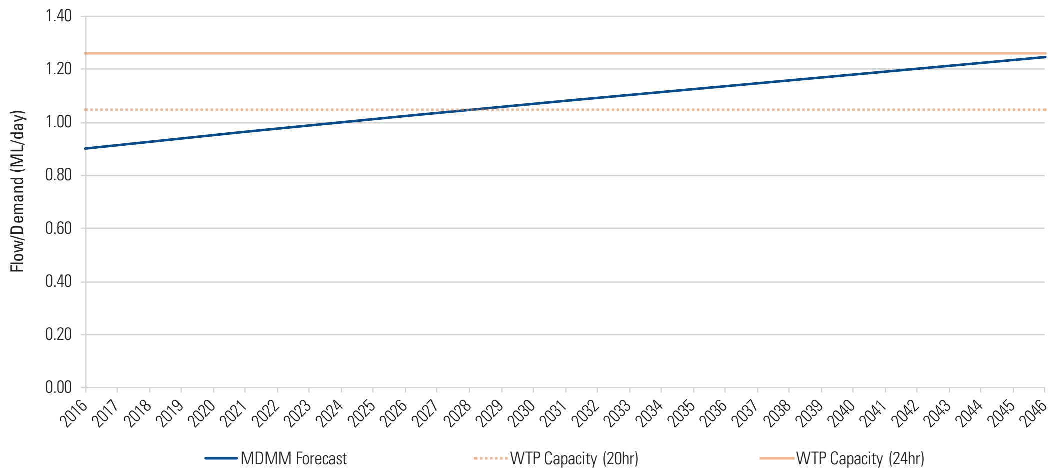


Figure N-32 Esk MDMM demand forecast and treatment capacity

System operation

The system operation options available to supply water to Esk include:

- Normal operation – extraction from Lake Wivenhoe and treatment at the Esk conventional water treatment plant is the normal operation for this scheme.
- Emergency operation – Water carting to meet essential minimum supply needs is a feasible solution to ensure supply for Esk, when supply is not available under emergency conditions including drought.

The trigger to change from normal operation to water carting will be driven by the ability to supply the community with potable water. For drought conditions this operation would commence when supply from Lake Wivenhoe cannot meet demand, in accordance with the Grid Drought Response Plan.

Based on the current operation plan, Seqwater is capable of meeting all water demands of Esk for the next 30 years using conventional water treatment and carting if/when required.

Esk Water future

Table N-18 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Esk. Based on this assessment an LOS yield of 380 ML/annum is deemed able to meet the future demand of Esk for the 30 year planning horizon.

Table N-18 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 36% from 220 ML/annum to 300 ML/annum. The demand lever options for the Esk off-grid community include all measures outlined within the Grid Drought Response Plan.
System Operations	The system operation options available to supply water to Esk include: Normal operation – Extraction from Lake Wivenhoe and treatment at the local Esk WTP is the normal operation for this scheme. The water entitlement associated with extraction from Lake Wivenhoe forms part of much larger entitlements associated with Wivenhoe Dam (combined 24,899 ML/annum for all end water users around Wivenhoe Dam). Emergency operation – Water carting to meet essential minimum supply volumes is a feasible solution to provide supply for Esk during emergency conditions including drought. It is estimated that up to 0.43 ML/day could be sourced through carting if required.
Supply	The LOS yield that can be achieved has been determined to be equivalent to 380 ML/annum. This has been aligned to the ability to cart and meet the essential minimum supply volume. The existing Lake Wivenhoe supply will remain the dominant supply for the Esk off-grid community, with water carting potentially required to supplement supply at times of peak demand. No new sources are required although an augmentation may be required to the Esk WTP over the 30 year horizon.

Esk has sufficient water security for the 30 year planning horizon; however a WTP upgrade may be required in 2028. Seqwater will monitor influences and trends in demand and supply, however at this point there is no major activity planned specifically for Esk. This plan will be reviewed every five years or on any of the following triggers:

- The Average Annual demand exceeding 300 ML/annum
- The Average Day demand exceeding 0.56 ML/day (equivalent to MDMM demand of 0.84 ML/day)

JIMNA OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Jimna off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak (MDMM) demand objectives over the 30-year planning period.

Jimna is a town in the Somerset region, located approximately 140km north of Brisbane. Jimna has a small population but is a popular destination for campers, increasing water demand at peak holiday times.

Figure N-33 provides regional context on the location of the Jimna township and its water supply service area.

Jimna water supply scheme

The Jimna water supply scheme supplies treated water to the township of Jimna. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for Jimna is typically sourced from "the Big Hole" in Yabba Creek, a tributary of the Mary River Catchment. The characteristics of the catchment influence the amount and quality of raw water available and impacts Seqwater's ability to treat and supply water to Jimna. The majority of the catchment upstream of Jimna comprises Conondale National Park, Imbil State Forest and Jimna State Forest. Jimna is the only designated settlement within the Yabba Creek catchment.

Raw water sourced from "the Big Hole" is treated to meet drinking water quality standards at Seqwater's local Jimna water treatment plant (WTP). The treated water is supplied to Queensland Urban Utilities (QUU) who own and operate the distribution network.' QUU have the responsibility for the retail and distribution of water to the end consumer.

Due to the small size of the community, carting water from Kilcoy or the water grid can support supply to Jimna in the event of any local water supply disruptions. This has been successfully employed in the past. Water carting also provides a means to assist in meeting the LOS objectives for the Jimna township.

Table N-19 provides a summary of the government authorities and water service providers associated with the Jimna supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

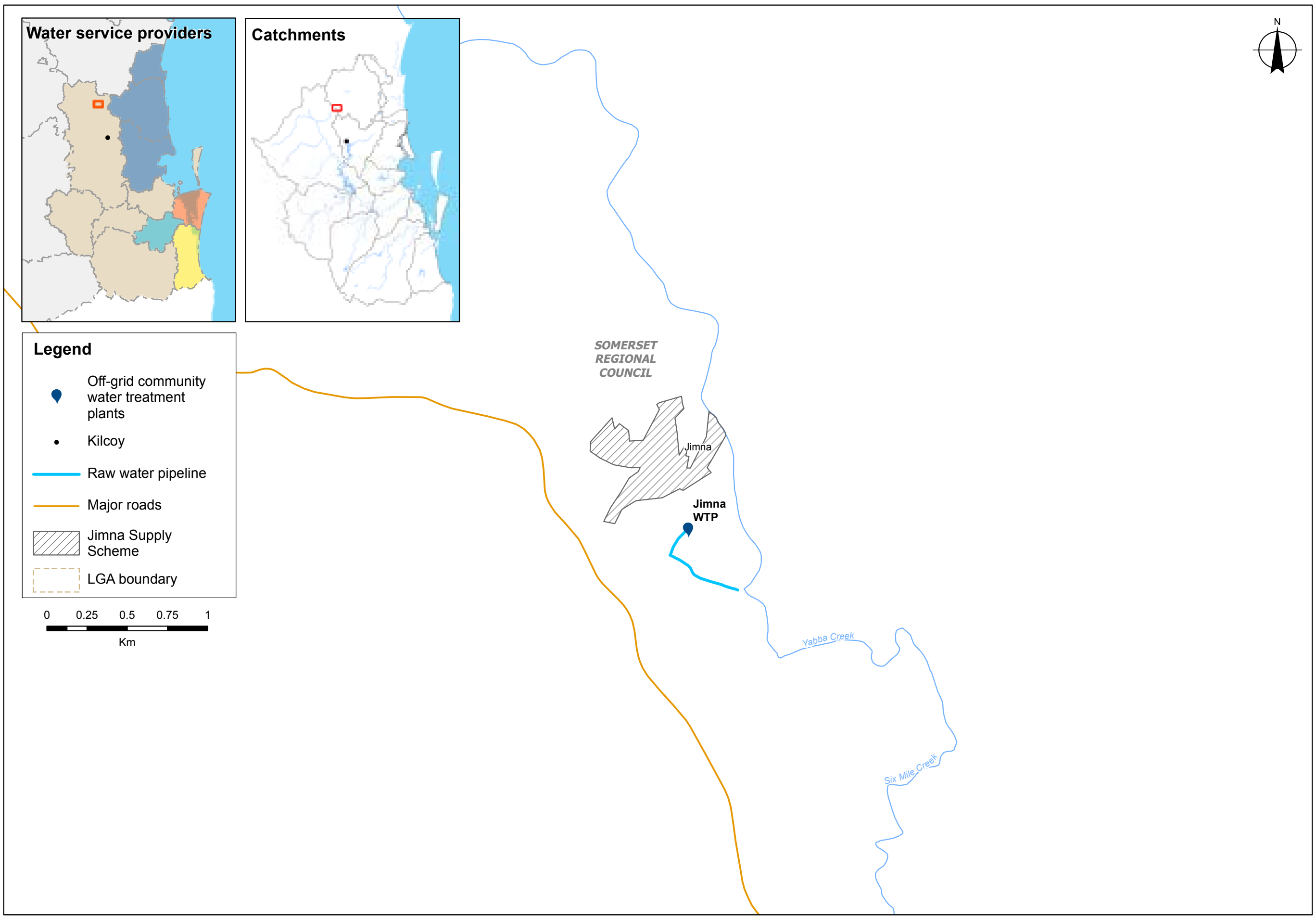


Figure N-33 Jimna water supply scheme – Location and service area

Table N-19 Summary – Local government, service providers and bulk supply description

Jimna off-grid water supply	
Local government	Somerset Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Jimna WTP is sourced from the Yabba Creek.
Water entitlement	The entitlement associated with the supply to the Jimna township is 20 ML/annum.
Water treatment plant	Jimna WTP with an existing capacity of 0.080 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of Demand, Supply and System Operation

The Jimna water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands.

There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water.

Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand Forecast

A demand forecast has been developed providing an estimate for Average Day (AD) demands and Peak (Mean Day Maximum Month (MDMM) demands within the Jimna water supply scheme out to 2046. The current annual demand for the water supply scheme is 5.2 ML/annum or an average of 0.014 ML/day. By 2046 it is expected that this demand will remain at approximately 5.2 ML/annum or an average of 0.014 ML/day. During hot dry summer periods, peak (MDMM) demand in 2046 is expected to be as high as 0.044 ML/day.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-34 shows Jimna's AD and MDMM forecast demand for the next 30 years.

Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

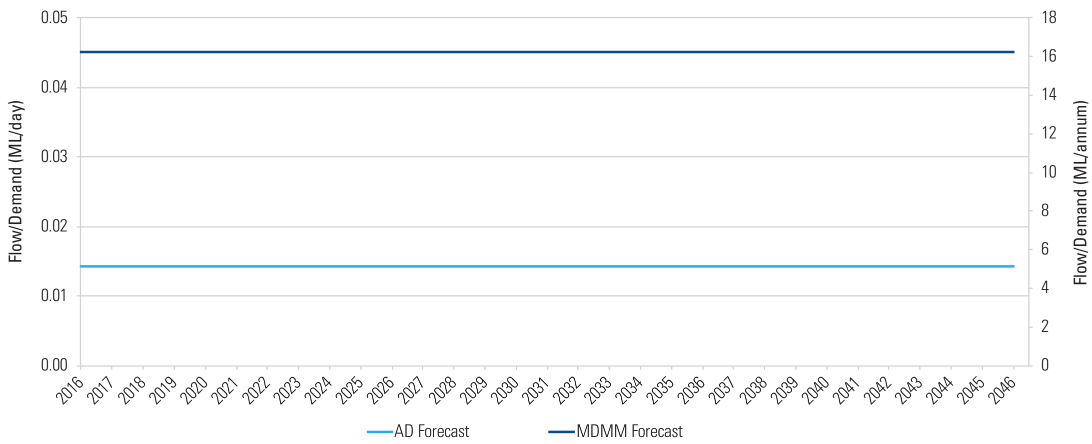


Figure N-34 Jimna Average Day and Mean Day Maximum Month Demand Forecasts

Demand Options

Demand management options offer an opportunity to influence demand outcomes and provide a basis to adjust to the LOS yield required to meet LOS objectives. Some typical demand management options may include:

- Pressure and leakage management
- Community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- Rebates for water efficient fittings and technologies
- Targeted demand management initiatives for high end water users
- Water restrictions

For Jimna, the demand management options considered in the determination of the LOS performance are outlined in the Jimna drought response plan which can be found at the end of this fact sheet.

Supply

Supply is the primary lever used to determine LOS yield for the Jimna water supply scheme. Consideration is therefore given to bulk supply options that could assist in supplying volumes required to meet demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30 year planning horizon.

Supply Source

There are two possible supply sources for Jimna:

- Yabba Creek – This supply has a regulatory restriction in the form of a water entitlement equivalent to 20 ML/annum, which is sufficient to accommodate average day demand over the next 30 years.
- Water carting – The carting of water has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers etc.). For the Jimna off-grid community the capability of water carting from the Grid is estimated at 0.48 ML/day or 180 ML/annum, which is greater than the forecast demand in 2046. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting is an emergency response to address severe drought and/or short term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Yabba Creek source and water carting sufficiently meet the demand of Jimna to 2046, no additional bulk water supplies are required.

The supply from the Yabba Creek will continue to be the normal source of supply for the Jimna off-grid community. This supply will be supplemented with water carting in times of drought.

The LOS yield has been aligned to the 20 ML/annum maximum annual water entitlement from Yabba Creek.

Figure N-35 demonstrates the ability of the 20 ML/annum LOS yield to securely supply Jimna demand over the next 30 years.

The planning for bulk water sources will be reviewed as part of the Water Security Program planning cycle, however this review will be considered earlier if the average day demand for Jimna reach 16 ML/annum (i.e. 80% of the LOS yield of 20 ML/annum).

Treatment Capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-36 shows the 20 hour capacity of the current WTP and the peak (MDMM) demand over the next 30 years. MDMM demand (0.044 ML/day) is below both the 20 hour operational capacity (0.067 ML/day) and the maximum 24 hour operational capacity (0.080 ML/day), indicating that at peak times operational requirements can be met with the existing water treatment capability. No additional WTP augmentations are required until beyond 2046.

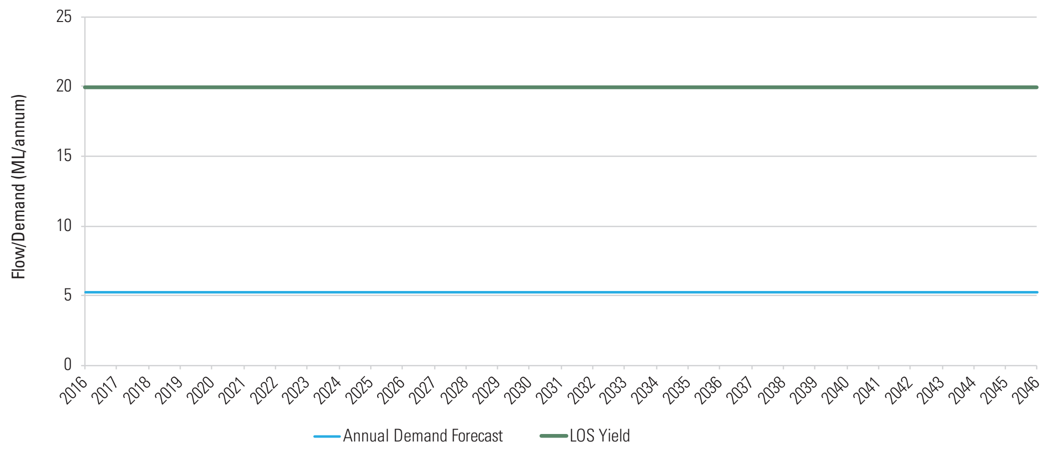


Figure N-35 Jimna annual demand forecast and LOS yield

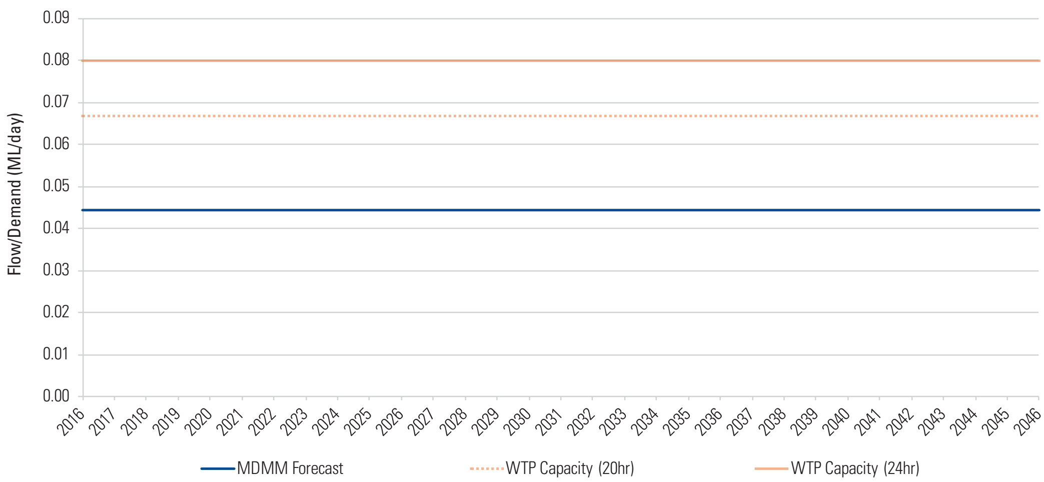


Figure N-36 Jimna MDMM demand forecast and treatment capacity

The planning for bulk supply treatment infrastructure will be reviewed at regular intervals as part of the Seqwater planning cycle. However, the planning review will be brought forward if average day demand reaches 0.017 ML/day, i.e. peak (MDMM) demand of 0.053 ML/day being 80% of the current WTP capability, or if the demand is likely to exceed current 20 hour capacity of the WTP within a two year period.

System operations

The system operation options available to supply water to Jimna include:

- Normal operation – extraction from 'The Big Hole' on the Yabba Creek within water entitlement limits and treatment at the Jimna conventional water treatment plant is the normal operation for this scheme.
- Emergency operation – Water carting to ensure supply for Jimna, when supply is not available during emergency conditions including drought.

The trigger to change from normal operation to water carting will be driven by the ability of operators to effectively supply the community with potable water supply. For drought conditions this operation would commence when the level of 'The Big Hole' is eight metres below its normal operating level.

Jimna Water Future

Table N-20 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Jimna. Based on this plan the LOS yield for the Jimna water supply scheme is 20 ML/annum.

Table N-20 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to remain stable at 5.2 ML/annum. The demand lever options for the Jimna off-grid community include all measures outlined within the Jimna drought response plan.
System Operations	The system operation options available to supply water to Jimna include: • Normal operation – Extraction from 'The Big Hole' on the Yabba Creek and treatment at the local Jimna WTP Emergency operation – Water carting from Kilcoy or the water Grid
Supply	The LOS yield for the water supply scheme is 20 ML/annum. No new sources are required and no augmentations to the Jimna WTP will be required over the 30 year horizon

Jimna has sufficient water security for the 30 year planning horizon. Seqwater will monitor influences and trends in demand and supply to provide adequate time to respond if the situation changes. This plan will be reviewed every five years or on any of the following triggers:

- The annual demand exceeding 16 ML/annum
- The Average Day demand exceeding 0.017 ML/day (equivalent to MDMM demand of 0.053 ML/day)

JIMNA DROUGHT RESPONSE PLAN

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	No water flowing over the weir	Normal demand pattern (where there are no obvious system leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	NA			
3. Voluntary conservation, restriction of standpipe and carting of water	The Big Hole is 8m below normal operating level	150 L/p/day (residential)	Hydrant standpipe prohibition, communications plan and carting of water	As per level 1 but monitor daily (S & QUU)
4. Restrictions and the appropriate regulatory measures	Water carting source is under water restrictions OR not maintaining supply.	140 L/p/day (residential)	Continue to cart water and impose water restrictions (as per water source)	As per level 3 (S & QUU)
Emergency Response	Access blocked – normal carting not possible	Maximum reduction (100 L/p/day residential and non-residential combined)	Implement EMSV plans	As per level 4 (S & QUU) Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Water supply level of a preceding drought response trigger and removal of the action is operationally appropriate	Maintain the target of the level implemented	Remove appropriate drought response actions	As per level 4 (S & QUU)
Complete drought exit	Big Hole replenished and weir overflowing	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM = Emergency Manager

Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
Advise Somerset Regional Council (SRC) and other major customers of the supply status (QUU)	Monitor hydrant standpipe use (QUU)	Nil	Update contact list and review actions (S)
• As per level 1 (S & QUU) • As per level 1 (S & QUU) • Commence public communications (QUU)	Hydrant standpipe prohibition (QUU)	Commence water carting S)	Communications planning (QUU)
As per level 3 (S & QUU)	• Hydrant standpipe prohibition (QUU) • Impose water restrictions on customers (QUU)	Continue and increase water carting (S)	**Emergency response** • Align with source water drought response plan (S&QUU) **Drought exit** • Communications planning (QUU)
As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain and possibly increase severity of water restrictions (QUU)	Implement appropriate EMSV plans (S&QUU)	Continue emergency response planning (S&QUU)
As per level 4 (S & QUU)	• Standpipe remains restricted (QUU) • Retain restrictions (QUU)	As per level implemented (S&QUU)	**Emergency response** • Continue emergency response planning (S&QUU) **Drought exit/re-entry to other levels** • Communications planning (QUU)
• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	• Remove hydrant standpipe prohibition (QUU) • Revoke water restrictions (QUU)	**Water source** • Cease carting water (S)	• Review and debrief (S&QUU) • Update the Jimna Disruption Plan (S)

KENILWORTH OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Kenilworth off-grid community. As part of South East Queensland's Water Secuirty Program 2016-2046, this plan aims to achieve the Level of Service (LOS) objectives and peak (MDMM) demand objectives over the 30-year planning period.

The Kenilworth water supply scheme services the regional community of Kenilworth which is located approximately 150 km north-west of Brisbane, west of the Sunshine Coast and behind the Blackall Ranges. The area is surrounded by mountain ranges and native forests making it a popular destination for camping, horse riding and walking. Kenilworth township is situated on the Mary River, at the junction with Obi Obi Creek.

Figure N-37 provides regional context on the location of the Kenilworth township and its water supply service area.

The Kenilworth water supply scheme supplies treated water to the township of Kenilworth. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

Raw water is sourced from the Mary River via a wet well located in a sandbank near the junction with Obi Obi Creek. The characteristics of the Mary River catchment influence the amount and quality of raw water available and impacts Seqwater's ability to treat water for supply to Kenilworth. Agricultural and other land use in the catchment has led to land clearing. Riparian vegetation cover is variable and as a result, sections of the river bank are unstable and susceptible to erosion and adverse impacts on water quality.

Raw water is treated to meet drinking water quality standards at Seqwater's local Kenilworth water treatment plant (WTP). The treated water is supplied to Unitywater who own and operate the distribution network. Unitywater has responsibility for retail and distribution of water to the end water users.

Due to the small size of the community, carting water from the water grid can support supply to Kenilworth in the event of any local water supply disruptions. This has been successfully employed in the past. Water carting also provides a means to assist in meeting the LOS objectives for the Kenilworth township.

Table N-21 provides a summary of the government authorities and water service providers associated with the Kenilworth supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

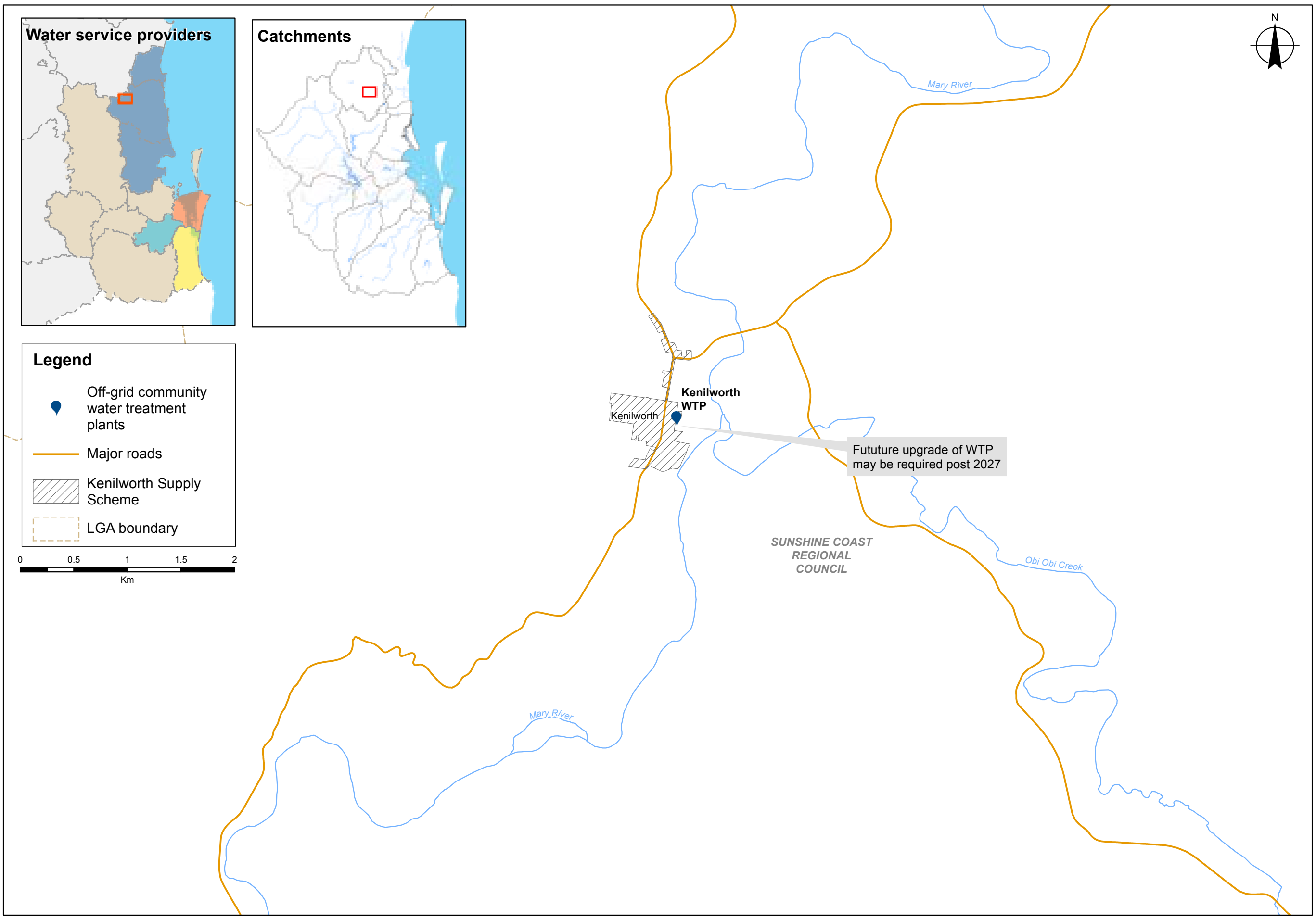


Figure N-37 Kenilworth water supply scheme

Table N-21 Summary – Local government, service providers and bulk supply description

Kenilworth off-grid water supply	
Local government	Sunshine Coast Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Unitywater
Raw water source	The raw water for the Kenilworth WTP is sourced from the Mary River.
Water entitlement	The entitlement associated with the supply to the Kenilworth township is 220 ML/annum.
Water treatment plant	Kenilworth WTP with an existing capacity of 0.52 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Kenilworth water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for Average Day (AD) and Peak (Mean Day Maximum Month (MDMM) demand within the Kenilworth water supply scheme out to 2046.

The current average demand for the water supply scheme is 62 ML/annum or an average of 0.17 ML/day. By 2046 it is expected that this demand will increase to approximately 120 ML/annum or an average of 0.33 ML/day. During hot dry summer periods MDMM demand in 2046 is expected to be as high as 0.49 ML/day.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-38 shows Kenilworth's AD and MDMM forecast demand for the next 30 years.

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high water end water users
- water restrictions.

For Kenilworth, the demand management options considered in the determination of the LOS performance are outlined in the Kenilworth drought response plan at the end of this fact sheet.

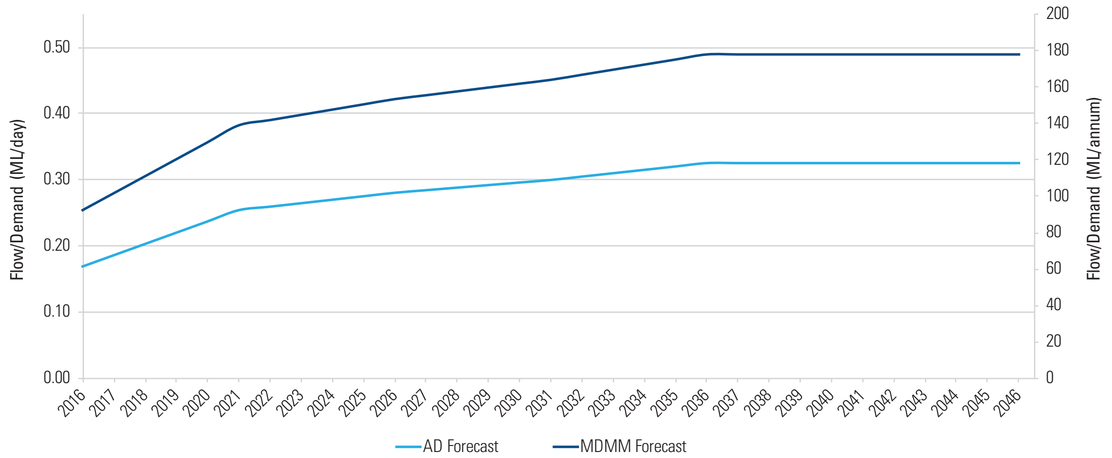


Figure N-38 Kenilworth Average Day and Mean Day Maximum Month Demand Forecasts

Supply

Supply is the primary lever used to determine LOS yield for the Kenilworth water supply scheme. Consideration is therefore given to bulk supply source options that could assist in supplying volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30 year planning horizon.

Supply source

There are two possible supply sources for Kenilworth:

- Mary River – This supply has a regulatory restriction in the form of a water entitlement equivalent to 220 ML/annum, this is sufficient to supply average day demand over the next 30 years. The average day demand in 2046 is forecast to be in the order of 120 ML/annum.
- Water carting – The carting of water has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers etc.).

  For Kenilworth the water carting capability is estimated at 0.5 ML/day or 183 ML/annum, which is greater than the forecast demand in 2046. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting is an emergency response to address severe drought and/or short term operational needs. It is a secure source and provides a means to achieve the required LOS performance. As the combination of the Mary River source and water carting sufficiently meet the demand of Kenilworth to 2046, no additional bulk supply options are required.

The supply from the Mary River will continue to be the normal source of supply for the Kenilworth off-grid community. This supply will be supplemented with water carting in times of drought. The LOS yield has been aligned to the 180 ML/annum maximum water carting capability.

Figure N-39 demonstrates the ability of the 180 ML/annum LOS yield to securely supply Kenilworth demand over the next 30 years.

Treatment capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-40 shows the 20hr capacity of the current WTP and the peak (MDMM) demand over the next 30 years. MDMM demand (0.49 ML/day) is above the 20-hour operational capacity (0.43 ML/day) indicating that there would be inadequate WTP production to meet peak demand by 2028. Water carting can supplement supply as required during such peak demand events. WTP augmentations may be required in 2028 pending demands and assessed WTP capability at the time. With raw water quality management, demand management and reliability improvements, increased capacity may not be required.

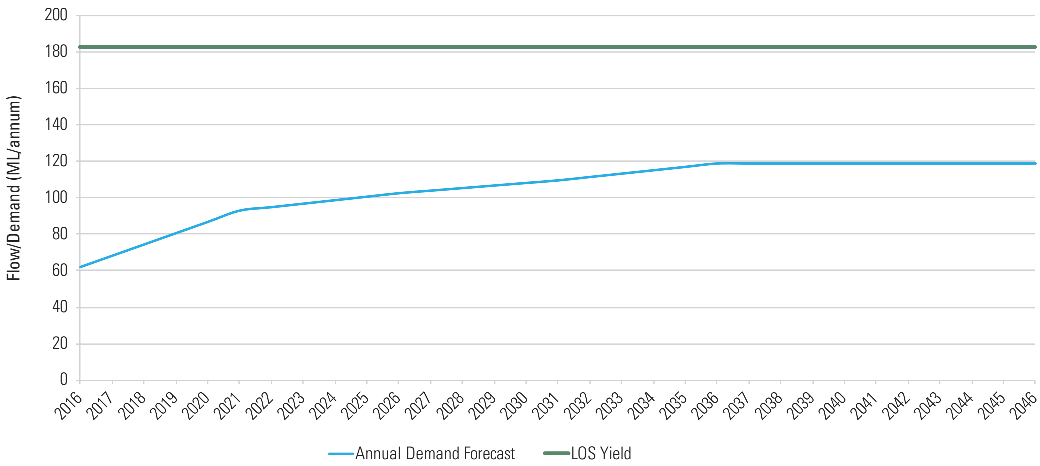


Figure N-39 Kenilworth annual demand forecast and LOS yield

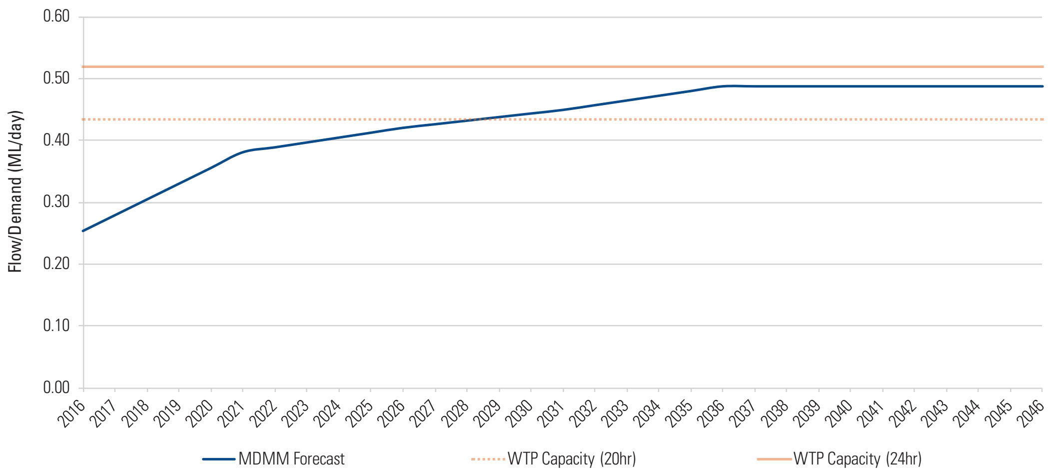


Figure N-40 Kenilworth MDMM demand forecast and treatment capacity

System operation

The system operation options available to supply water to Kenilworth include:

- Normal operation – extraction from the wet well within water entitlement limits and treatment at the Kenilworth water treatment plant.
- Emergency operation – Water carting to ensure supply for Kenilworth, when supply is not available under emergency conditions including drought.

The trigger to change from normal operation to water carting will be driven by the ability of operators to effectively supply the community with potable water supply. For drought conditions this operation would commence when the wet well doesn't recharge overnight.

Kenilworth water future

Table N-22 provides a summary of the three levers and how they will be managed to meet the LOS objectives for Kenilworth. Based on this plan the LOS yield for the Kenilworth water supply scheme is 180 ML/annum.

Table N-22 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 94% from 62 ML/annum to 120 ML/annum. The demand lever options are outlines in the Kenilworth drought response plan.
System Operations	The system operation options available to supply water to Kenilworth include: Normal operation – Extraction from the Mary River. Emergency operation – Water carting.
Supply	The LOS yield for the scheme is 180 ML/annum. This is the maximum volume that can be supplied through water carting. The existing Mary River supply will remain the dominant supply for the Kenilworth off-grid community out to 2046, with water carting potentially required to supplement supply at times of peak demand and during drought. No new sources are required although augmentations may be required to the Kenilworth WTP over the 30 year horizon.

Kenilworth has sufficient water security for the 30 year planning horizon, however a WTP upgrade may be required in 2028. Seqwater will monitor influences and trends in demand and supply to provide adequate time to respond if required. This plan will be reviewed every five years or on any of the following triggers:

- the Average Annual demand exceeding 150 ML/annum
- the Average Day demand exceeding 0.23 ML/day (equivalent to MDMM demand of 0.35 ML/day).

KENILWORTH DROUGHT RESPONSE PLAN

This is a guide.

Level	Trigger	Target	Key actions	Monitor, manage and report	
1. Drought alert, preparedness and monitoring	River flow drops to 0 ML/day at Bellbird Creek off the Mary River (gauge 138110A OR Supply to the community being maintained, however experiencing problems with river well drawing down close to and/or tripping stop pump trigger, i.e. having to stop pumping to wait for recharge and pump again.	Demand management strategy targets to meet the level of service objectives	Reporting and readiness	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (UW) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S) • Update Drought Response Plan contact list and review actions (S)	
2. Voluntary conservation	NA for Kenilworth				
3. Voluntary conservation and isolation of standpipe	Well doesn't recharge overnight	Residential demand reduction to 150 L/p/day	Standpipe shut down and carting of water	As per level 1 but monitor daily (S & Unitywater)	
4. Targeted demand management	Water carting and well not meeting demand	Residential demand reduction to 140 L/p/day	Continue to cart water and implement targeted demand management	As per level 3 (S & Unitywater)	
Emergency Response	NA for Kenilworth. follow emergency response plan for the carted water area				
Stepped exit	NA for Kenilworth – full recovery required				
Complete drought exit	Well back to normal operation levels	Normal demand pattern	Return to normal operations	• Completion and cessation of drought actions (S) • Contact Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)	

S = Seqwater, UW = Unity Water, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	Advise Sunshine Coast Regional Council (SCRC) and other major customers of the supply status (UW)	Monitor standpipe use (UW)	Nil	• Communications planning (S&UW) • Check water carter availability and suitable access to draw points (S)
	• As per level 1 (S & UW) • Increased communications strategy (UW)	Standpipe isolation (UW)	Commence water carting (S)	• Communications planning (UW) • Develop targeted demand management (UW)
	• As per level 1 (S & UW) • Increased communications (UW)	• Standpipe remains isolated (UW) • Implement targeted demand management (UW)	Continue and increase water carting (S)	**Emergency response** • Communications planning (UW) • Determine and prepare for emergency response (S&UW) **Drought exit** • Communications planning (UW)
	• As per level 1 (S & Unitywater) • Drought exit communications (S)	• Re-open standpipe (UW) • Remove appropriate targeted demand management (UW)	**Water source** • Cease carting water (S)	• Review and debrief (S&UW) • Update the Kenilworth Disruption Plan (S)

KILCOY OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Kilcoy off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

The Kilcoy water supply scheme services the regional community of Kilcoy, which is located approximately 94 km north-west of Brisbane, and directly north of Lake Somerset.

Figure N-41 provides regional context on the location of the Kilcoy township and its water supply service area.

Kilcoy water supply scheme

The Kilcoy water supply scheme supplies treated water to the township of Kilcoy. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

Raw water is sourced from Somerset Dam in the Stanley River catchment. The characteristics of the Stanley River catchment impact raw water quality, which affects the ability of treatment assets to meet quality and capacity requirements. Recreational activities at Somerset Dam, intensive agriculture, onsite waste water systems, industry and grazing are features of the catchment that impact on water quality risks.

Raw water is treated to meet drinking water quality standards at Seqwater's local Kilcoy WTP. The treated water is supplied to Queensland Urban Utilities who own and operate the distribution network and have responsibility for retail and distribution of water to the end water users.

Table N-23 provides a summary of the government authorities and water service providers associated with the Kilcoy supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

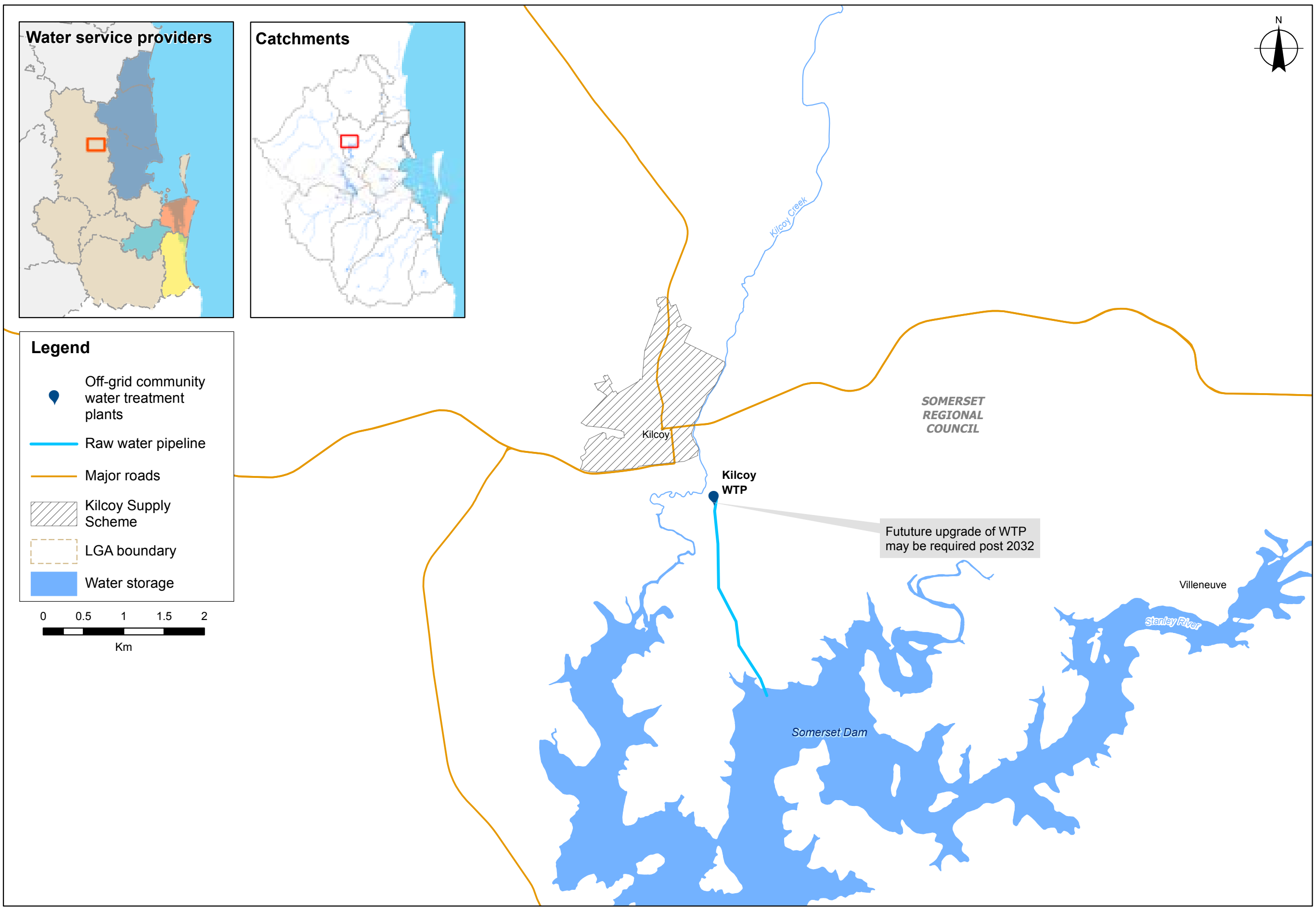


Figure N-41 Kilcoy water supply scheme – Location and service area

Table N-23 Summary – Local government, service providers and bulk supply description

Kilcoy off-grid water supply	
Local government	Somerset Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Kilcoy WTP is sourced from Lake Somerset
Water entitlement	The entitlement associated with the supply to the Kilcoy township is 1,520 ML/annum.
Water treatment plant	Kilcoy WTP with an existing capacity of 4.8 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Kilcoy water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for Average Day (AD) and Peak (Mean Day Maximum Month (MDMM)) demands within the Kilcoy water supply scheme out to 2046. The current average demand for the water supply scheme is 720 ML/annum or an average of 2.0 ML/day. By 2046 it is expected that this demand will increase to approximately 1,300 ML/annum or an average of 3.5 ML/day. Subsequently the peak (MDMM) demand is expected to be as high as 4.9 ML/day by 2046.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Kilcoy's demand includes an abattoir, which is the largest consumer and can significantly impact future demand forecasts. Figure N-42 shows Kilcoy's AD and MDMM forecast demand for the next 30 years, which represent the envisaged average and upper bound of demand for planning purposes over the 30 year period.

Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water secuirty is required.

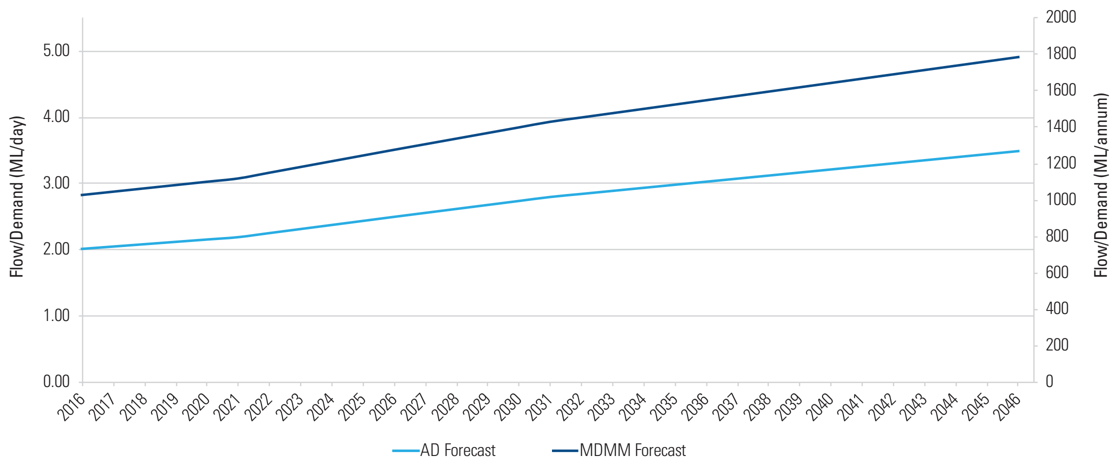


Figure N-42 Kilcoy Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high water end water users
- water restrictions.

For Kilcoy, the demand management options considered in the determination of the LOS performance are aligned with the water grid drought response approach.

Supply

Supply is the primary lever used to determine the LOS yield for the Kilcoy water supply scheme. Consideration is therefore given to bulk supply options that can assist in supplying the volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30 year planning horizon.

Supply Source

There are two possible supply sources for Kilcoy:

- Somerset Dam – This supply has a regulatory restriction in the form of a water entitlement equivalent to 1,520 ML/annum, which is sufficient to accommodate average day demand over the next 30 years. The average day demand in 2046 is forecast to be in the order of 1,300 ML/annum. Somerset Dam provides security in the order of 1 in 10,000 years, however an alternative supply is required to supply the Essential Minimum Supply Volume.
- Water carting – Contingency supply will involve carting in water from either Caboolture or Woodford to the Kilcoy reservoirs at Saleyard Road. The carting of water has limitations driven by the maximum hours of operation, the distance from the alternative source and available resources (i.e. tankers etc.). For the Kilcoy off-grid community the capability to cart water from the grid is estimated at 0.56 ML/day or 200 ML/annum, which is less than the forecast demand in 2046. The carting of water for bulk supply purposes would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting is considered an emergency response to address severe drought and/or short term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Somerset Dam source and water carting sufficiently meet the demand of Kilcoy to 2046, no additional bulk supply options are required.

The supply from Lake Somerset will continue to be the dominant source of supply for the Kilcoy off-grid community. This supply will be supplemented with water carting in times of extreme drought to supply EMSV of 0.48 ML/day. The LOS yield has been estimated to be 1,480 ML/annum based on ongoing supply from Somerset Dam and the ability to cart to meet the Essential Minimum Supply Volume.

Figure N-43 demonstrates the ability of the 1,480 ML/annum LOS yield to securely supply Kilcoy demand over the next 30 years.

Treatment capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

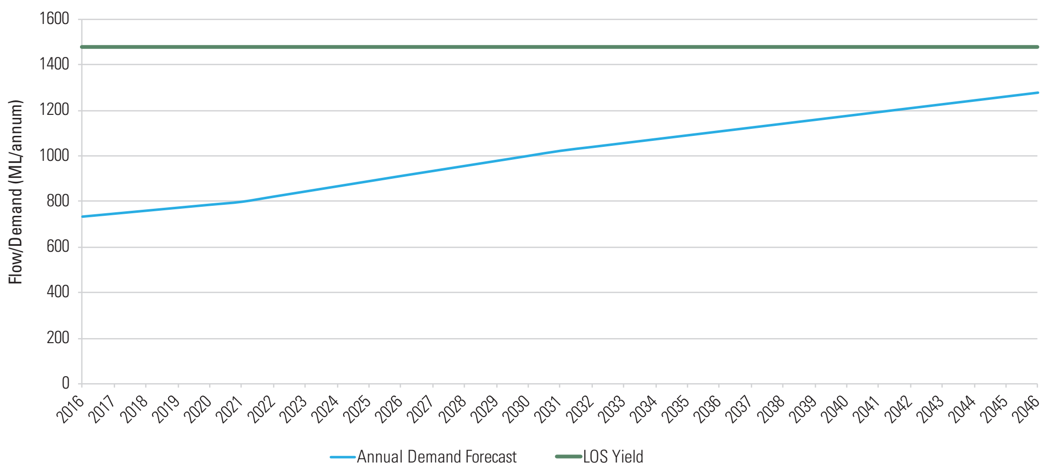


Figure N-43 Kilcoy annual demand forecast and LOS yield

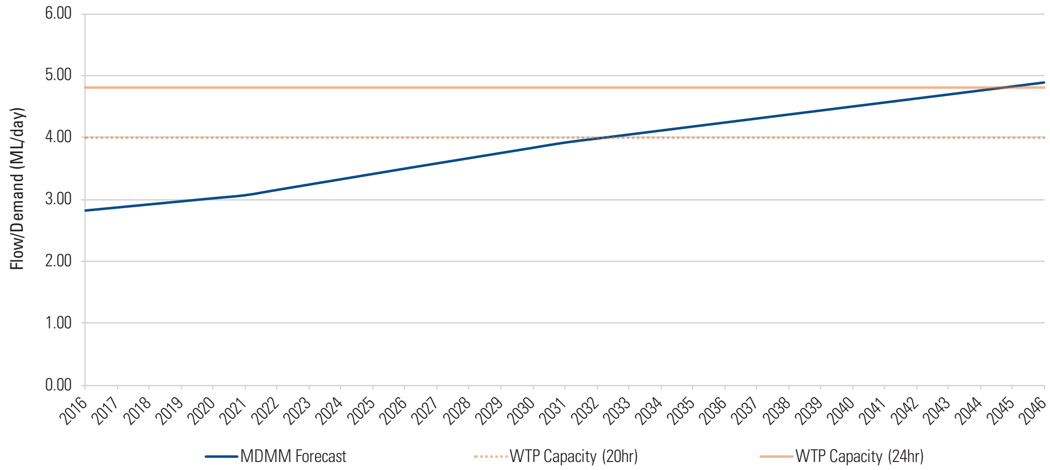


Figure N-44 Kilcoy MDMM demand forecast and treatment capacity

Figure N-44 shows the 20hr capacity of the current WTP and the peak (MDMM) demand over the next 30 years. The projected MDMM demand (4.9 ML/day) in 2046 is above both the 20-hour operational capacity (4.0 ML/day), and the maximum 24-hour operational capacity (4.8 ML/day), indicating that at peak times there may be an operational shortfall due to water treatment plant capacity. Water carting can supplement supply as required during such peak demand events. WTP augmentations may be required in 2032 pending demands and assessed WTP capability at the time.

System operation

The system operation options available to supply water to Kilcoy include:

- Normal operation – Supply from Somerset Dam and the Kilcoy Water Treatment Plant.
- Emergency operation – Water carting to ensure supply for Kilcoy, when supply is not available under emergency conditions including drought.

When Somerset Dam is below around 25% capacity, it is possible that the pontoon used for raw water pumping may encounter operational issues. In a drought scenario, the performance of the raw water pontoon will be monitored as Somerset Dam capacity decreases. If required, the pontoon will be modified or improved to allow full utilisation of the raw water available in Somerset dam.

In the case that raw water is not able to be drawn from Somerset dam due to drought, it is assumed that the entire SEQ region will be in drought. Drought response actions will therefore be taken in accordance with the Grid Drought Response Plan as detailed in Chapter 6 – Planning for resilience. The Grid Drought Response Plan provides a sound basis to continue supply to Kilcoy within LOS limits.

Table N-24 summarises additional measure to be considered in addition to the Grid Drought Response Plan for Kilcoy in relation to the raw water pontoon pump station.

Table N-24 Additional Kilcoy drought response measures

Somerset Dam Capacity	Key Actions	Demand Management Targets
35% capacity	Investigate modifications of raw water pontoon and when they may be required	Normal demand pattern as per Grid Drought Response Plan
25% capacity	Expected implementation of raw water pontoon modifications Investigate alternative supply options based on when raw water pontoon may be above water	As per Grid Drought Response Plan
10% capacity	Expected level at which the raw water pontoon may be above water Implement temporary supply Water carting to supplement supply	As per Grid Drought Response Plan

The trigger to change from normal operation to water carting will be driven by the ability of operators to effectively supply the community with potable water supply. For drought conditions this operation would commence when the water supply capacity of Lake Somerset reaches 10%.

Based on the current operation plan, Seqwater is capable of meeting all water demands of Kilcoy for the next 30 years using conventional water treatment and carting if and when required.

Kilcoy Water Future

Table N-25 provides a summary of the three levers and how they will be managed to meet the LOS objectives for Kilcoy. Based on this assessment an LOS yield for the Kilcoy water supply scheme is 1,480 ML/annum.

Table N-25 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 80% from 720 ML/annum to 1,300 ML/annum. The demand lever options for the Kilcoy off-grid community include all measures outlined within the Grid Drought Response Plan (Chapter 6 – Planning for resilience).
System Operations	The system operation options available to supply water to Kilcoy include: • Normal operation – Source water from lake somerset Lake Somerset and treatment at the local Kilcoy WTP. The water entitlement associated with extraction from Lake Somerset is equivalent to 1,520 ML/annum. • Emergency operation – Water carting to meet Essential Minimum Supply Volumes. It is estimated that up to 0.56 ML/day could be supplied through carting if required. Water carting to commence when Somerset Dam reaches its 10% full supply level.
Supply	The LOS yield that can be achieved is 1,480 ML/annum[1]. This has been aligned to the ability of the scheme to address the LOS objective for EMSV. The existing Somerset Dam supply will remain the dominant supply for the Kilcoy off-grid community out to 2046, with water carting potentially required to supplement supply at times due to drought. No new sources are required although augmentations may be required to the Kilcoy WTP over the 30 year horizon

1 The LOS yield has been restricted to align with the ability of the water supply scheme to service the 2046 EMSV need. The EMSV is proposed to be achieved through the carting of water. As outlined the maximum carting capability is considered to be 0.56 ML/day, which has been normalised to an unrestricted supply equivalent to determine the LOS yield of 1,480 ML/annum.

Kilcoy has sufficient water security for the 30 year planning horizon; however a WTP upgrade may be required in 2032. Seqwater will monitor influences and trends in demand and supply to provide adequate time to respond if required. This plan will be reviewed every 5 years or on any of the following triggers:

- The annual demand exceeding 1,200 ML/annum for LOS
- The Average Day demand exceeding 2.3 ML/day (equivalent to peak (MDMM) demand of 3.2 ML/day) for WTP capacity considerations.

KOORALBYN OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines the water security plan for the Kooralbyn off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak (MDMM) demand objectives over a 30-year planning period.

The Kooralbyn water supply scheme services the rural township of Kooralbyn located south-west of Beaudesert, approximately 64 km south of Brisbane in the Scenic Rim. The township is in close proximity to the upper reaches of the Logan River and downstream of the Burnett Creek and Logan River confluence. Maroon Dam is located on Burnett Creek and therefore provides a source of supply for Kooralbyn. Figure N-45 shows the general location of Kooralbyn and the water supply scheme.

Kooralbyn water supply scheme

The Kooralbyn water supply scheme supplies treated water to the township of Kooralbyn. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for Kooralbyn is sourced from the Logan River via a pump station at Tamrookum. The bulk raw water infrastructure of the Logan River water supply scheme supplements the amount of water available to Kooralbyn though infrastructure such as Maroon Dam. Seqwater holds a high priority water entitlement of 80ML/annum from the scheme to supply Kooralbyn. The Logan River water supply scheme also supports irrigation and other urban water uses. Raw water is released from Maroon Dam into the Logan River system to provide for environmental flows, irrigations and industrial activities and for urban water supply to the Rathdowney, Kooralbyn, and Beaudesert off-grid communities

The Logan River catchment forms an important aspect of the drinking water supply chain. The characteristics of the catchment have an influence on the raw water quality which has implications for the ability of treatment assets to effectively meet quality and capacity requirements. The quality of the raw water at Tamrookum pump station varies depending on weather conditions such as drought or rain. Raw water can be stored in the Bigfoot Lagoon (an off stream storage at Kooralbyn) prior to treatment, however the preferred method for normal supply is to treat raw water taken directly from the Logan River.

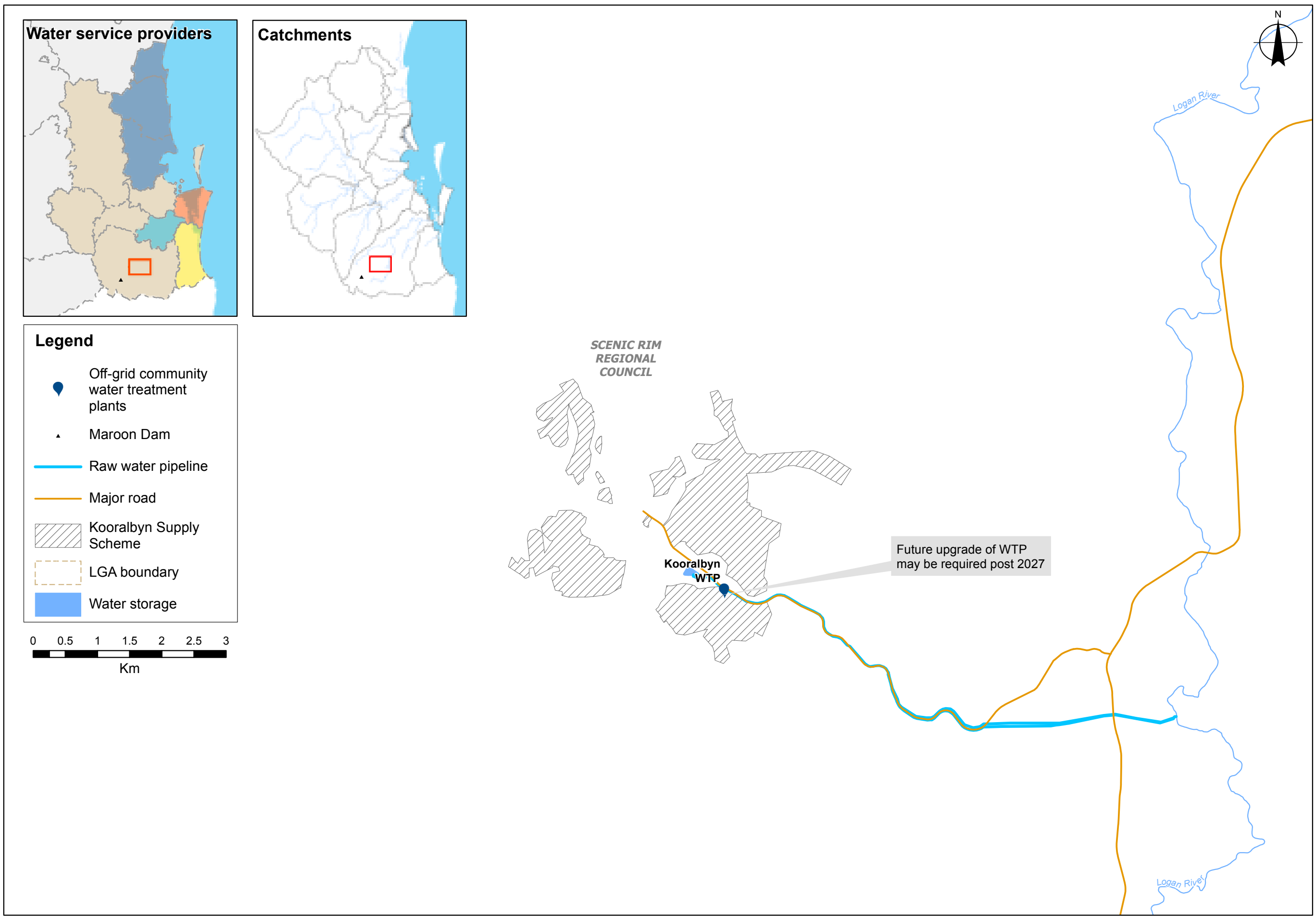


Figure N-45 Kooralbyn water supply scheme Overview

Activities and characteristics of the catchment that influence raw water quality include the level of degradation of the natural ecosystem, cattle grazing, intensive agriculture such as dairy and poultry production as well as horse industries. Other land uses in the area include lifestyle blocks, industry and regional transport corridors. Natural areas in the catchment include the National Parks of Mt Tamborine, Mt Barney, Moogerah Peaks, Main Range and Lamington Plateau and numerous council-owned reserves and conservation areas.

Due to the small size of the community, carting water from an alternative source can support supply to Kooralbyn in the event of any local water supply disruptions. When supplemented with carting, the Logan River provides the level of reliability required to meet LOS objectives for Kooralbyn. Bigfoot Lagoon does not contribute to LOS yield but serves as an alternative source if water quality in the Logan River is poor.

Raw water sourced from the Logan River at Tamrookum or Bigfoot Lagoon is treated to meet drinking water quality standards at Seqwater's local Kooralbyn WTP. The bulk treated water is transferred to Queensland Urban Utilities (QUU) who own and operate the distribution network. QUU have the responsibility for the retail and distribution of water to the end water users.

An influencing factor for Kooralbyn water supply security is the use of the 13,500 ML of medium priority entitlements, used predominantly for irrigation purposes. There are also unregulated users of the scheme with an unknown total take from the system. When Maroon Dam is at or below 22% of full supply volume, water is not released to supply the medium priority entitlements, substantially improving the security of the region's urban water supply.

Table N-26 provides a summary of the various government authorities and water service providers associated with the Kooralbyn supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-26 Summary – Local government, service providers and bulk supply description

Kooralbyn – Local government/Water Service Provider/Bulk supply description	
Local Government	Scenic Rim Regional Council
Catchment Manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk Water Service Provider	Seqwater
Local SEQ Service Provider	Queensland Urban Utilities
Raw Water Source	The raw water for the Kooralbyn WTP is sourced from the Logan River.
Water Entitlement	The entitlement associated with the supply to the Kooralbyn township is 450 ML/annum.
Water Treatment Plant	Kooralbyn WTP with an existing capacity of 1.4 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Kooralbyn water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment, they are:

- Demand
- Supply
- System Operations

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak demands for the Linville water supply scheme out to 2046. The mean day of the maximum month (MDMM) is used as a measure of the peak demand that the bulk water supply system must supply. The current average demand for the water supply scheme is 190 ML/annum or an average of 0.52 ML/day. By 2046 it is expected that this demand will increase to 380 ML/annum or an average of 1.0 ML/day. During hot dry summer periods MDMM demand in 2046 is expected to be as high as 1.5 ML/day.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-46 shows Kooralbyn's AD and MDMM forecast demand for the next 30 years.

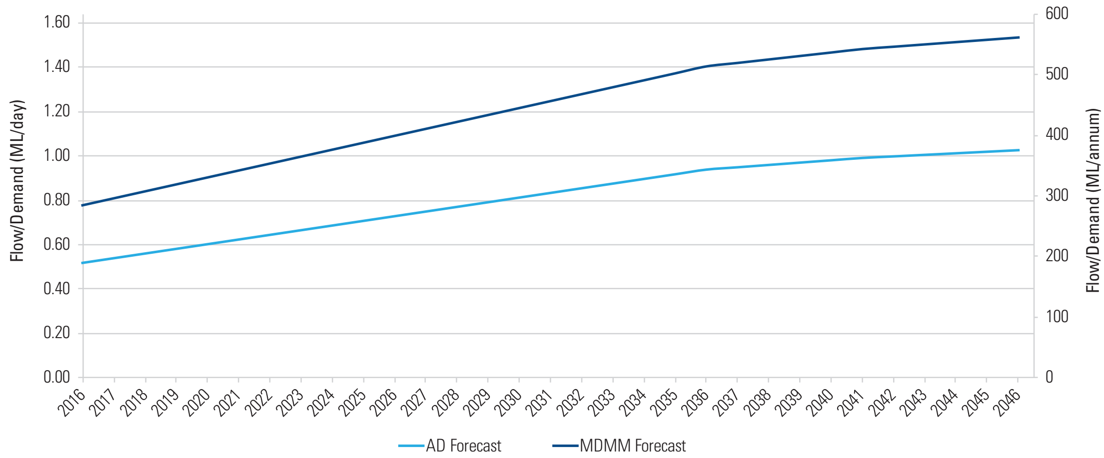


Figure N-46 Kooralbyn Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options offer an opportunity to influence demand outcomes and provide a basis to adjust to the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high end water users
- water restrictions.

For Kooralbyn, the demand management options considered in the determination of the LOS performance are outlined in the Kooralbyn drought response plan at the end of this fact sheet.

Supply

Supply is the primary lever used to determine the LOS yield for the Kooralbyn water supply scheme. Consideration is therefore given to bulk supply options that can assist in supplying the volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30 year planning horizon.

Supply source

There are two possible supply sources for Kooralbyn:

- Logan River – This supply has a regulatory restriction in the form of a water entitlement equivalent to 450 ML/annum, this is sufficient to accommodate the forecast annual average demand over the next 30 years. The average annual demand in 2046 is forecast to be in the order of 380 ML/annum. The Logan River is also the water source used to fill Bigfoot Lagoon.
- Water carting – Water carting is limited by the available hours of operation, the distance from the alternative source and available resources such as tankers. For the Kooralbyn off-grid community, carting supplies could be sourced from Beaudesert or Woodhill, as follows:
  - Carting of water from Beaudesert would provide an estimated capability of 0.53 ML/day. Beaudesert will be connected to the grid from 2019 and therefore more capable of supporting other off-grid communities and their carting needs from this point.
  - Carting of water from Woodhill would provide an estimated capability of 0.43 ML/day. Prior to the extension of the Grid connected network to encompass Beaudesert in 2019, Woodhill would be considered the next closest grid connected network to support water carting for Kooralbyn.

Water carting is considered an emergency response to address severe drought and or short term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Logan River source and water carting sufficiently meet the demand of Kooralbyn to 2046, no additional bulk supplies are required.

The supply from the Logan River will continue to be the normal source of supply for the Kooralbyn off-grid community. This supply will be supplemented with water carting in times of drought, providing a yield in excess of the existing water entitlement. The adopted LOS yield has been limited to the existing water entitlement of 450 ML/annum, which is sufficient to meet forecast demand up to 2046.

Figure N-47 demonstrates the ability of the 450 ML/annum LOS yield to securely supply Kooralbyn demand over the next 30 years.

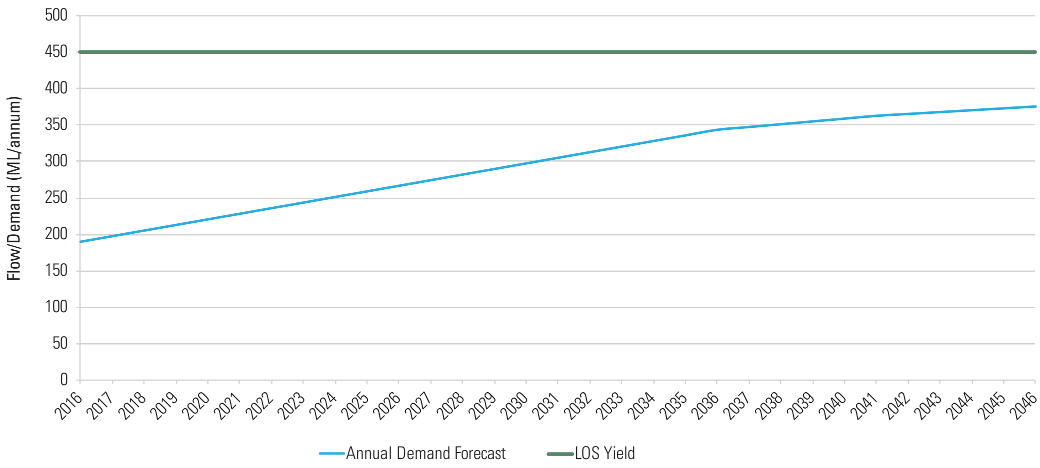


Figure N-47 Kooralbyn annual demand forecast and LOS yield

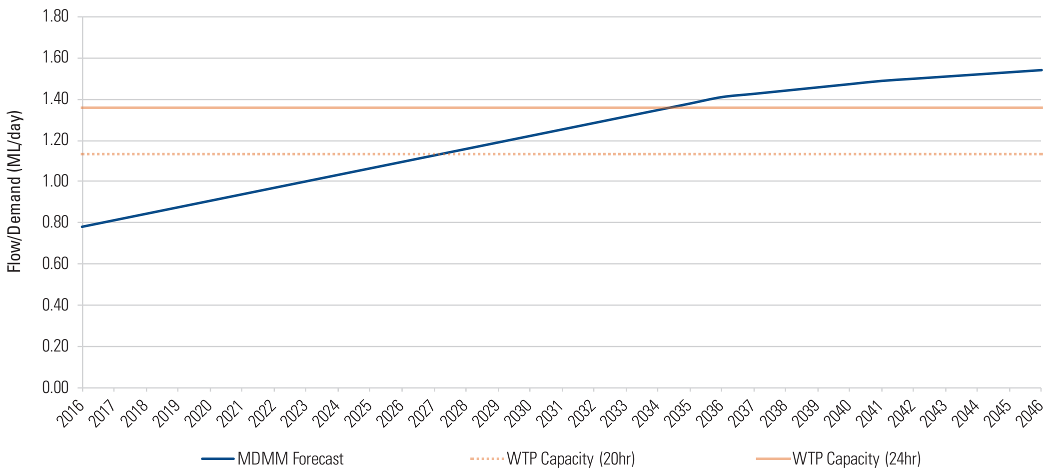


Figure N-48 Kooralbyn MDMM demand forecast and treatment capacity

Treatment capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-48 how the 20 hour capacity of the current WTP and the peak (MDMM) demand over the next 30 years. In 2046 the MDMM demand is estimated to be 1.5 ML/day, which is above both the 20 hour operational capacity (1.1 ML/day) and the 24 hour operational capacity (1.4 ML/day). Therefore, a WTP augmentation may be required in 2025 pending ongoing assessment of demand and treatment plant capacity.

With raw water quality management, demand management and reliability improvements, the need for WTP upgrade may be deferred.

System operation

The system operation options available to supply water to Kooralbyn include:

- Normal operation – extraction of raw water from the Logan River and treatment at the Kooralbyn water treatment plan.
- Emergency operation – water carting to ensure supply for Kooralbyn when supply is not available during emergency conditions including drought.

The trigger to change from normal operation to water carting will either be the operational status of the water treatment plant or water levels in Maroon dam. For drought conditions this operation would commence when the capacity of Maroon Dam reaches 10%.Further details are included in the Kooralbyn drought response plan at the end of this fact sheet.

Kooralbyn water future

Table N-27 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Kooralbyn. Based on this plan the LOS yield for the Kooralbyn water supply scheme is 450 ML/annum.

Table N-27 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 100 % from 190 ML/annum to 380 ML/annum by 2046. The demand lever options for the Kooralbyn off-grid community include all measures outlined within the Kooralbyn drought response plan.
System Operations	The system operation options available to supply water to Kooralbyn include: Normal operation – Extraction from the Logan River and treatment at the local Kooralbyn WTP. The water entitlement associated with extraction from the Logan River is equivalent to 450 ML/annum. Emergency operation – Water carting from an alternative source. It is estimated that between 0.43 ML/day and 0.53 ML/day could be sourced through carting if required. Triggers to commence emergency operation are in accordance with the Kooralbyn drought response plan.
Supply	The LOS yield is 450 ML/annum. This has been aligned to the water entitlement from the Logan River water supply scheme. The existing Logan River supply will remain the normal supply for the Kooralbyn off-grid community out to 2046, with water carting potentially required to supplement supply at times of peak demand and during drought. No new sources are required but an augmentation to the Kooralbyn WTP may be required in 2025.

Kooralbyn has sufficient water security for the 30 year planning horizon, however a WTP upgrade would be required in 2025 based on the current demand forecast. Seqwater will monitor influences and trends in demand and supply so that time is available to adapt the plan if the situation changes. This plan will be reviewed every five years or on any of the following triggers:

- The average annual demand exceeds 360 ML/annum
- The average day demand exceeds 0.60 ML/day (equivalent to MDMM demand of 0.91 ML/day).

KOORALBYN DROUGHT RESPONSE PLAN

This is a guide, where your assessment indicates that you need to take these actions in another order, or additional actions do so.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	50% capacity Maroon Dam	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	25% capacity Maroon Dam	160 L/p/day (residential)	Implement communications plan and undertake leak detection and repair	As per level 1 (S & QUU)
3. Voluntary conservation, restriction of standpipe and carting of water	15% capacity Maroon Dam	150 L/p/day (residential)	• Communications plan • Confirm water carter availability	As per level 1 but monitor daily (S & QUU)
4. Voluntary conservation, restrictions and the appropriate regulatory measures	10% capacity Maroon Dam	140 L/p/day residential use	• Continue to cart water and impose water restrictions • Communications plan	As per level 3 (S & QUU)
4a.	7.5% capacity Maroon Dam	130 L/p/day residential use	• Commence carting • Further water restrictions	As per level 4 (S & QUU)
Emergency Response	5% capacity Maroon Dam	Maximum possible demand reduction (100 L/p/day residential & non-res use)	• Implement EMSV plans • Communications plan	• As per level 4 (S & QUU) • Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Water supply level of a preceding drought response trigger and removal of the action is operationally appropriate.	Maintain the target of the level implemented	• Remove appropriate drought response actions • Communications plan	As per level 4 (S & QUU)
Complete drought exit	60% capacity Maroon Dam	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Contact Seqwater emergency response hotline (3270 4040) to close out incident as per ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Scenic Rim Regional Council (SRRC) and other major customers of the supply status (QUU) • Advise Irrigators of town actions (S)	Monitor standpipe use (QUU)	Nil	Update DRP contact list and review actions (S)
	• As per level 1 (S & QUU) • Commence low level public communications (QUU) • Advise standpipe users of restriction at next level (QUU)			Communications planning (QUU)
	• As per level 2 (S & QUU) • Increased communications (QUU)			• Communications planning (QUU) • Make necessary arrangements for water carters to cart water to Kooralbyn (S) • Obtain approval to impose water restrictions schedule (QUU)
	As per level 3 (S & QUU)	Impose water restrictions on customers(QUU)	Commence water carting (S)	**Emergency response** • Communications planning (QUU) • Determine and prepare for emergency response (S&QUU) **Drought exit** • Communications planning (QUU)
	• As per level 4 (S & QUU) • Increased communications (QUU)	Increase water restrictions on customers(QUU)	Continue water carting (S)	As per level 4 (S & QUU)
	As per level 4 (S & QUU)	Retain and possibly increase severity of water restrictions (QUU)	Implement appropriate EMSV plans (S&QUU)	Continue emergency response planning (S&QUU)
	As per level 4 (S & QUU)	Retain restrictions (QUU)	As per level implemented (S&QUU)	**Emergency response** • Continue emergency response planning (S&QUU) **Drought exit/re-entry to other levels** • Communications planning (QUU)
	• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	Revoke water restrictions (QUU)	**Water source** • Cease carting water (S)	• Review and debrief (S&QUU) • Update the Kooralbyn Disruption Plan (S)

LINVILLE OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Linville off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

The Linville water supply scheme services the small township of Linville which is a rural locality, located approximately 100 km northwest of Brisbane in the Somerset region. The township is in close proximity to the upper reaches of the Brisbane River and located upstream of Wivenhoe Dam. Figure N-49 provides a regional context on the location of Linville, its water supply service area and bulk supply infrastructure.

Water supply scheme

The Linville water supply scheme supplies treated water to the township of Linville. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for Linville is sourced from two bores in close proximity to the Brisbane River. The Brisbane River catchment is an important aspect to the supply chain. The characteristics of the catchment have an influence on raw water quality, which has implications for the ability of treatment assets to effectively meet quality and capacity requirements.

Activities in the catchment influencing water quality include upstream onsite wastewater treatment systems, cattle grazing and cattle access to river, recreation and agriculture.

The river flows regularly and is prone to flooding due to the large catchment. Flooding can also impact water quality.

Due to the small size of the community, carting water from Kilcoy or from the water grid can support supply to Linville in the event of any local water supply disruptions. This has been the normal operational practice for a number of years because the existing water treatment plant cannot always reliably treat the raw water to appropriate standards. Seqwater plans to upgrade the Linville water treatment plant in 2017 to enable efficient local treatment.

After treatment, the bulk water is transferred to Queensland Urban Utilities (QUU) who own and operate the distribution network. They take responsibility for the retail and distribution of water to the end water users.

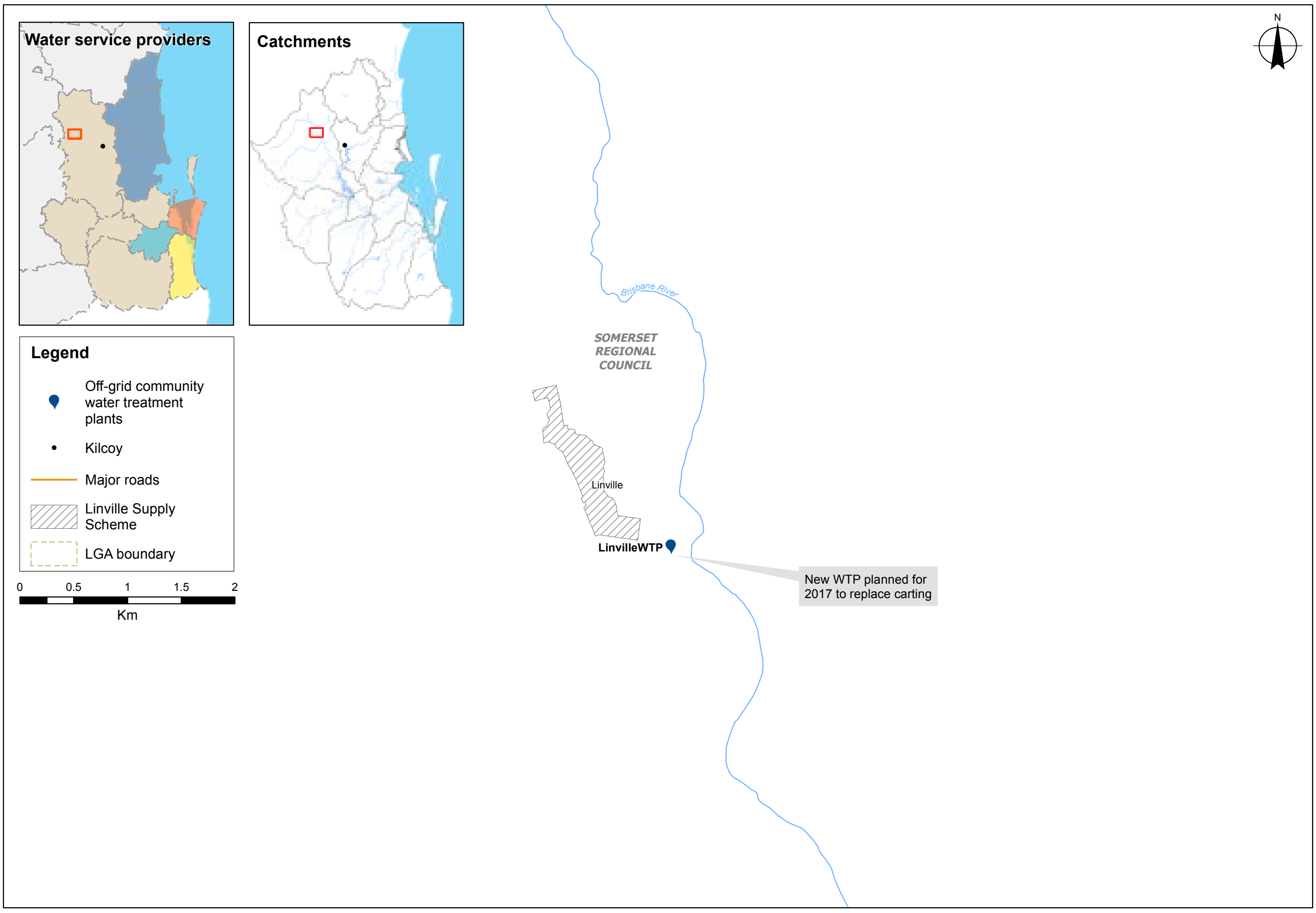


Figure N-49 Linville water supply scheme – Location and service area

Table N-28 provides a summary of the government authorities and water service providers associated with the Linville supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-28 Summary – Local government, service providers and bulk supply description

Linville off-grid water supply	
Local government	Somerset Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water used to supply Linville is likely to be sourced under the following arrangements: • Short term arrangement – Due to the need to cart water to Linville the current supply is via Kilcoy, which extracts raw water directly out of Somerset Dam. • Medium to long term arrangement – Raw water is to be sourced from existing bores in proximity to the upper reaches of the Brisbane River.
Water entitlement	The entitlement associated with the supply from the Brisbane River for Linville is 35 ML/annum.
Water treatment plant	Linville WTP is currently being planned for construction in 2017.

Influence of demand, supply and system operation

The Linville water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan.

This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak demands for the Linville water supply scheme out to 2046. The mean day of the maximum month (MDMM) is used as a measure of the peak demand that the bulk water supply system must supply. The current average demand for the water supply scheme is 10 ML/annum or 0.027 ML/day. By 2046 it is expected that the average demand will increase to approximately 12 ML/annum or 0.033 ML/day. Subsequently the peak (MDMM) demand is expected to be as high as 0.063 ML/day in 2046.

The demand will fluctuate over time due to many factors, including customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-50 shows Linville's AD and MDMM forecast demand for the next 30 years. Demand is not expected to increase significantly however Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

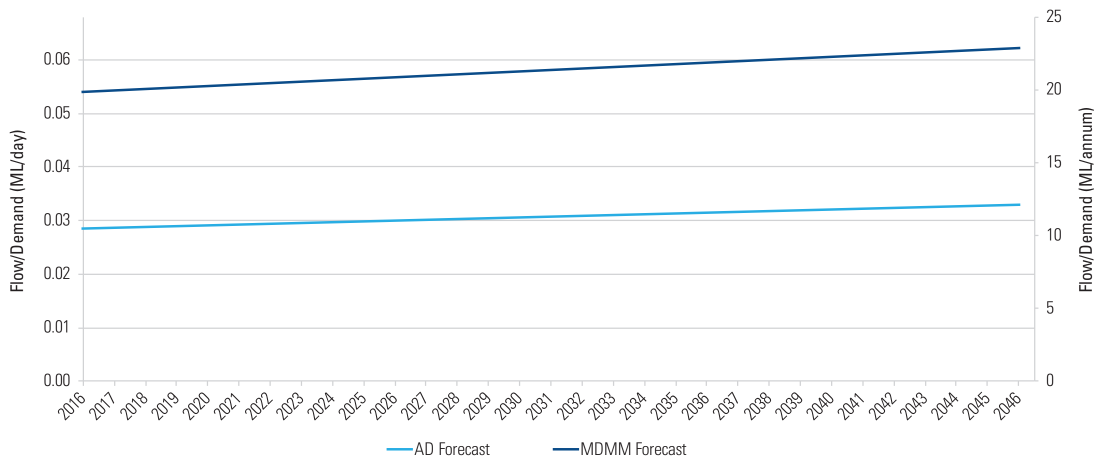


Figure N-50 Linville Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high water end water users
- water restrictions.

For Linville, the demand management options considered in the determination of the LOS performance are outlined in the Linville drought response plan which can be found at the end of this fact sheet.

Supply

Supply is the primary lever used to determine the LOS yield for the Linville water supply scheme. Consideration is therefore given to bulk supply options that can assist in supplying the volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30 year planning horizon.

Supply source

There are two possible supply sources for Linville:

- Brisbane River Bores – This supply has a regulatory restriction in the form of a water entitlement equivalent to 35 ML/annum, this is sufficient to accommodate average day demand over the next 30 years. The average demand in 2046 is forecast to be in the order of 12 ML/annum.
- Water carting from Kilcoy or the water grid – Water carting is limited by the available hours of operation, the distance from the alternative source and available resources such as tankers. For Linville, the maximum water carting volume is estimated at 0.48 ML/day or 180 ML/annum. This is greater than the forecast demand in 2046. Water carting would generally be undertaken over a daily 15 hour operational window to minimise the impact on the local community.

Water carting is considered an emergency response to address severe drought and or short term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Brisbane River source and water carting sufficiently meet the demand of Linville to 2046, no additional bulk supplies are required.

The supply from the Brisbane River will be the normal source of supply for the Linville off-grid community once the water treatment plant is upgraded in 2017. This supply will be supplemented with water carting in times of drought. The LOS yield has been aligned to the 35 ML/annum water entitlement, but could be considered as high as the maximum water carting capability.

Figure N-51 demonstrates the ability of the 35 ML/annum LOS yield to securely supply Linville Annual Demand over the next 30 years.

Treatment capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-52 shows the 20hr capacity of the planned upgraded WTP (i.e. 0.080 ML/day) and the peak (MDMM) demand over the next 30 years (i.e. 0.063 ML/day at 2046). Based on the proposed 2017 augmentation capacity and current raw water quality characteristics, no additional WTP augmentations are required over the 30 year period.

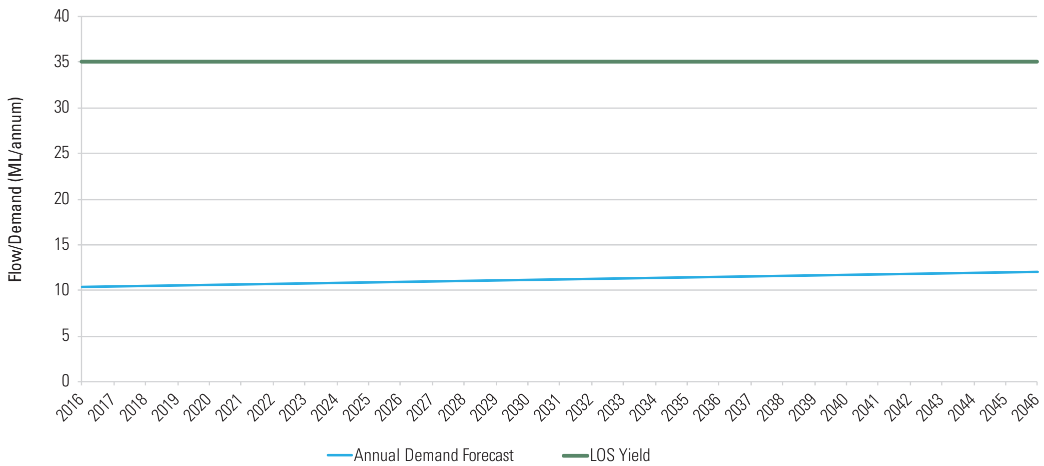


Figure N-51 Linville annual demand forecast and LOS yield

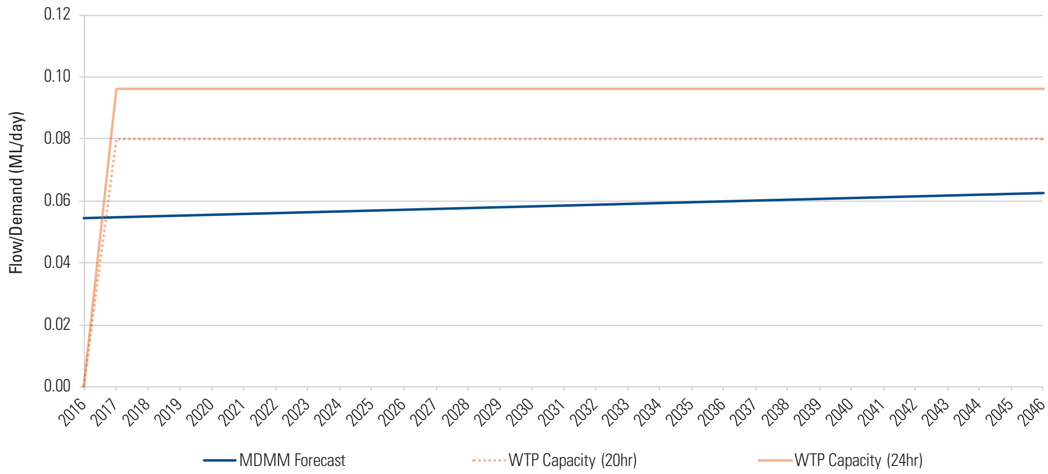


Figure N-52 Linville MDMM demand forecast and treatment capacity

System operation

The system operation options available to supply water to Linville include:

- Normal operation – carting water from Kilcoy or the water grid. Once the Linville water treatment plant is upgraded supply from this treatment plant will become the normal operating mode.
- Emergency operation – Water carting to ensure supply for Linville when supply is not available during emergency conditions, including drought.

The trigger to change from treatment plant operations to water carting will be the operational status of the water treatment plant and the ability of the water source to meet demand. The drought response will not change with changes to the water source for normal operating mode and will be consistent with the grid's Drought Response Plan with additional measures outlined in the Linville Drought Response Plan at the end of this fact sheet.

Linville water future

Table N-29 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Linville. Based on this plan the LOS yield for the Linville water supply scheme is 35 ML/annum.

Table N-29 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecast to grow by 20% from 10 to 12 ML/annum. The demand lever options for the Linville off-grid community include all measures outlined within the Linville drought response plan.
System Operations	The system operation options available to supply water to Linville include: • Normal operation – Currently carting from Kilcoy or the water grid but will change to supply from the treatment plant after 2017. Water carting will continue to be used as a supply option in the event that local conditions limit production at the water treatment plant • Emergency operation (including drought) – Water carting from Kilcoy or the water Grid
Supply	The LOS yield is 35 ML/annum. This quantity of supply can be supported through water carting allowing for LOS objectives to be met. Once the augmented Linville WTP is constructed, the existing Brisbane River supply will remain the dominant supply for the Linville off-grid community out to 2046. No new sources are required and it is not expected that any further augmentations will be required over the 30 year horizon

Linville has sufficient water security for the 30-year planning horizon. Seqwater will monitor influences and trends in demand and supply so that time is available to adapt the plan if the situation changes. This plan will be reviewed every five years or on any of the following triggers:

- the average annual demand exceeds 28 ML/annum
- the average day demand exceeds 0.040 ML/day (equivalent to a peak demand of 0.080 ML/day)

LINVILLE DROUGHT RESPONSE PLAN

This is a guide, where your assessment indicates that you need to take these actions in another order, or additional actions, do so.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	As per the grid drought response plan			
2. Voluntary conservation	As per the grid drought response plan			
3. Voluntary conservation, restriction of standpipe and carting of water	As per the grid drought response plan			
4. Restrictions and the appropriate regulatory measures	Water carting source is under water restrictions OR carting not maintaining supply and reticulation reservoir is less than 50% full	140 L/p/day residential demand	Continue to cart water and impose water restrictions (as per water source)	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
Complete drought exit	Drought exit for source water location has occurred	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Advise Seqwater emergency response hotline (3270 4040) to close out incident who will follow ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Somerset Regional Council (SRC) and other major customers of the supply status (QUU) • Commence public communications (QUU)	• Hydrant standpipe prohibition (QUU) • Impose water restrictions on customers (QUU)	Continue and increase water carting (S)	**Emergency response** • Align with source water drought response plan (S&QUU) **Drought exit** • Communications planning (QUU)
	• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	• Remove hydrant standpipe prohibition (QUU) • Revoke water restrictions (QUU)	**Water source** • Cease carting water (S)	• Review and debrief (S&QUU) • Update the Linville Disruption Plan (S)

LOWOOD OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Lowood off-grid community, which includes communities in the Somerset and Lockyer Valley regional council areas. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives for the Lowood water supply scheme over a 30-year planning period.

The scheme's bulk water assets are located at Lowood, which is located near the Brisbane River downstream of Wivenhoe Dam, 66 kilometres west of Brisbane. Major centres supplied from the scheme include:

- Lowood (population 3,336) and Fernvale (population 2,367) in the Somerset Regional Council area.
- Glenmore Grove, Gatton, Helidon, Withcott, Grantham, Forest Hill and Laidley in the Lockyer Valley Regional Council area (approximate population 35,000).

Figure N-53 provides an overview of the scheme and the area it supplies.

Lowood water supply scheme

The Lowood water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for the scheme is sourced from the Brisbane River, downstream of Wivenhoe Dam and the river's confluence with the Lockyer Creek. The Brisbane River and Lockyer Creek Catchments are important to the supply chain.

The characteristics of the catchments impact raw water quality, which affects the ability of treatment assets to meet quality and capacity requirements.

Activities in the catchment that influence water quality include land clearing, extractive industry, and cropping along the river banks which has led to the loss of riparian buffer. Channels and gullies are now significantly eroded and vulnerable to damage during flow events. Land clearing for grazing and agriculture, coupled with bore water extraction for irrigation in some areas of the catchment has exacerbated salinity and water hardness. This cannot always be treated effectively at the Lowood water treatment plant. Sewer infrastructure, on-site sewage treatment, and agriculture (cattle and poultry) are significant pathogen risks during wet weather flows. The proportion of flow in the system from Wivenhoe Dam is key to maintaining optimal water quality.

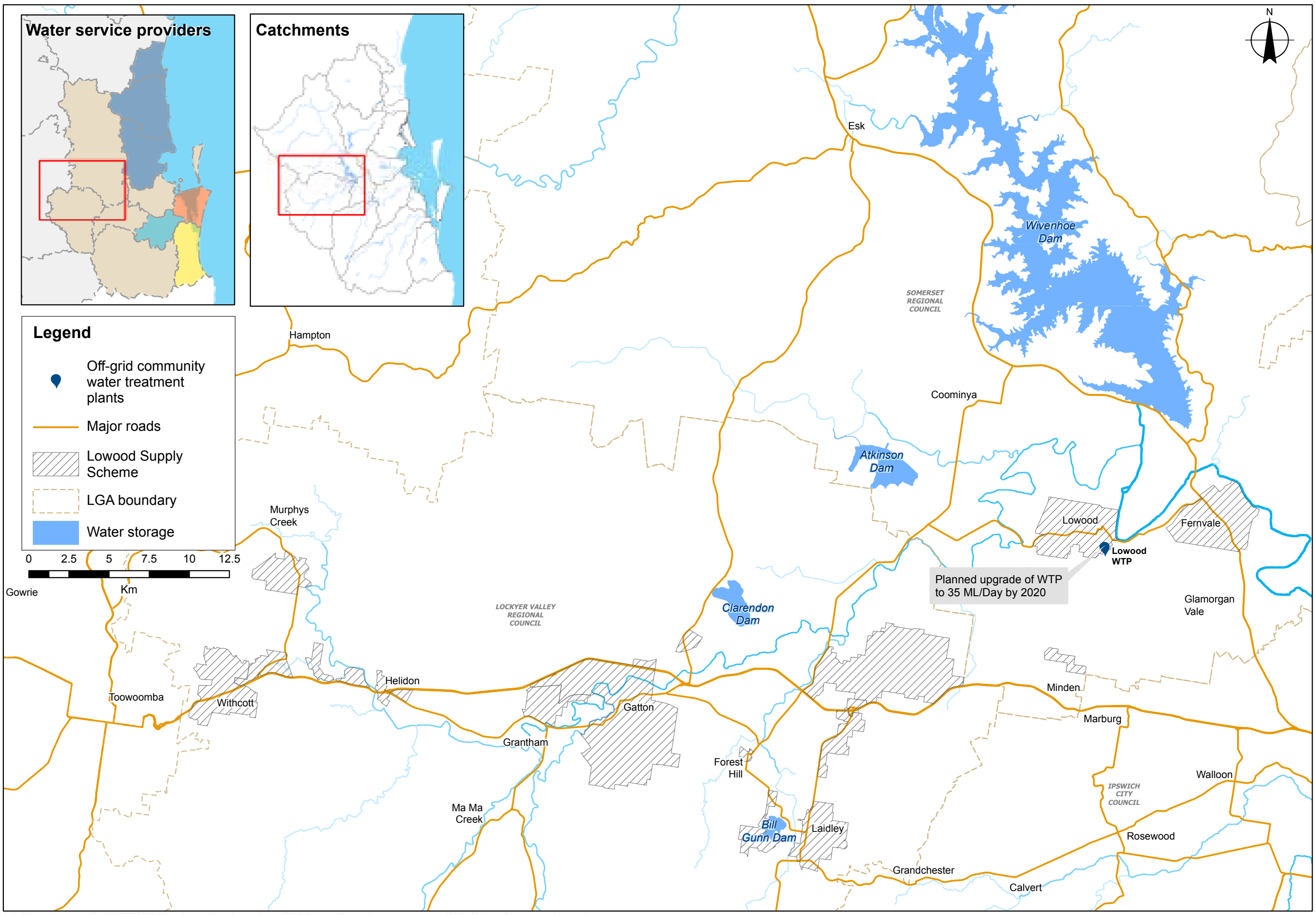


Figure N-53 Location of Fernvale and the Lockyer Valley

Water is treated to meet drinking water quality standards at Seqwater's Lowood water treatment plant. The bulk treated water is then transferred to Queensland Urban Utilities (QUU) who own and operate the distribution network. They take responsibility for retail and distribution of water to the end water users.

Table N-30 provides a summary of the government authorities and water service providers associated with the Lowood water supply scheme along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-30 Summary – Local government, service providers and bulk supply description

Lowood off-grid water supply	
Local government	Somerset Regional Council and Lockyer Valley Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Lowood WTP is sourced from the Brisbane River.
Water entitlement	The entitlement associated with the supply to the Lowood township is part of a high priority allocation of 253,288 ML/annum for Lowood and Mt Crosby water treatment plants.
Water treatment plant	Lowood WTP with an existing capacity of 16 ML/day[1], with upgrade scheduled in 2020 to increase capacity to 35 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of Supply, Demand and System Operations

The Lowood water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan.

This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak demands for the Lowood water supply scheme out to 2046. The mean day of the maximum month (MDMM) is used as a measure of the peak demand that the bulk water supply system must supply. The current average demand for the water supply scheme is 3,400 ML/annum or an average of 9.3 ML/day. By 2046 it is expected that this demand will increase to 5,900 ML/annum or an average of 16 ML/day. The peak (MDMM) demand in 2046 is expected to be as high as 24 ML/day.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing on unconnected rural residents through water carting. Figure N-54 shows the schemes AD and MDMM forecast demand over the next 30 years.

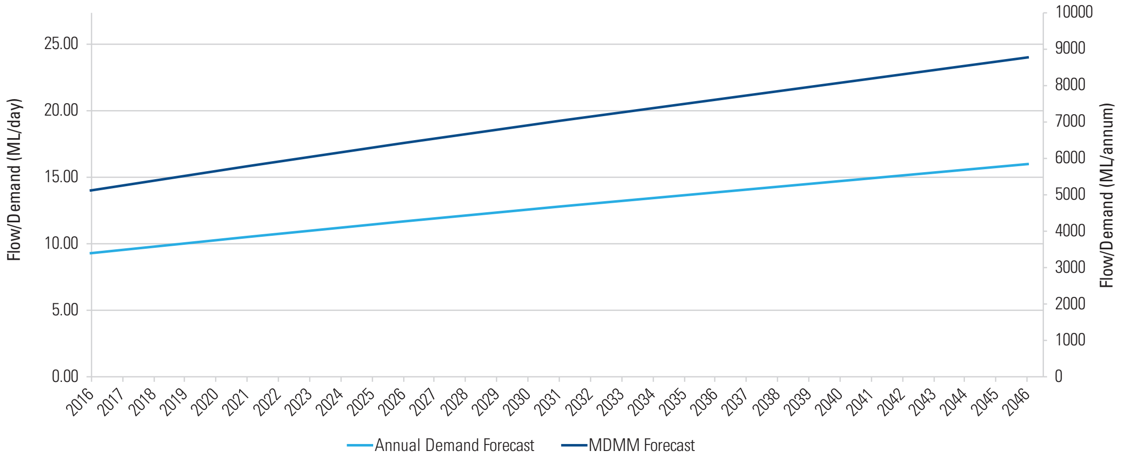


Figure N-54 Lowood Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high water end water users
- water restrictions.

For Lowood, the demand management options considered in the determination of the LOS performance align with the Grid drought response plan.

Supply

Supply is the primary lever used to determine the LOS yield for the Lowood water supply scheme. Consideration is therefore given to bulk supply options that can assist in supplying the volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30 year planning horizon.

Supply source

The primary supply source for the Lowood WTP is the Brisbane River, downstream of Wivenhoe Dam. Releases from Wivenhoe Dam ensure that flows in Brisbane River are always available. Lowood supply is therefore dependent on Wivenhoe Dam, which is a key component of the regional bulk water supply and will be operated to ensure continued supply to the water grid.

Consequently, LOS compliance for the scheme is linked to and consistent with the water grid which is compliant until beyond 2046. In an extreme drought when supply is restricted to the essential minimum supply volume (EMSV), water would continue to be drawn from Wivenhoe Dam, and during this time, Wivenhoe Dam would be supplemented with water from the Western Corridor Recycled Water Scheme (WCRWS).

Work is currently underway to upgrade the Lowood water treatment plant so that it can supply 35ML/day or 12,700ML/annum. This work is expected to be delivered in 2020. LOS yield for Lowood is constrained by this planned future water treatment plant capacity rather than the raw water source yield. The LOS yield and annual demand forecast is summarised in Figure N-55 below.

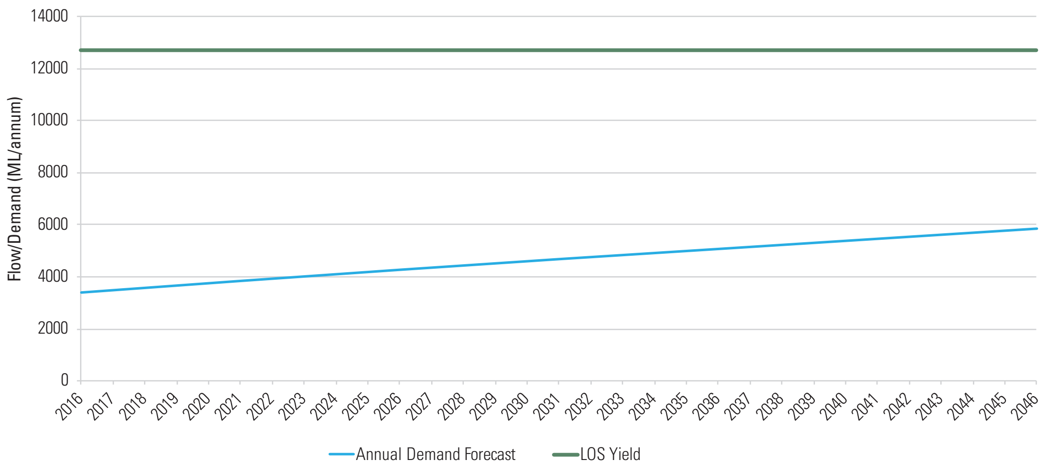


Figure N-55 Lowood annual demand forecast and LOS yield

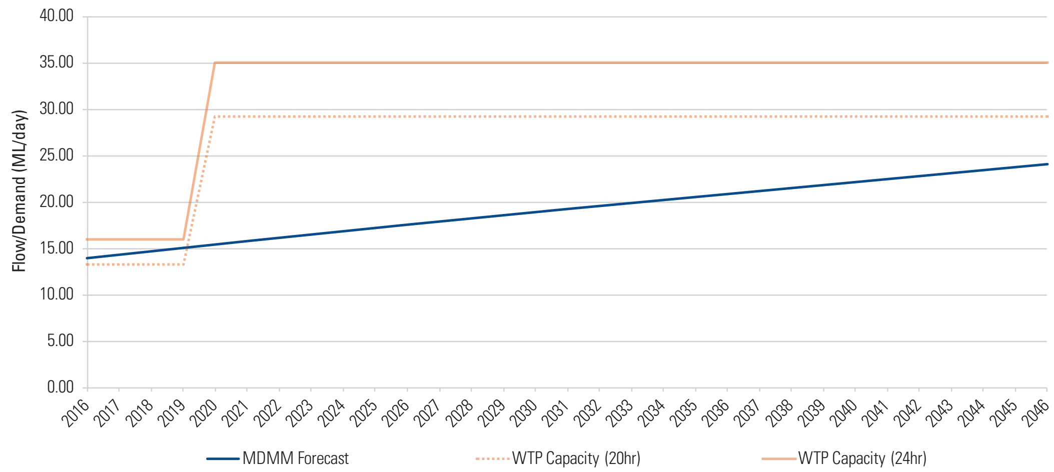


Figure N-56 Lowood MDMM demand forecast and treatment capacity

Treatment Capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-56 shows the 20 hour capacity of the current WTP and the peak demand over the next 30 years. The peak demand in 2046 (24 ML/day) is greater than the existing 20 hour and 24 hour water treatment capacities (13 ML/day and 16 ML/day respectively). If water demand grows as projected, the peak demand may exceed the 24 hour plant capacity of 16 ML/day at around 2022 (see Figure N-56). Current plans are to upgrade the Lowood WTP in 2020, to a capacity of 35 ML/day. This upgrade would provide enough capacity for the plant to meet peak demand objectives beyond 2046.

System Operations

The system operation options available to supply water to Lowood include:

- Normal operation – Water is extracted from the Brisbane River downstream of Wivenhoe Dam and treated at the Lowood WTP.
- Drought operation – Drought response actions will be taken in accordance with the Grid Drought Response Plan. Wivenhoe Dam and the Lowood WTP will continue as the major supply assets for the scheme.

Loowood water future

Table N-31 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Lowood. Based on plan the LOS yield for the Lowood water supply scheme is 12,700 ML/annum.

Table N-31 Demand, system operation and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to grow by 72% from 3400 ML/annum to 5900 ML/annum. The demand lever options for the Lowood off-grid community includes all options outlined within the Grid Drought Response Plan.
System Operations	The system operation options available to supply water to Lowood include: • Normal operation – Extraction from the Brisbane River and treatment at the local Lowood WTP. • Emergency operation – Drought response actions will be taken in accordance with the Grid Drought Response Plan. For Lowood the system operation will continue with extraction of water from the Brisbane River and treatment at the Lowood WTP. The Grid Drought Response Plan provides a basis to maintain a level of supply through Wivenhoe Dam during drought conditions.
Supply	The LOS yield is limited by the planned treatment capacity at Lowood – 2,700 ML/annum. The Brisbane River will remain the supply source for the Lowood water supply scheme out to 2046. No new sources are required although augmentations will be required to the Lowood WTP over the 30 year horizon.

The Lowood water supply scheme has sufficient water security for the 30 year planning horizon. Seqwater will monitor influences and trends in demand and supply so that time is available to adapt this plan if the situation changes. This plan will be reviewed every five years or on any of the following triggers:

- The average day demand exceeds 10 ML/day (equivalent to a MDMM demand of 15 ML/day). This may trigger an acceleration of the planned WTP upgrade.

RATHDOWNEY OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Rathdowney off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan aims to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

The Rathdowney water supply scheme services the township of Rathdowney located around 30 km south of Beaudesert. The township is in close proximity to the upper reaches of the Logan River and downstream of the Burnett Creek and Logan River confluence. Maroon Dam is located on Burnett Creek and therefore provides a source of supply for Rathdowney. Figure N-57 provides regional context on the location of the Rathdowney township and its water supply service area.

Water supply scheme

The Rathdowney water supply scheme supplies treated water to the township of Rathdowney. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for Rathdowney is sourced from the Logan River. The bulk raw water infrastructure of the Logan River water supply scheme supplements the amount of water available to Rathdowney though infrastructure such as Maroon Dam. Seqwater holds a high priority water entitlement of 80 ML/annum from the scheme used to supply Rathdowney. The Logan River water supply scheme also supports irrigation and other urban water uses. Raw water is released from Maroon Dam into the Logan River system to provide for environmental flows, irrigation and industrial activities and for urban water supply to the Rathdowney, Kooralbyn, and Beaudesert off-grid communities.

The Logan River catchment is important to the drinking water supply chain. The characteristics of the catchment impact the raw water quality which affects the ability of treatment assets to meet quality and capacity requirements. The quality of raw water at Rathdowney is also affected by weather conditions, such as drought or rain.

Activities in the catchment influencing raw water quality include cattle grazing, intensive agriculture as well as horse industries. Other land uses in the area include lifestyle blocks, industry and regional transport corridors. Natural areas in the catchment include the National Parks of Mt Tamborine, Mt Barney, Moogerah Peaks, Main Range and Lamington Plateau and numerous council-owned reserves and conservation areas.

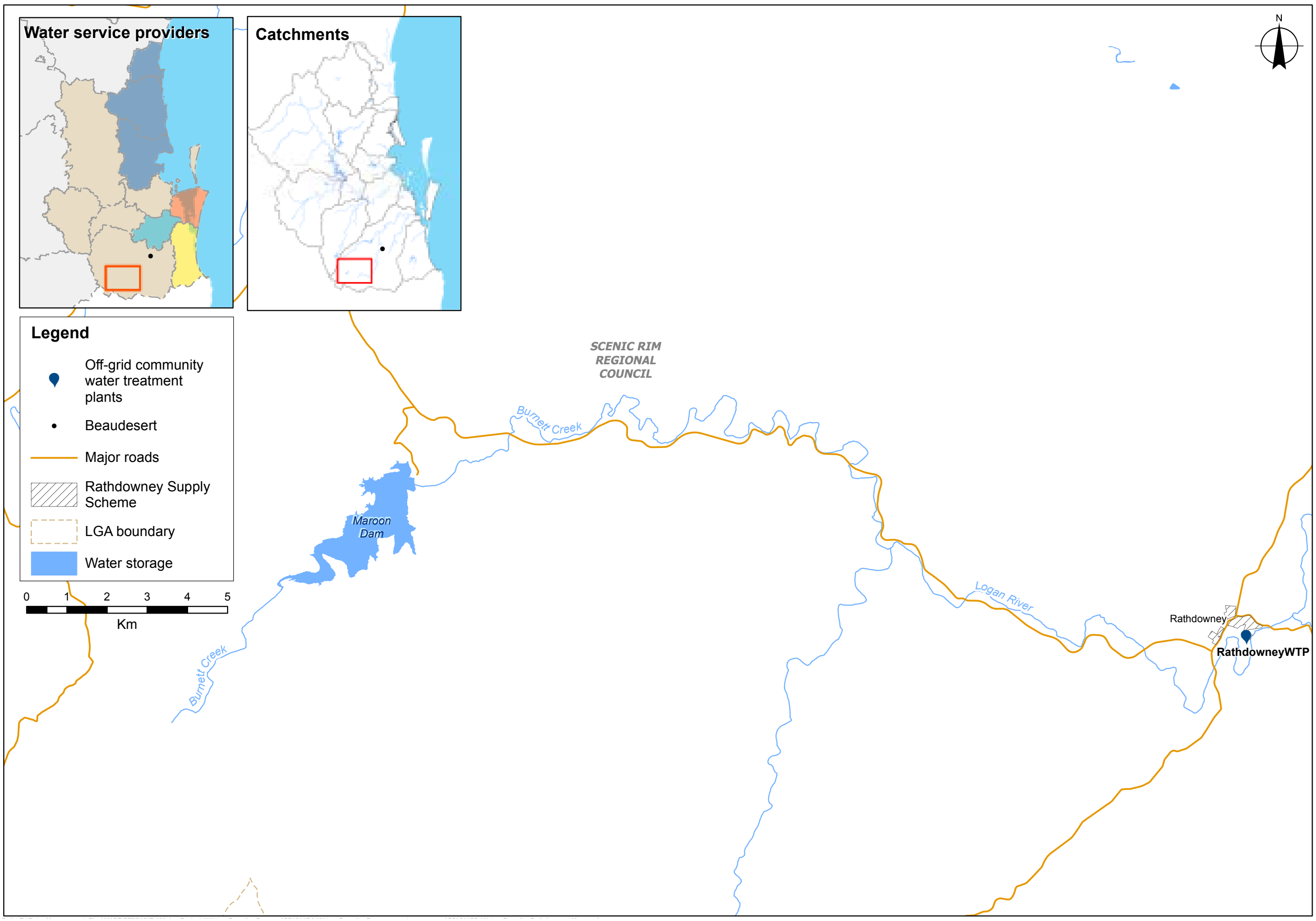


Figure N-57 Rathdowney water supply scheme – Location and service area

Water is treated to meet drinking water quality standards at Seqwater's Rathdowney water treatment plant. The bulk treated water is then transferred to Queensland Urban Utilities (QUU) who own and operate the distribution network and they take responsibility for the retail and distribution of water to the end water users.

Due to the small size of the community, carting water from an alternative source can support supply to Rathdowney in the event of any local water supply disruptions, including drought, and help meet LOS objectives for the township.

Table N-32 provides a summary of the government authorities and water service providers associated with the Rathdowney supply along with a brief description of the bulk supply assets and water entitlement associated with the scheme.

Table N-32 Summary – Local government, service providers and bulk supply description

Rathdowney off-grid water supply	
Local government	Scenic Rim Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Rathdowney WTP is sourced from the Logan River, which can be attributed to either Maroon Dam releases or through run of the river flows downstream of the dam.
Water entitlement	The entitlement associated with the supply to Rathdowney is 80 ML/annum.
Water treatment plant	Rathdowney WTP with an existing capacity of 0.30 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, supply and system operation

The Rathdowney water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands. There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme. Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak demands for the Rathdowney water supply scheme to 2046. The mean day of the maximum month (MDMM) is used as a measure of the peak demand that the bulk water supply system must supply. The current average demand for the water supply scheme is 23 ML/annum or an average of 0.063 ML/day. It is expected that this demand will remain consistent with current demand until 2046. The peak demand (MDMM) is expected to be in the order of 0.099 ML/day.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Figure N-58 shows Rathdowney's AD and MDMM forecast demand for the next 30 years. Future demand is not expected to increase significantly into the future, however Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water security is required.

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- Community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high water end water users
- water restrictions.

For Rathdowney, the demand management options considered in determining the LOS performance are outlined in the Rathdowney drought response plan which can be found at the end of this fact sheet.

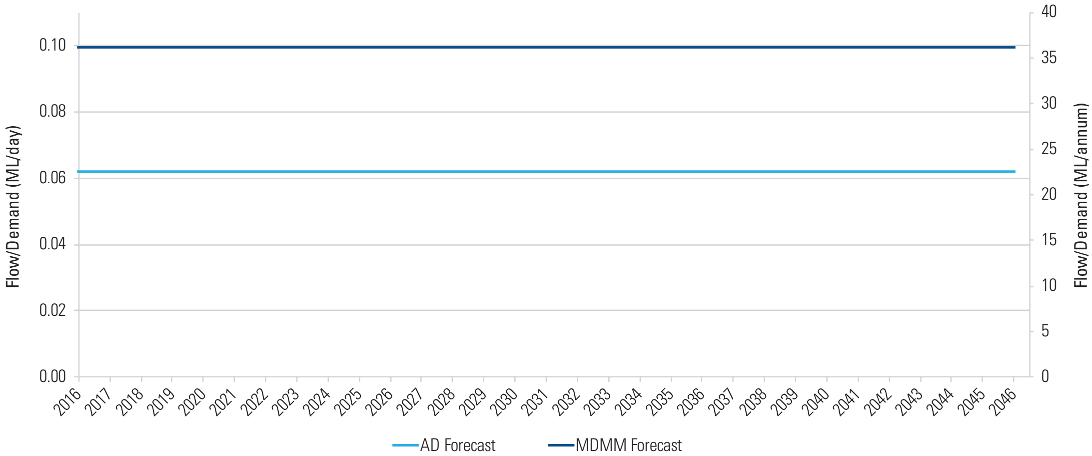


Figure N-58 Rathdowney Average Day and Mean Day Maximum Month demand forecasts

Supply

Supply is the primary lever used to determine the LOS yield for the Rathdowney water supply scheme. Bulk supply options that can help supply the volumes required to meet growing demand (LOS performance needs) have been considered along with the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply source

There are two possible supply sources for Rathdowney:

- Logan River – This supply has a regulatory restriction in the form of a water entitlement equivalent to 80 ML/annum, which is sufficient to accommodate average day demand over the next 30 years. The average demand in 2046 is forecast to be in the order of 23 ML/annum.
- Water carting – Water carting is limited by the available hours of operation, the distance from the alternative source and available resources such as tankers. For the Rathdowney off-grid community the maximum carting volume is 0.45 ML/day or 180 ML/annum. This is greater than the forecast demand in 2046. Water carting would generally be undertaken over a daily 15 hour operational window to minimise the impact on the local community.

Water carting is considered an emergency response to address severe drought and short-term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Logan River source and water carting sufficiently meet the demand of Rathdowney, no additional bulk supply options are required.

The supply from the Logan River will continue to be the normal source of supply for the Rathdowney off-grid community. This supply will be supplemented with water carting in times of drought. The LOS yield has been aligned to the 80 ML/annum water entitlement, but could be considered as high as the maximum water carting capability.

Figure N-59 demonstrates the ability of the 80 ML/annum LOS yield to securely supply Rathdowney demand over the next 30 years.

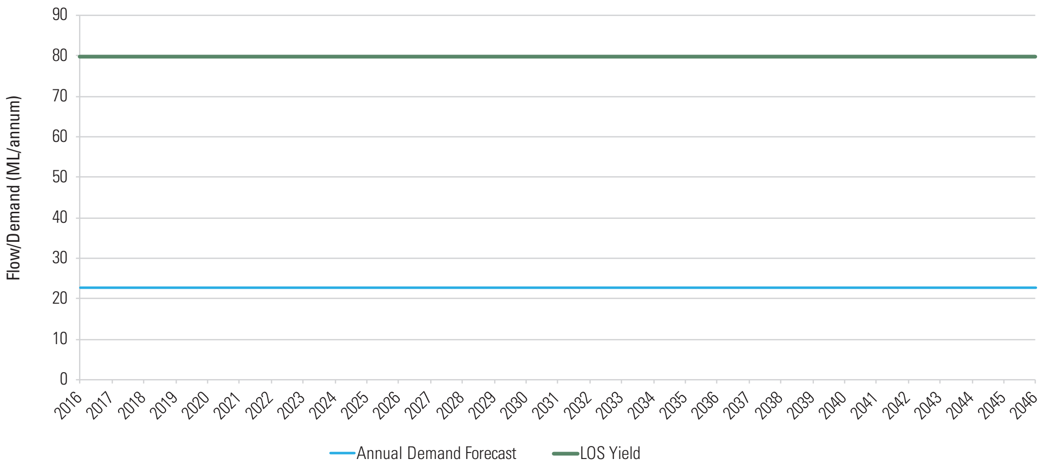


Figure N-59 Rathdowney annual demand forecast and LOS yield

Treatment capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able to treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-60 shows the 20hr capacity of the current WTP (i.e. 0.25 ML/day) and the peak demand (MDMM) over the next 30 years (i.e. 0.099 ML/day at 2046). Based on current raw water quality characteristics and the existing WTP, no further augmentations are required over the 30-year planning period.

System operation

The system operation options available to supply water to Rathdowney include:

- Normal operation – Extraction from Logan River as run of the river flow or in combination with Maroon Dam releases within water entitlement limits and treatment at the local Rathdowney water treatment plant.
- Emergency operation – Water carting to ensure supply for Rathdowney when normal supply is not available during emergency conditions including drought.

The trigger to change from normal operation to water carting will be the operational status of the water treatment plant or when the capacity of Maroon Dam reaches 10% of its full supply level. Further details are outlined in the Rathdowney drought response plan at the end of this fact sheet.

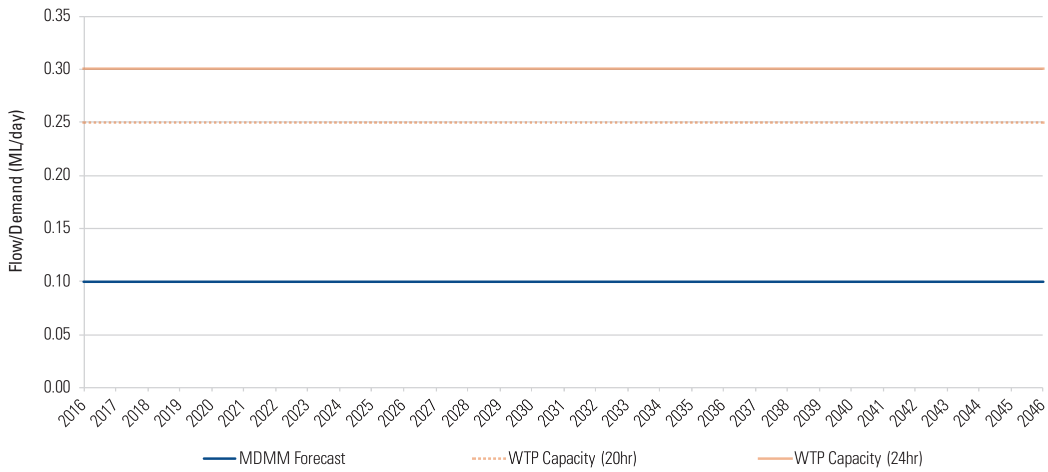


Figure N-60 Rathdowney MDMM demand forecast and treatment capacity

Rathdowney water future

Table N-33 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for Rathdowney. Based on this plan, the LOS yield for the Rathdowney water supply scheme is 80 ML/annum.

Table N-33 Demand, system operations and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecasted to remain stable at 23 ML/annum. The demand lever options for the Rathdowney off-grid community include all measures outlined within the Rathdowney Drought Response Plan.
System operation	The system operation options available to supply water to Rathdowney include: Normal operation – Extraction from the Logan River and treatment at the local Rathdowney WTP. The water entitlement associated with extraction from the Logan River is equivalent to 80 ML/annum. Emergency operation – Water carting from an alternative source. It is estimated that up to 0.45 ML/day could be supplied through carting.
Supply	The LOS yield is 80 ML/annum. This has been aligned to the water entitlement from Logan River water supply scheme. This quantity of supply is supported through water carting to ensure LOS objectives to be met. The existing Logan River supply supported by Maroon Dam will remain the normal supply for the Rathdowney off-grid community out to 2046. No new sources are required and it is not expected that any augmentations will be required to the Rathdowney WTP over the 30 year horizon

Rathdowney has sufficient water security for the 30-year planning horizon. Seqwater will monitor influences and trends in demand and supply so that time is available to adapt the plan if the situation changes. This plan will be reviewed every five years or on any of the following triggers:

- The average annual demand exceeds 64 ML/annum
- The average day demand exceeds 0.13 ML/day (equivalent to a peak demand of 0.20 ML/day)

RATHDOWNEY DROUGHT RESPONSE PLAN – PLAN ON A PAGE

This is a guide, where your assessment indicates that you need to take these actions in another order, or additional actions, do so.

Level	Trigger	Target	Key actions	Monitor, manage and report
1. Drought alert, preparedness and monitoring	50% capacity Maroon Dam	Normal demand pattern (where there are no obvious leaks)	Reporting and readiness, monitoring, leak detection and repair	• Monitor: supply status, drought response actions weekly (S) • Monitor demand status weekly (QUU) • Report weekly to DEWS (S) • Contact Seqwater emergency response hotline (3270 4040) who will act in accordance with the ERP (S)
2. Voluntary conservation	25% capacity Maroon Dam	160 L/p/day (residential)	Implement communications plan and undertake leak detection and repair	As per level 1 (S & QUU)
3. Voluntary conservation, restriction of standpipe and carting of water	10% capacity Maroon Dam	150 L/p/day residential demand	• Standpipe restriction • Communications plan • Confirm water carter availability	As per level 1 but monitor daily (S & QUU)
4. Voluntary conservation, restrictions and the appropriate regulatory measures	10% capacity Maroon Dam	140 L/p/day residential demand including isolation of standpipe	• Continue to cart water and impose water restrictions • Communications plan	As per level 3 (S & QUU)
4b.	7.5% capacity Maroon Dam	130 L/p/day residential demand	• Commence carting • Further water restrictions	As per level 4 (S & QUU)
Emergency Response	5% capacity Maroon Dam	Maximum demand reduction (100 L/p/day res and non-res)	• Implement EMSV plans • Communications plan	• As per level 4 (S & QUU) • Where required discuss with the Minister the need for a water supply emergency response (S)
Stepped exit	Water supply level of a preceding drought response trigger and removal of the action is operationally appropriate.	Maintain the target of the level implemented	• Remove appropriate drought response actions • Communications plan	As per level 4 (S & QUU)
Complete drought exit	60% capacity Maroon Dam	Normal demand pattern (where there are no obvious leaks)	Return to normal operations	• Completion and cessation of drought actions (S & QUU) • Contact Seqwater emergency response hotline (3270 4040) to close out incident as per ERP (S)

S = Seqwater, QUU = Queensland Urban Utilities, EM = Emergency Manager

	Communications	Restrictions (Standpipe and community)	Water Source	Preparation for future levels
	• Advise Scenic Rim Regional Council (SRRC) and other major customers of the supply status (QUU) • Advise Irrigators of town actions (S)	Monitor standpipe use (QUU)	Nil	Update DRP contact list and review actions (S)
	• As per level 1 (S & QUU) • Commence low level public communications (QUU) • Advise standpipe users of restriction at next level (QUU)	Monitor standpipe use (QUU)		Communications planning (QUU)
	• As per level 2 (S & QUU) • Increased communications (QUU)	• Standpipe restriction (QUU)		• Communications planning (QUU) • Make necessary arrangements for water carters to cart water to Rathdowney (S) • Obtain approval to impose water restrictions schedule (QUU)
	As per level 3 (S & QUU)	• Standpipe isolation (QUU) • Impose water restrictions on customers(QUU)	Commence water carting (S)	**Emergency response** • Communications planning (QUU) • Determine and prepare for emergency response (S&QUU) **Drought exit** • Communications planning (QUU)
	• As per level 4 (S & QUU) • Increased communications (QUU)	• Standpipe isolation (QUU) • Increase water restrictions on customers(QUU)	Commence water carting (S)	As per level 4 (S & QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain and possibly increase severity of water restrictions (QUU)	Implement appropriate EMSV plans (S&QUU)	Continue emergency response planning (S&QUU)
	As per level 4 (S & QUU)	• Standpipe remains isolated (QUU) • Retain restrictions (QUU)	As per level implemented (S&QUU)	**Emergency response** • Continue emergency response planning (S&QUU) **Drought exit/re-entry to other levels** • Communications planning (QUU)
	• As per level 1 but advising of exit (S & QUU) • Drought exit communications (S)	• Re-open standpipe (QUU) • Revoke water restrictions (QUU)	**Water source** • Cease carting water (S)	• Review and debrief (S&QUU) • Update the Rathdowney Disruption Plan (S)

SOMERSET OFF-GRID COMMUNITY FACT SHEET

This fact sheet outlines Seqwater's plan for water security for the Somerset off-grid community. As part of South East Queensland's Water Security Program 2016-2046, this plan works to achieve Level of Service (LOS) objectives and peak demand (MDMM) objectives over a 30-year planning period.

The Somerset water supply scheme services the small township of Somerset, a rural community located at the Somerset Dam, approximately 100km northwest of Brisbane. The area is surrounded by mountain ranges, native forests and waterways, making it a popular destination for adventure sports, camping and four-wheel driving. Figure N-61 provides the location of the Somerset township and its water supply service area.

Somerset water supply scheme

The Somerset water supply scheme supplies treated water to the township of Somerset. The water supply scheme comprises natural assets (such as the catchment) and infrastructure assets (such as the water treatment plant).

The raw water supply for Somerset is sourced from Somerset Dam on the Stanley River. The river catchment is important to the supply chain. The characteristics of the catchment impacts raw water quality, which affects the ability of treatment assets to meet quality and capacity requirements.

Activities in the catchment influencing raw water quality include upstream onsite wastewater treatment systems and small wastewater treatment plants, industry and agriculture (e.g. chicken farms, turf farms, abattoirs and a fertiliser and potting mix manufacturer). Some areas of the catchment have unrestricted cattle grazing in riparian areas and at parts of Lake Somerset cattle graze to the water's edge. The lake is used extensively for recreational activities including boating, water skiing and swimming. The quality of raw water is also affected by weather conditions such as drought or flood.

Water is treated to meet drinking water quality standards at Seqwater's Somerset water treatment plant. The treated water is then transferred to Queensland Urban Utilities (QUU) who own and operate the distribution network and they take responsibility for the retail and distribution of water to the end water users.

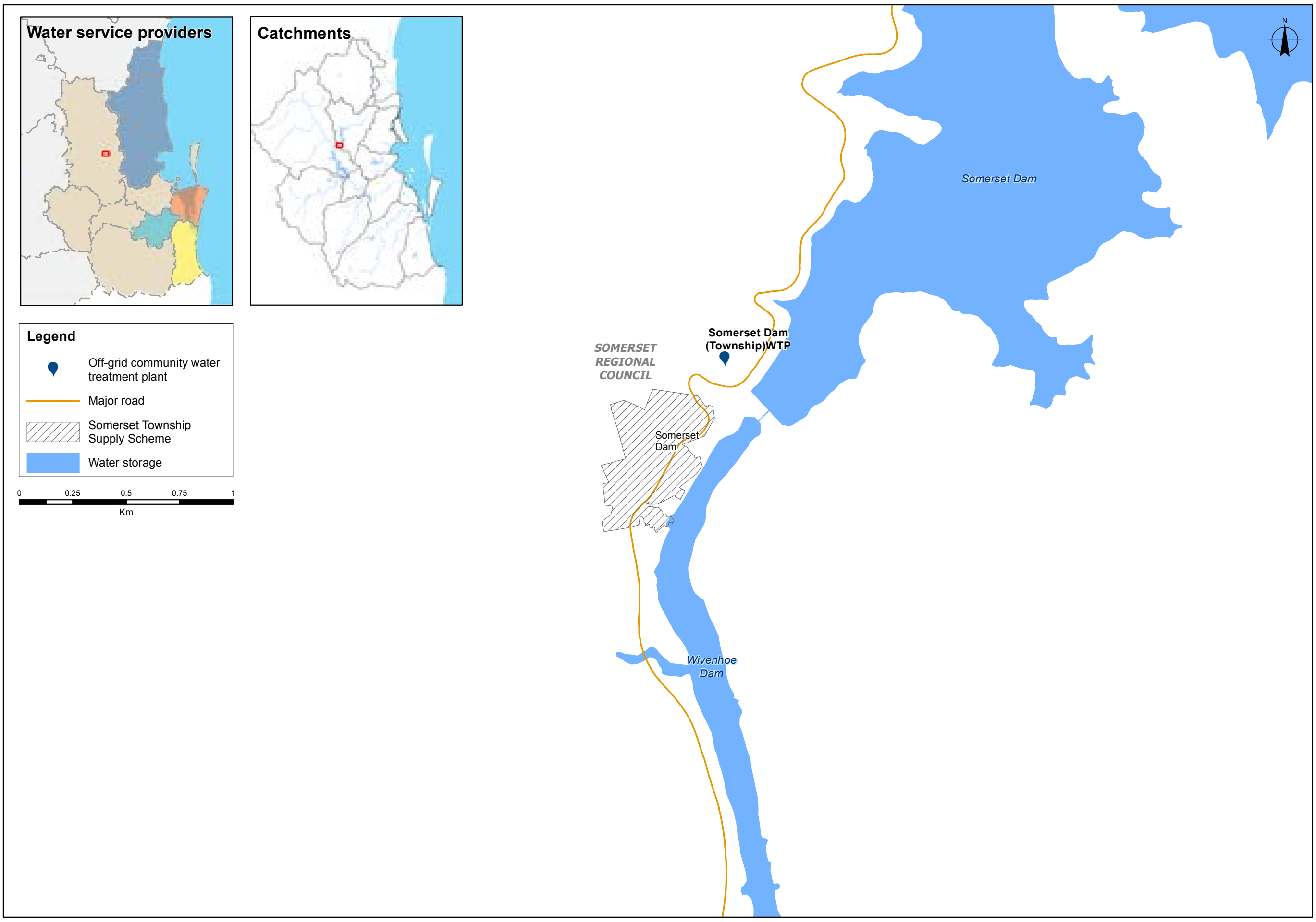


Figure N-61 Somerset water supply scheme – location and service area

Due to the small size of the community, carting water from the water grid can support supply to Somerset in the event of any local water supply disruptions, including drought, and help to meet LOS objectives for the township.

Table N-34 provides a summary of the government authorities and water service providers associated with the Somerset supply along with a brief description of the bulk supply assets and entitlement associated with the scheme.

Table N-34 Summary – Local government, service providers and bulk supply description

Somerset off-grid water supply	
Local government	Somerset Regional Council
Catchment manager(s)	Distributed between federal, state, local government; individual land owners/managers; and not-for-profit groups
Bulk water service provider	Seqwater
Local water service provider	Queensland Urban Utilities
Raw water source	The raw water for the Somerset WTP is sourced from Somerset Dam.
Water entitlement	The entitlement associated with the supply to the Somerset township is 40 ML/annum.
Water treatment plant	Somerset WTP with an existing capacity of 0.25 ML/day[1]. This capacity has been determined based on the capability of the treatment facility to meet water quality guidelines.

1 Rated capacity of the WTP over a 24 hour period.

Influence of demand, system operation and supply

The Somerset water supply scheme has been assessed to determine the extent to which LOS and treatment capacity objectives (Chapter 8 – Planning for off-grid communities) can be met and how these will be managed over the 30-year duration of this plan. This is informed by an assessment of the LOS yield and treatment plant capacity compared to the forecast average and peak system demands.

There are three levers that influence the outcomes of the assessment:

- demand
- supply
- system operation.

Demand

Demand for water and forecast growth in demand is considered when determining the LOS performance of the scheme.

Population growth and growth in commercial and industrial activity will lead to a growth in demand for water. Water demand will also be influenced by the efficiency and behaviour of water users, efficiency of water fittings and efficiency of the supply system.

Demand forecast

A demand forecast has been developed providing an estimate for average day (AD) demands and peak demands for the Somerset water supply scheme to 2046. The mean day of the maximum month (MDMM) is used as a measure of the peak demand that the bulk water supply system must supply. The current average demand for the water supply scheme is 16 ML/annum or 0.045 ML/day. By 2046 it is expected that this demand will increase to approximately 17 ML/annum or 0.047 ML/day. Subsequently the peak demand is expected to be as high as 0.086 ML/day in 2046.

The demand will fluctuate over time due to many factors, some of which may include customer end use behaviour, climatic conditions and the servicing of unconnected rural residents through water carting. Large numbers of tourists visit on weekends, public holidays and school holidays leading to further variation in demand over short time periods. Figure N-62 shows Somerset's AD and MDMM forecast demand for the next 30 years. Demand is not expected to increase significantly into the future however Seqwater will continue to monitor demand trends to determine if further assessment of the scheme and its water secuirty is required.

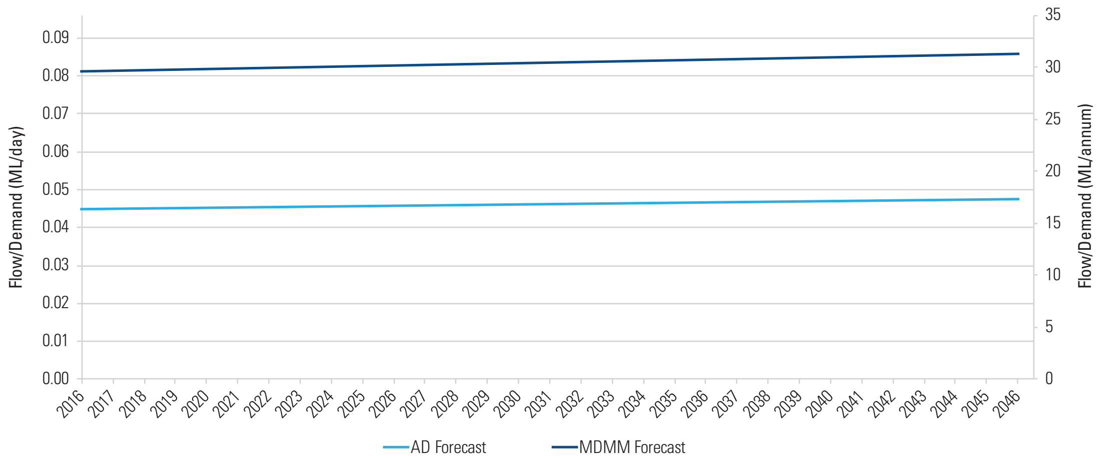


Figure N-62 Somerset Average Day and Mean Day Maximum Month Demand Forecasts

Demand options

Demand management options can influence demand outcomes, providing a basis to adjust the LOS yield required to meet LOS objectives. Some typical demand management options include:

- pressure and leakage management
- community education and awareness campaigns to help end water users to understand how they use water and how to make changes
- rebates for water-efficient fittings and technologies
- targeted demand management initiatives for high water end water users
- water restrictions.

For Somerset, the demand management options considered in the determination of the LOS performance are outlined in the grid drought response plan.

Supply

Supply is the primary lever used to determine the LOS yield for the Somerset water supply scheme. Consideration is therefore given to bulk supply options that can assist in supplying the volumes required to meet growing demand (LOS performance needs) and the ability of WTP infrastructure to effectively treat the required peak demands over the 30-year planning horizon.

Supply source

There are two possible supply sources for the Somerset township:

- Somerset Dam – This supply has a regulatory restriction in the form of a water entitlement equivalent to 40 ML/annum, which is sufficient to accommodate average day demand over the next 30 years. The average demand in 2046 is forecast to be in the order of 17.4 ML/annum.
- Water carting from the water grid – Water carting is limited by the available hours of operation, the distance from the alternative source and available resources such as tankers. For Somerset the maximum water carting volume is estimated at 0.5 ML/day or 183 ML/annum. This is greater than the forecast demand in 2046. Water carting would generally be undertaken over a 15 hour per day operational window to minimise the impact to the local community.

Water carting is considered an emergency response to address severe drought and or short term operational needs. It is also a secure source and provides a means to achieve the required LOS performance. As the combination of the Somerset Dam source and water carting sufficiently meet the demand of Somerset to 2046, no additional bulk supply options are required.

The supply from Somerset Dam will continue to be the normal source of supply for the Somerset off-grid community. This supply will be supplemented with water carting in times of drought.

The LOS yield has been aligned to the 40 ML/annum water entitlement from Somerset Dam but could be considered as high as the maximum water carting capability.

Figure N-63 demonstrates the ability of the 40 ML/annum LOS yield to securely supply Somerset demand over the next 30 years.

Treatment capacity

Seqwater's planning assumption for treatment capacity is that the treatment plant should be able treat the peak daily demand (MDMM) over a 20 hour operational window. This accommodates routine maintenance and some contingency for unplanned shutdown.

Figure N-64 shows the 20hr operational capacity of the current WTP (0.21 ML/day) and the peak demand (MDMM) over the next 30 years (0.086 ML/day at 2046). It is evident that that no further augmentations are required over the 30-year period.

System operation

The system operation options available to supply water to Somerset include:

- Normal operation – supply from Somerset Dam and the Somerset water treatment plant.
- Emergency operation – water carting to ensure supply for Somerset when supply is not available from sources during emergency conditions including drought.

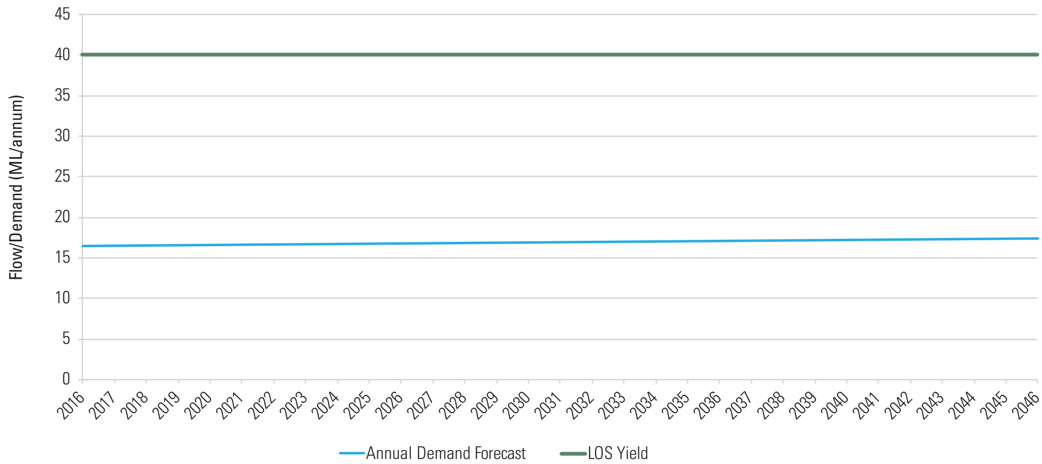


Figure N-63 Somerset annual demand forecast and LOS yield

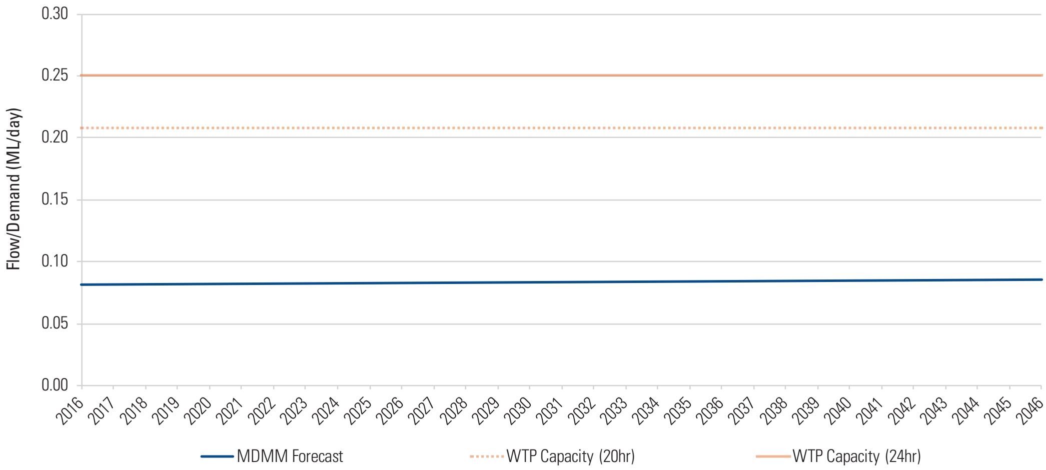


Figure N-64 Somerset MDMM demand forecast and treatment capacity

The trigger to change from treatment plant operations to water carting will be either the operational status of the water treatment plant or when water levels in Somerset Dam cannot supply local demand. It is estimated that this operation would commence when the level of Somerset Dam reached 10% of its full supply level, however this will be determined as per the specific drought response operations for the Somerset Inlet works as per Table N-35.

Table N-35 Somerset township drought response operations plan

Somerset dam capacity	Key actions	Demand management targets
35% capacity	Investigate modifications of raw water inlet and when they may be required	Normal demand pattern as per South East Queensland drought response plan
25% capacity	Expected implementation of raw water inlet modifications Investigate alternative supply options based on when raw water inlet may no longer operate	As per South East Queensland drought response plan
10% capacity	Expected level at which the raw water inlet may no longer operate Implement temporary supply Water carting to supplement supply	As per South East Queensland drought response plan
5% capacity	Lowest possible inlet level which may delay carting	As per South East Queensland drought response plan

Somerset Water Future

Table N-36 provides a brief summary of the three levers and how they will be managed to meet the LOS objectives for the Somerset township. Based on this plan the LOS yield for the Somerset water supply scheme is 40 ML/annum.

Table N-36 Demand, system operations and supply lever summary

Levers – Demand, System Operation and Supply	
Demand	Demand is forecast to grow by 6 % from 16 ML/annum to 17 ML/annum. The demand lever options for the Somerset off-grid community include all measures outlined within the Grid Drought Response Plan (Chapter 6 – Planning for resilience).
System Operations	The system operation options available to supply water to Somerset include: • Normal operation – extraction from Somerset Dam and treatment at the local Somerset WTP. • Emergency operation – water carting from the water grid
Supply	The LOS yield is 40 ML/annum. This has been aligned to the equivalent supply that can be sourced from Somerset Dam under normal operation. This quantity of supply can also be supported through water carting allowing LOS objectives to be met. The existing Somerset Dam supply source will remain the normal supply for the Somerset off-grid community to 2046, supported by water carting at time of drought. No new sources are required and it is not expected that any augmentations will be required to the Somerset WTP over the 30-year planning horizon.

Somerset has sufficient water security for the 30-year planning horizon. Seqwater will monitor influences and trends in demand and supply so that time is available to adapt the plan if the situation changes. This plan will be reviewed every five years or on any of the following triggers:

- the average annual demand exceeds 32 ML/annum
- the average day demand exceeds 0.1 ML/day (equivalent to a peak demand of 0.15 ML/day)