ATTACHMENT ONE

TOOWOOMBA REGIONAL COUNCIL

Water Vision 2050

Final Report

December 2020

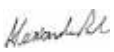
M34000_090-REP-003

www.engeny.com.au
P: 07 3221 7174
Level 7, 500 Queen St Brisbane QLD 4000 | PO Box 10183 Brisbane QLD 4000

DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of TOOWOOMBA REGIONAL COUNCIL and is subject to and issued in accordance with TOOWOOMBA REGIONAL COUNCIL instruction to Engeny Water Management (Engeny). The content of this report was based on previous information and studies supplied by TOOWOOMBA REGIONAL COUNCIL

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party. Copying this report without the permission of TOOWOOMBA REGIONAL COUNCIL or Engeny is not permitted.

M34000-090 TOOWOOMBA WATER FUTURES						
DOC PATH FILE: \\online.com\files\Management\Projects\M34000_Toowoomba RC\M34000_090 TRC Water Futures\07 Deliv\Docs\Report\M34000_090-REP-003-2 Toowoomba Water Futures Final.docx						
REV	**DESCRIPTION**	**AUTHOR**	**REVIEWER**	**PROJECT MANAGER**	**APPROVER (PD)**	**DATE**
Rev 0	Client Issue	Joshua Lake & Alexander Park	Kate Lanskey	Kate Lanskey	James Moffatt	7 July 2020
Rev 1	Final	Alexander Park & Kate Lanskey	James Moffatt	Kate Lanskey	James Moffatt	16 October 2020
Rev 2	Revised Final	Alexander Park	James Moffatt	Alexander Park	James Moffatt	2 December 2020
Signatures						

CONTENTS

Appendices

List of Tables

List of Figures

1. EXECUTIVE SUMMARY

1.1 Introduction

The Toowoomba Regional Council (TRC) covers approximately 13,000km^2 and encompasses communities from north of Yarraman to south-west of Millmerran, including the city of Toowoomba.

TRC has commissioned Engeny Water Management (Engeny) to develop a long-term water security strategy for the region (*Water Vision 2050*). Water Vision provides an overview of the plan for the provision of water and wastewater services for the Toowoomba region, and is supported by sophisticated modelling and robust decision-making processes. The purpose of this report is to provide an overview of the Toowoomba region water supply system, the challenges faced and opportunities available, and importantly to outline options to ensure the current and future water supply issues are met.

1.2 Scope

The *Water Vision 2050* program outlines a water security strategy that meets Toowoomba's water supply service needs for the next 30 years. *Water Vision 2050* is also designed to align with Toowoomba's wastewater and catchment management strategies. A contemporary 'all options on the table' approach has been adopted to maintain transparent decision making and to develop an effective strategy that meets the long-term needs of the region. The key focus areas for this version of Water Vision are to:

- Identify and understand existing and emerging water supply challenges facing the bulk water supply system.
- Assess possible options to maintaining appropriate water supply into the future.

This is the first integrated water security strategy for TRC incorporating the needs of peak demand, Level of Service (LOS) objectives and long-term yield into a single water strategy. It is expected that as the strategy evolves with future revisions, the scope will also expand. An example of this is the planning horizon, with 30 years considered appropriate for this first integrated assessment. Future versions of Water Vision should extend the planning horizon to at least 50 years.

At the time of development of this version of Water Vision, a project is underway between TRC, Southern Downs Regional Council (SDRC) and the Queensland State Government regarding the provision of supply (either raw or treated water) to Warwick. *Water Vision 2050* will provide a base case for TRC to review the impact of any changes required to the Toowoomba water supply system as a result of the provision of supply to Warwick.

This current assessment has been completed excluding the provision of supply to Warwick due to insufficient information being available.

1.3 Existing Water Supply System

The Toowoomba bulk water supply infrastructure supplies the majority of the region's population, including the centralised area of Toowoomba, major townships and other "connected communities". This includes all raw water and bulk water distribution infrastructure connected to the Mount Kynoch Water Treatment Plant (WTP). Key bulk water assets are as follows:

- Cooby, Perseverance and Cressbrook Dams.
- The Wivenhoe pipeline supplying bulk raw water to Cressbrook Dam.
- An extensive network of groundwater bores.
- The reticulation pipework to supply the connected communities.

Additionally, TRC is also responsible for the supply of drinking water to eleven rural towns with independent supplies. The rural town of Vale View will be connected to the Toowoomba bulk water supply system by 2021 and investigations are currently underway to determine the viability of connecting an additional four rural towns (Cambooya, Greenmount, Nobby and Clifton).

Asset capability has been determined for existing assets, including the dams, bores and trunk network infrastructure as well as water supply assets for rural towns.

1.4 Bulk Water Demands

The projected Average Day (AD) demand on the Toowoomba bulk water supply system is expected to increase over the next 30 years, primarily driven by population growth over the period. The population connected to the Toowoomba bulk water supply system is projected to grow by approximately 80,000 Equivalent Persons (EP) to around 270,000 EP by the Year 2050.

Table 1.1 presents the projected 30-year average day demands, including an allowance of 13% non-revenue water as per current TRC bulk water planning criteria.

Table 1.1 Projected Population and Demand

Demand Forecast	2020		2050	
	Population (Equivalent Population)	Average Day Demand (ML/d)	Population (Equivalent Population)	Average Day Demand (ML/d)
Low Series	193,000	39	251,114	50
Medium Series			268,070	61
High Series			276,397	71

The Water Vision strategy represents an integrated assessment of supply sources to meet long-term AD demands as well as reviewing infrastructure capacity to meet sustained peak demand, such as during a period of extended high summer demand. TRC planning criteria adopts a Mean Day of a Maximum Month (MDMM) for defining the capacity of the bulk water supply system.

1.5 Service Standards

Service standards are a set of planning criteria that water supply assets should be able to meet to maintain the desired standards of service. The performance of the water supply system against specific parameters over time can be quantified and used to guide planning and investment. The service standards and their application for this assessment is summarised in Table 1.2.

Table 1.2 Overview of Service Standards

Service Standard	Description
Long-term yield (supply sources)	Long-term yield is the ability of a system to supply water on an average day, under average climatic conditions and is generally prescribed by water extraction entitlement limits defined from hydrological assessments for the respective water Resource Operating Plans. When average annual demand exceeds the total available annual volume of the water entitlement, the long-term yield of the system becomes a supply constraint and a new source of supply is required.
Level of Service objectives (drought performance)	LOS objectives characterise the long-term drought security performance of the bulk water supply system by defining the frequency, severity and duration that the community will be subjected to water restrictions.
Peak demand (infrastructure capacity)	System performance for peak demand is assessed by comparing the projected Mean Day Maximum Month (MDMM) forecast against the current infrastructure capacity.

There are three different water accounting definitions that apply to defining long-term yield for the Toowoomba bulk water supply system:

1. Surface water entitlement: A surface water entitlement is a licensed, allocated share of the available water resource in a catchment and is regulated by the Queensland Department of Natural Resources, Mines and Energy.
2. Surface water safe yield: Safe Yield (also known as Historical No Failure Yield) is the maximum amount of water that could have been extracted from a surface water storage each year for which flow data exists, while ensuring the storage does not reach minimum operating level.

3. Groundwater safe yield: Safe yield for groundwater is generally considered to be the average replenishment rate of the aquifer from natural and artificial (if applicable) recharge.

Cressbrook and Perseverance Dam yield has been based on the combined entitlement set by DNRME. As there is no entitlement limit for Cooby Dam (i.e. there is no annual extraction limit) Safe Yield has been adopted.

The Toowoomba City Basalt bores are currently being operated at a nominal safe yield due to concerns about long term sustainability and as such this has been adopted as the current extraction limit.

1.6 Performance Assessment

A performance assessment was undertaken for the TRC bulk water supply system infrastructure by comparing the existing asset capability against the service standards and demand forecast for the duration of the planning horizon (Year 2020 to Year 2050).

Figure 1.1 shows that based on the projected medium series AD demand forecast and the existing bulk water supply assets; the total entitlement from Cressbrook and Perseverance Dams plus the safe yield from Cooby Dam plus the nominal safe yield from the City Basalt bores will result in a supply deficit around Year 2026 with the deficit being 15ML/d by Year 2050 without augmentation. Long-term yield is the ability of a system to supply water on an AD, under average climatic conditions and therefore does not include supply from the Wivenhoe pipeline, as this is currently only operated as a drought security measure.

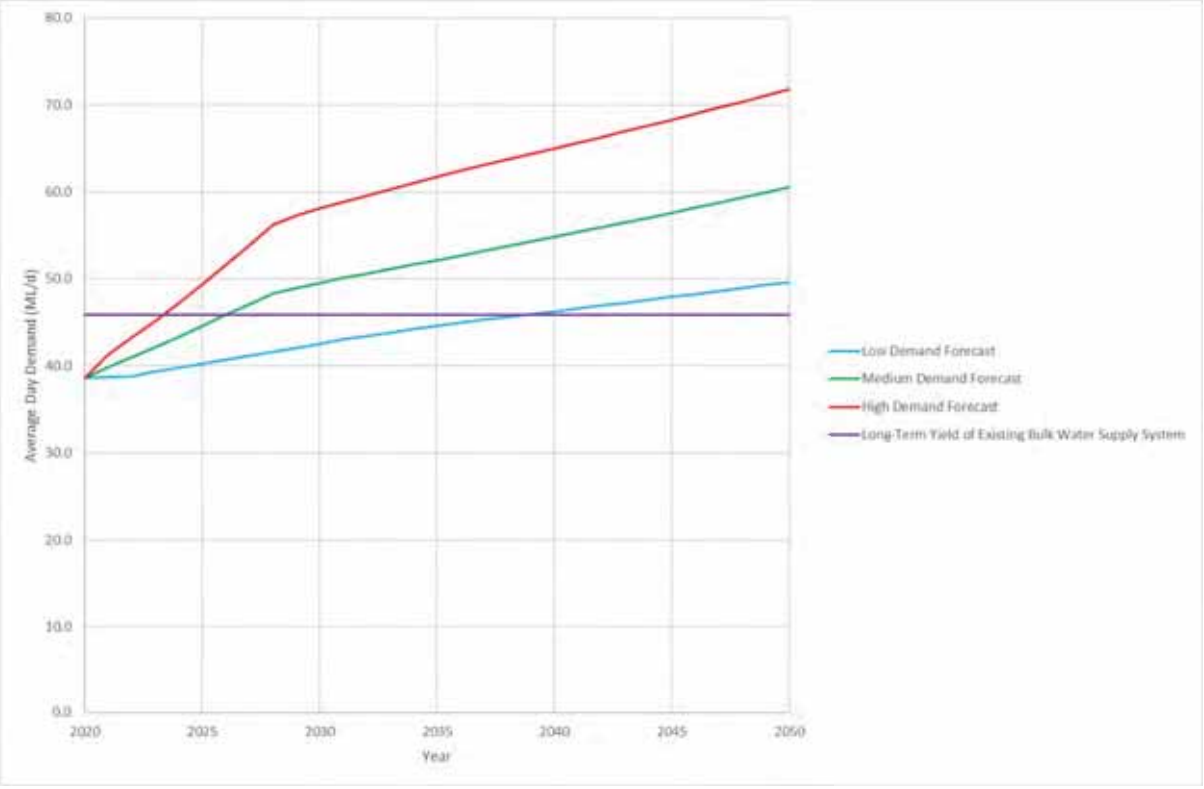


Figure 1.1 Bulk Water Supply System Performance Assessment – Long-Term Yield

Based on the projected medium series demand forecast (MDMM) and the existing bulk water supply assets, a deficiency in treated water capacity will occur in Year 2022 and will reach 23ML/d by Year 2050 (refer Figure 1.2).

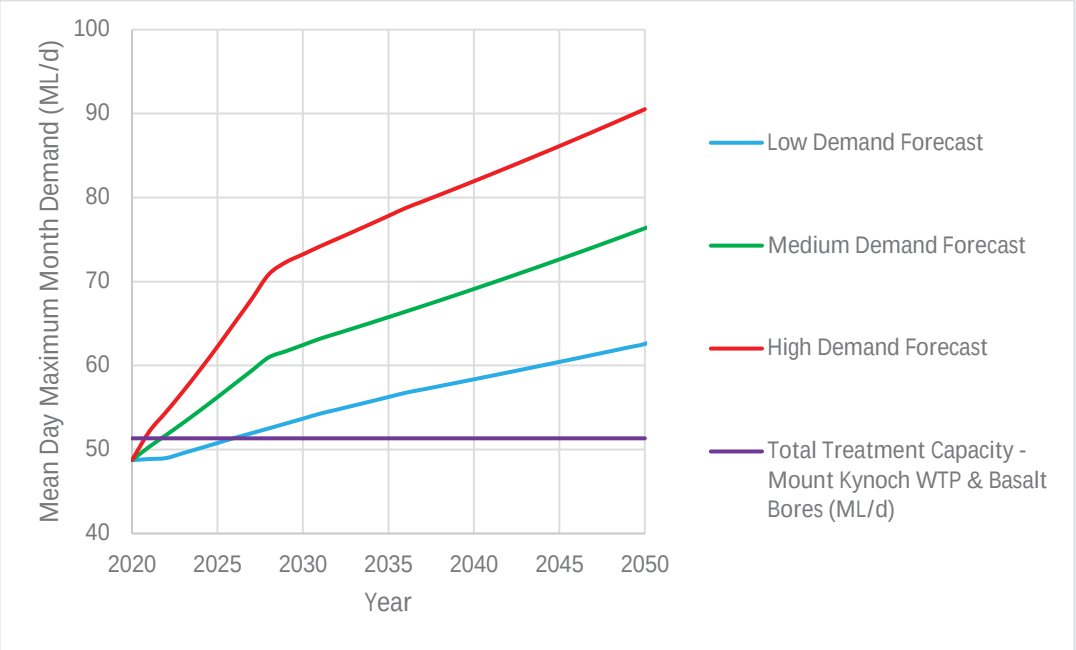


Figure 1.2 Bulk Water Supply System Performance Assessment – Treatment Capacity

A summary of the system constraints is detailed below in Table 1.3. The assessments of future capacity constraints adopt the medium series demand forecast, however, results for the low and high series demand forecasts are also shown to indicate potential variation to these dates.

These results show that securing additional treated water production capacity and resolving the emerging water entitlement constraint through a new bulk supply source are critical to Toowoomba's Water Future in the next 10 years. These results are based on utilising the Wivenhoe to Cressbrook raw water pipeline according to the existing operating rules.

Table 1.3 Summary of Bulk Water Supply Constraints

Service Standard	Constraint	Deficit at Year 2050	Year		
			Medium Series Demand	Low Series Demand	High Series Demand
Water Treatment Capacity	Peak Demand (MDMM)	23ML/d	2022	2032	2022
Long-Term Yield	Supply sources (AD)	15ML/d	2026	2039	2023
LOS Objectives	Nil		Nil during planning horizon.		

1.7 Options Assessment

Future water treatment options and other infrastructure requirements are dependent on the proposed new bulk water supply source. Therefore, it was important to shortlist potential supply options to then identify and assemble complementary water treatment and other infrastructure options into defined investment strategies.

This project has taken an “all options on the table” approach to identify new water supply options, starting with the development of a “Blue Sky” list of possible supply sources. Separately, additional options were identified to resolve infrastructure capacity constraints defined as part of the performance assessment.

Table 1.4 provides an overview of the assessment criteria used to shortlist options.

Table 1.4 Overview of Assessment Criteria

Gate	Gate Criteria
1	Can the option be costed (+/- 100%)? Can a yield be estimated?
2	Is the option cost effective compared to other options (capital cost)? Does the option fall outside a "logical cost threshold” (levelized cost)?
3	Comparative assessment of new source options, aligned with TRC’s Corporate Goals, with additional specific water strategy considerations.
4	Comparative assessment of investment strategies, aligned with TRC’s Corporate Goals, with additional specific water strategy considerations.

Where an identified option did not have sufficient data to conclusively rule it out at any of the assessment gates, it has been deferred for further assessment rather than removed. Deferred options should be revaluated during the next revision of the Water Vision project.

1.7.1 Supply Options

Table 1.5 presents the results of the gated options assessment process for water supply options (Gates 1 to 3).

Table 1.5 Overview of Supply Options Assessment

Gate	Gate Criteria	Number of Options			
		Considered	Removed	Deferred	Passed
1	Can the option be costed (+/- 100%)? Can a yield be estimated?	48	9	12	27
2	Is the option cost effective compared to other options (capital cost)? Does the option fall outside a "logical cost threshold" (levelized cost)?	27	2	14	11
3	Comparative assessment aligned with TRC's Corporate Goals, with additional specific water strategy considerations	11	0	7	4

The four remaining options that were considered further as part of this version of Toowoomba's Water Vision were:

- Dam Replenishment using Purified Recycled Water to Cooby.
- Wivenhoe to Cressbrook Raw Water Pipeline - Permanent use, limited to cover annual supply deficits.
- New Wivenhoe to Cressbrook Raw Water Pipeline sized only to transfer the supply deficit to Year 2050, operated as required.
- Wivenhoe to Cressbrook Raw Water Pipeline - Permanent use of existing infrastructure to full design capacity.

As part of the performance assessment against the LOS objectives for the Wivenhoe to Cressbrook raw water pipeline options, a modified option was identified that combined aspects of each of the three options and resulted in improved performance. This modified option supersedes the three previously shortlisted Wivenhoe to Cressbrook Raw Water Pipeline options.

Inter-regional transfer options could be demonstrated to have a wider regional benefit; however, as currently identified, they are not cost effective as a dedicated supply to TRC. If the project was expanded to include other beneficiaries, such as adjacent local government areas, the cost may be justified. In this arrangement, they could proceed if

funding from State or Federal Governments was secured as part of a broader regional water security strategy.

1.7.2 Treatment Options

There are three variations of options to add treatment capacity to Toowoomba's bulk supply system:

1. Continue to utilise Mount Kynoch WTP as the central treatment facility.
2. Construct an alternative treatment facility and maintain Mount Kynoch WTP at 55ML/d.
3. Construct an alternative treatment facility and decommission Mount Kynoch WTP after Year 2028.

Common to all investment strategies is the interim upgrade of Mount Kynoch WTP to treat projected peak demand up to Year 2028. This is the assumed base case for treatment capacity.

Treatment facilities beyond Year 2028 will be dependent on the new supply source.

1.7.3 Investment Strategies

The shortlisted supply sources and infrastructure capacity options were assembled into investment strategies designed to meet TRC's water supply needs to Year 2050. The investment strategies identified potential infrastructure upgrades to existing assets such as Mount Kynoch WTP and raw water supply pipelines for each of the shortlisted supply options. The following were calculated for each of the investment strategies:

- Cost – Net Present Cost (NPC) and initial capital investments.
- Performance against LOS and service objectives.
- Residual asset value.

Based on the results of the above, each investment strategy was further assessed against the Gate 4 criteria from the Options Assessment Framework (refer Table 1.4).

Following the assessment of investment strategies against Gate 4 criteria from the Options Assessment Framework, the investment strategies based on the Wivenhoe to Cressbrook Raw Water Pipeline supply option present as the preferred option.

The investment strategies with the Wivenhoe to Cressbrook Raw Water Pipeline as the supply source have the lowest capital and NPC with the advantage of these investment strategies being that existing assets are utilised as much as possible. While these investment strategies achieve all the LOS objectives, Toowoomba's water supply remains heavily dependent on surface water sources and will therefore be vulnerable to the impacts of climate change. The ability to respond to drought would continue to be an issue. The

implementation of this option is dependent on increased allocation for the Cressbrook and Perseverance system and the renegotiation of the current Bulk Water Supply Agreement with Seqwater to improve supply security.

Investment strategies that include Dam Replenishment using Purified Recycled Water as a supply option would create a diverse supply strategy for Toowoomba and would improve drought contingency; however, these options have costs that are generally twice as expensive as the investment strategies underpinned by the Wivenhoe to Cressbrook Raw Water Pipeline. Community acceptance of this option is critical to the successful implementation of this option and an extensive community engagement program would be required prior to being considered for implementation.

Inter-regional transfer options should only be considered if funding from State or Federal Governments is available. There is a significant level of infrastructure investment and funding required for these options to proceed.

Critical to all strategies is the future treatment plant location. Regardless of the supply option, the strategy to utilise the existing Mount Kynoch WTP is preferred based on NPC, followed by options that continue to use Mount Kynoch WTP in a limited capacity. A condition assessment of the Mount Kynoch WTP should be undertaken to determine the viability of continuing to operate the plant. If the plant does not have capacity or is incompatible with TRC's future planning, a new site should be investigated.

1.8 Water Vision 2050 - Sewerage

Bulk sewage treatment assets have been considered as part of *Water Vision 2050* for alignment and consistency with the water security strategy.

This assessment has indicated that the existing capacity at Wetalla WRF is insufficient to treat projected flows to the Year 2050 and that an additional 6 ML/d of sewage treatment capacity is required. This deficiency has been resolved via an upgrade to the Wetalla WRF. Alternate strategies and locations have not been considered by the *Water Vision 2050* program, however, may be considered in future versions.

1.9 Rural Towns

TRC is responsible for the supply of drinking water to 11 townships that are not connected to the bulk water supply system (rural towns). The population of these towns range from 77 in Kulpi to 3,100 in Pittsworth.

Connection to the bulk water supply system is planned for five of these rural towns (Cambooya, Greenmount, Nobby, Clifton and Vale View). For the other towns, this review has indicated that for most towns the groundwater supply volume from the bores is enough to meet future demand; however, there are some deficiencies relating to treatment capability for water quality issues and infrastructure capacity for peak demand.

1.10 Next Steps

This assessment is the first step in the process of developing a contemporary water security strategy for the Toowoomba region. Further iterations of Water Vision will be required to evolve and improve the strategy, with the maturity and scope of assessment improving with each revision. The Water Vision document needs to be updated and improved on a regular cycle. It is recommended that the next version of Water Vision targets completion in 2022. This is to allow time to undertake high priority further investigations but still have sufficient time to refine the strategy before major capital investment is required. Water Vision should then move to a typical five-year review timeframe, unless there are triggers that warrant an earlier review.

Actions have been identified by this strategy, including high priority items relating to technical investigations of deferred options and stakeholder and community engagement.

Overall, options to utilise and upgrade existing assets are preferred. The investment strategy of the Wivenhoe to Cressbrook Raw Water Supply Pipeline combined with upgrades to Mount Kynoch WTP performed most favourably when assessed against other investment strategies using the options assessment framework criteria. This assessment is based on available information and as such key assumptions have been made. It is critical that the following items are confirmed prior to committing to this investment strategy:

- This strategy would require amendment to the existing *Cressbrook Creek Water Supply Scheme Operations Manual* with modification to the resource entitlement volumes (up to 20,000ML/a from 14,000ML/a) as well upgrades to the Cressbrook raw water pump station and changes to the operating rules for the Wivenhoe to Cressbrook Raw Water Pipeline to allow operation of the pipeline at a higher initial level in Cressbrook Dam. Further consideration of the Environmental Flow Objectives would be required, which may modify the results presented here.

- This option relies on agreement of operational protocol with a third party, and negotiation with Seqwater would be required to ensure the increase extraction volumes from Wivenhoe (up to 14,000ML/a from 10,000ML/a) are available. The current agreement allows Seqwater to cancel supply should South East Queensland be in drought. In addition, increased supply from the Wivenhoe system outside of drought conditions may require TRC to be subject to the same LOS and service standards as South East Queensland.

- Continuing to utilise Mount Kynoch WTP as the central treatment facility requires a condition assessment of this existing plant to confirm its suitability to continue operation to Year 2050.

Identified above are options that would secure Toowoomba's water future with an increased reliability through to Year 2050. However, it is noted that the identified constraints for both supply sources and treatment capacity are immediate, within the next five years.

There is the potential to optimise the use of existing assets to ensure the preferred Year 2050 strategy can be implemented. This would include expanding the use of the

Toowoomba City Basalts and the Great Artesian Basin (GAB) bores. Both options have been considered but not progressed as the preferred supply source, as alone they do not resolve the Year 2050 supply deficiency and there is insufficient information to determine their long-term sustainability as a supply source.

However, they potentially offer TRC redundancy to allow the preferred supply option to be delivered within more reasonable timeframes. It is noted that activation of the GAB bores is currently being investigated by TRC as a response to the current drought conditions. Similarly, works to determine the viability of the continued and increase usage of the Toowoomba City Basalt groundwater source should be undertaken as a priority.

TRC is currently operating the Toowoomba City Basalt bores at 5ML/d but have an entitlement of up to 10.4ML/d. The GAB bores have an entitlement of 5.5ML/d. If the additional supply from the GAB bores can be added to the system, the supply constraint could be deferred by up to seven years to Year 2033. If the full entitlement of the basalt bores can be realised this would further extend the supply by up to Year 2043.

While the reliability of these supply sources at these increased volumes is currently uncertain, any increase in yield achieved would assist to defer timing and capital investment required for a new supply source. Pursuing these options should be a priority for TRC.

2. INTRODUCTION

The Toowoomba Regional Council (TRC) encompasses approximately 13,000km^2 and includes communities from the north of Yarraman to south-west of Millmerran and includes the city of Toowoomba. For comparative purposes this is nearly 10 times the area covered by the nearby Brisbane City or Gold Coast City Councils. While spanning a very large area, the Toowoomba region is also experiencing population growth and has consistently recorded one of the highest growth rates in the state outside the South East corner.

In 2019, the Toowoomba Regional Council adopted a 2019-2024 Corporate Plan that includes five goals: People, Place, Sustainability, Prosperity and Performance. These goals set the context for actions and budgets for the five-year planning horizon. While water supply is arguably incorporated into all the goals, the Sustainability Goal articulates a need for "... good planning and sustainable infrastructure networks to enhance our communities. Our infrastructure is well maintained and enables growth into the future."

Therefore, a fundamental activity for the Council is to undertake and periodically review a water security assessment and develop plans to ensure the infrastructure is both functional and augmented as the need arises.

Across Australia, new supply sources are becoming increasingly limited and the traditional approach of supplying urban water through a combination of dams and conventional WTPs is often not available or is insufficient to meet demand. Aging infrastructure, technological improvements, a changing climate and population growth all influence the selection of new supply sources and associated treatment facilities.

TRC has commissioned Engeny Water Management (Engeny) to develop a long-term water strategy for the region (*Water Vision 2050*). *Water Vision 2050* provides an overview of the plan for the provision of water and sewerage services for the Toowoomba region and is supported by sophisticated modelling and robust decision-making processes. The purpose of this report is to provide an overview of the Toowoomba region water supply system, the challenges faced and opportunities available, and importantly to outline options to ensure the current and future water supply issues are met.

Water Vision 2050 will outline a water security strategy that meets Toowoomba's water supply service needs for the next 30 years, using an optimised combination of infrastructure, operating strategies and non-infrastructure solutions. *Water Vision 2050* is also designed to align with Toowoomba's sewerage and catchment strategies which ensures a contemporary 'all options on the table' approach has been adopted to maintain transparent decision making and to develop an effective strategy that meets the long-term needs of the region.

Additionally, registered water service providers are required to report annually on the water security position with a general obligation to have plans in place to show robust monitoring, plans to meet supply obligations and drought contingency arrangements. This strategy will support this requirement.

The key focus areas for *Water Vision 2050* are to:

- Identify and understand existing and emerging water supply challenges facing the bulk water supply system and sewage treatment capabilities.
- Prioritise actions to address immediate challenges to maintaining water supply to the Toowoomba region.
- Assess possible options to maintaining appropriate water supply and sewage treatment services into the future.

This version of Water Vision is the first step in the process and further iterations will be required to evolve and improve the strategy, with the maturity and scope of assessment improving with each revision. For example, for the first version of a water security strategy a 30-year horizon is appropriate in order to clearly establish the base case. Benchmarking identified that a 50-year horizon was industry best practice and it is recommended that TRC consider extending the planning horizon for future versions of Water Vision.

The Water Vision document needs to be updated and improved on a regular cycle. It is recommended that the next version of Water Vision targets completion in 2022. This is to allow time to undertake high priority further investigations but still have sufficient time to refine the strategy before major capital investment is required. Water Vision should then move to a typical five-year review timeframe.

3. SCOPE

The planning boundaries for *Water Vision 2050* are to:

- Include the geographic area within the TRC region.
- Consider towns with an existing reticulated water supply (bulk supply and rural towns).
- Include a 30-year planning horizon (Year 2020- Year 2050).
- Consider both drought-response and long-term needs.

Water Vision 2050 has been developed based on the following guiding principles:

- 'Catchment to Tap' objectives considered as part of planning, with consideration of the risks and actions identified in the draft *Catchment Management Strategy* (Engeny, 2020).
- 'All options considered' in the assessment process, including supply, demand and system operation opportunities, noting that some options will be progressively removed through the Gateway assessment for various reasons. As this is the first iteration, many options will not have sufficient level of detail to proceed. However, they may be deferred for future investigation.
- Alignment between the water security strategy, the sewerage strategy and the *Catchment Management Strategy*.

The scope of *Water Vision 2050* is to:

- Confirm the current capability of water supply assets, with reference to existing planning documentation.
- Define the service standards required to undertake a water supply performance assessment, including adoption of appropriate water security Level of Service (LOS) objectives for the bulk supply system.
- Undertake a gap analysis between the current capability of the water supply assets and desired service standards to identify supply constraints over the 30-year planning horizon.
- Review existing sewerage network planning reports for relevance and alignment with *Water Vision 2050* (bulk supply area only).
- Document the asset capability, service standards and supply constraints (*Water Futures Planning Basis*, Engeny 2020).
- Identify and characterise options that address TRC's supply constraints, including concept development and cost estimation.

- Undertake a detailed options assessment, including:
  - Develop an *Options Assessment Framework*.
  - Shortlist supply options.
  - Shortlist treatment options.
- Integrate shortlisted options to create potential investment strategies, including capital plans, operating strategies and performance assessments against the *Options Assessment Framework* (bulk supply area only).
- Analyse and compare investment approaches to present effective and efficient investment strategies for Toowoomba's water future.
- Review TRC's sewerage strategy and identify opportunities for integration with *Water Vision 2050*.
- Identify and recommend a preferred investment strategy for Toowoomba's water future including a 'low cost – low volume' set of early actions.

Figure 3.1 provides a schematic of the various work streams and scope of *Water Vision 2050* with the following approach taken to deliver the scope outlined above:

1. Use of existing information where possible (if reliable and contemporary).
2. Focus on major infrastructure elements.
3. Identify information gaps and assess uncertain data for reliability.
4. Note uncertainty in available information and/or further work that will be required to confirm assessment findings.
5. In some cases, assessments have been deferred until sufficient information is available. These are noted but not progressed in *Water Vision 2050*.
6. Note opportunities for improvement in future revisions.

Exclusions for this phase of the project, but recommended for inclusion by TRC as part of future project implementation phases include:

- Community engagement.
- Stakeholder engagement.
- Detailed technical studies (i.e. hydrological and bathymetric assessments).
- Dam Safety upgrade requirements (hydrological updates required).
- Environmental scanning.

- Scenario analysis, including the potential impacts of climate change.
- Review of Wivenhoe pipeline operating trigger.
- The role of demand management, including water restrictions.
- Review of leakage rates and non-revenue or unaccounted for water.
- Sewerage network assessments.

At the time of the development of *Water Vision 2050*, a project is underway between TRC, Southern Downs Regional Council (SDRC) and the Queensland State Government regarding the provision of supply (either raw or treated water) to Warwick. This current assessment has been completed excluding the provision of supply to Warwick.

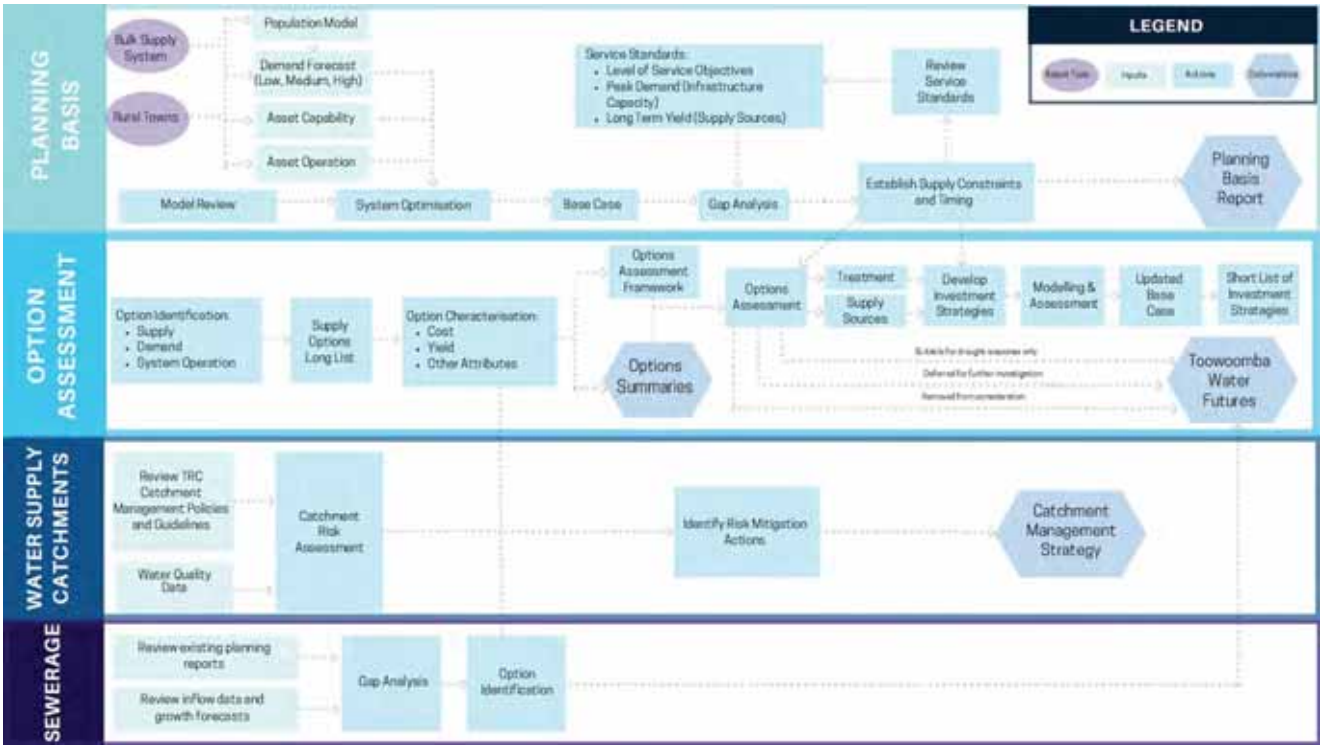


Figure 3.1 Schematic of *Water Vision 2050* Scope

4. EXISTING WATER SUPPLY SYSTEM

4.1 Overview

TRC owns and operates the region's water supply system, including dams and weirs[1], pump stations, bulk supply pipelines, water treatment plants, groundwater bores, groundwater treatment facilities and the water reticulation network to supply treated drinking water to customers and the community. TRC's current supply sources for the bulk water system are based on traditional surface water supplies augmented by local groundwater supplies. The distribution of supply sources is approximately 90% surface water and 10% groundwater in the current operation.

While the majority of the region's centralised population is serviced by an integrated system of bulk water assets, TRC is also responsible for the supply of drinking water to 11 rural towns with independent supplies. The bulk water supply and rural towns supply systems operate independently. Figure 4.1 provides an overview of the Toowoomba water supply networks with Figure 4.2 providing a schematic with the planning capacities of key water supply assets.

There are three different water accounting definitions that apply to defining long-term yield for the Toowoomba bulk water supply system:

1. Surface water entitlement: A surface water entitlement is an allocated share of the available water resource in a catchment and is regulated by the Queensland Department of Natural Resources, Mines and Energy (DNRME).
2. Surface water safe yield: Safe Yield (also known as Historical No Failure Yield) is the maximum amount of water that could have been extracted from a surface water storage each year for which flow data exists, while ensuring the storage does not reach minimum operating level.
3. Groundwater safe yield: Safe yield for groundwater is generally considered to be the average replenishment rate of the aquifer from natural and artificial (if applicable) recharge.

This assessment has been undertaken using the known entitlements or safe yields for existing infrastructure. Cressbrook and Perseverance Dam yield has been based on the combined entitlement set by DNRME. As there is no entitlement limit for Cooby Dam (i.e. there is no annual extraction limit) Safe Yield has been adopted. The Toowoomba City Basalt bores are currently being operated at a nominal safe yield due to concerns about long term sustainability and as such this has been adopted as the current extraction limit.

Reviews of the entitlement and allocation volumes have not been undertaken beyond the current values. Further investigation of these volumes and the long-term availability of these volumes is required.

Appendix A provides maps of the existing water supply network.

[1] Noting that Ted Pukallus Weir is owned by TRC and Cecil Plains Weir is owned by SunWater.

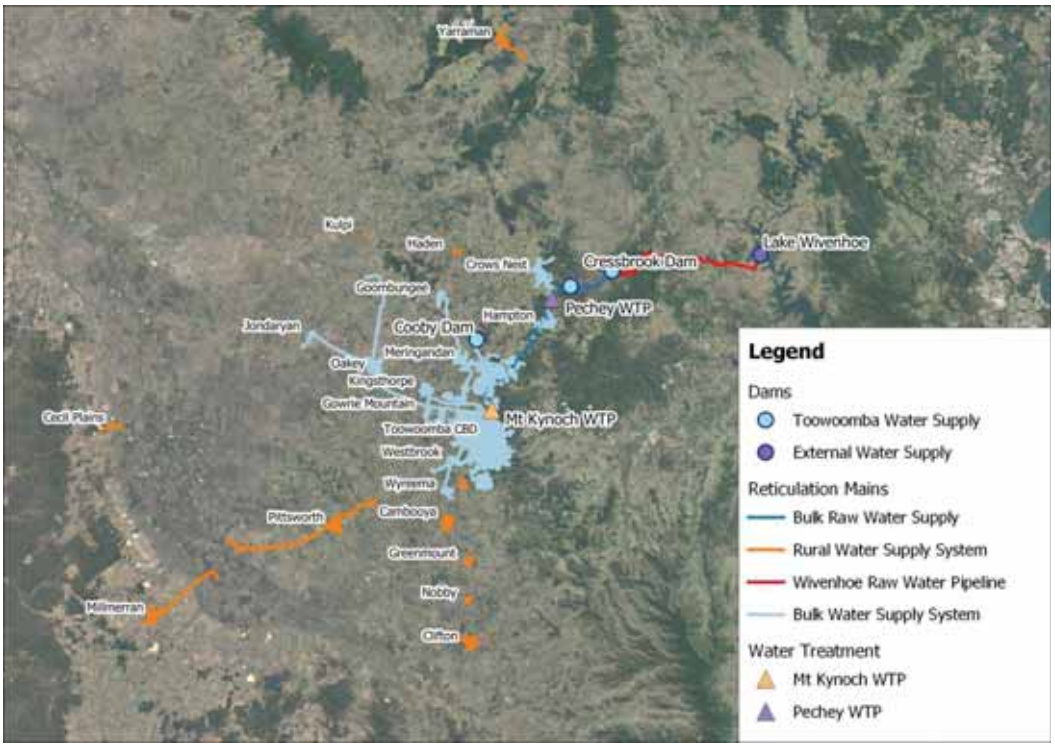


Figure 4.1 Toowoomba Water Supply Network

4.2 Bulk Water Supply System

The Toowoomba bulk water supply infrastructure supplies the centralised area of Toowoomba, major townships and other "connected communities" and includes all raw water and bulk water distribution infrastructure connected to the Mount Kynoch Water Treatment Plant (WTP). This includes:

- Cooby, Perseverance and Cressbrook Dams.
- The Wivenhoe pipeline supplying bulk raw water.
- An extensive network of groundwater bores.
- The reticulation pipework to supply the connected communities.

4.2.1 Catchments

All TRC water supply catchments are considered to be 'open' and used for multiple purposes. 'Closed' water supply catchments generally prohibit uses other than water supply as a precaution to protecting drinking water supplies from various sources of risk or contamination. Toowoomba's 'open' catchments allow multiple uses that include grazing residential, reserves, forestry, horticulture, intensive livestock, cultivation and recreation. The dams and land immediately surrounding are used for active recreational purposes including water skiing, boating, fishing, sailing and camping.

'Open' catchments are generally more exposed to water quality risks, and typically require more advanced levels of treatment. While 'open' catchments for water supply is different to other parts of the country it is consistent with the nearby South East Queensland catchments where various activities are allowed in drinking water catchments. A robust methodology for assessment of risk with recommended actions is included in the *Catchment Management Strategy*.

TRC also uses groundwater to supplement the bulk water supply from dams in Toowoomba. There are 19 town bores, that source water from the basalt aquifers in the Main Range Volcanics Formation within the Toowoomba City Basalts Groundwater Management Area. Land use within the Aquifer area is mainly urban; however, groundwater also needs to be monitored and assessed for risk. The *Catchment Management Strategy* risk assessment for the rural town bores indicated that most bores had very high-risk water quality issues. Very high-risk hazards included pH, hardness, turbidity, chloride, iron, manganese, total dissolved solids, nitrate, E. coli, sodium and fluoride. These hazards are likely a result of natural geology, wastewater contamination from onsite wastewater management systems or insecure bores leading to surface water connection.

4.2.2 Asset Capability

Asset capability has been determined for existing assets, including the dams, bores and trunk network infrastructure. The capacity for the dams and bores has been based on the

available entitlement and safe yield volumes where known. Trunk network infrastructure has been based on published capacities.

The raw water delivery infrastructure is comprised of both pumped and gravity mains. Each dam has a dedicated raw water delivery system:

- Cooby Dam includes a dedicated trunk main from the dam to the Mount Kynoch WTP inlet works.
- Both Cressbrook and Perseverance Dams include a pumped raw water delivery system to the Pechey Reservoirs.
- From the Pechey reservoirs dual gravity trunk mains deliver flows to the Mount Kynoch WTP inlets.

It is understood TRC has plans in place to renew the Perseverance gravity mains from Pechey reservoir to Mount Kynoch WTP. The capacity of the Pechey mains has been taken as the expected capacity at the end of the renewal program (Year 2025). Figure 4.2 shows the capability of the major assets of the bulk supply system with a summary of the key infrastructure elements and their capacities detailed in Table 4.1.

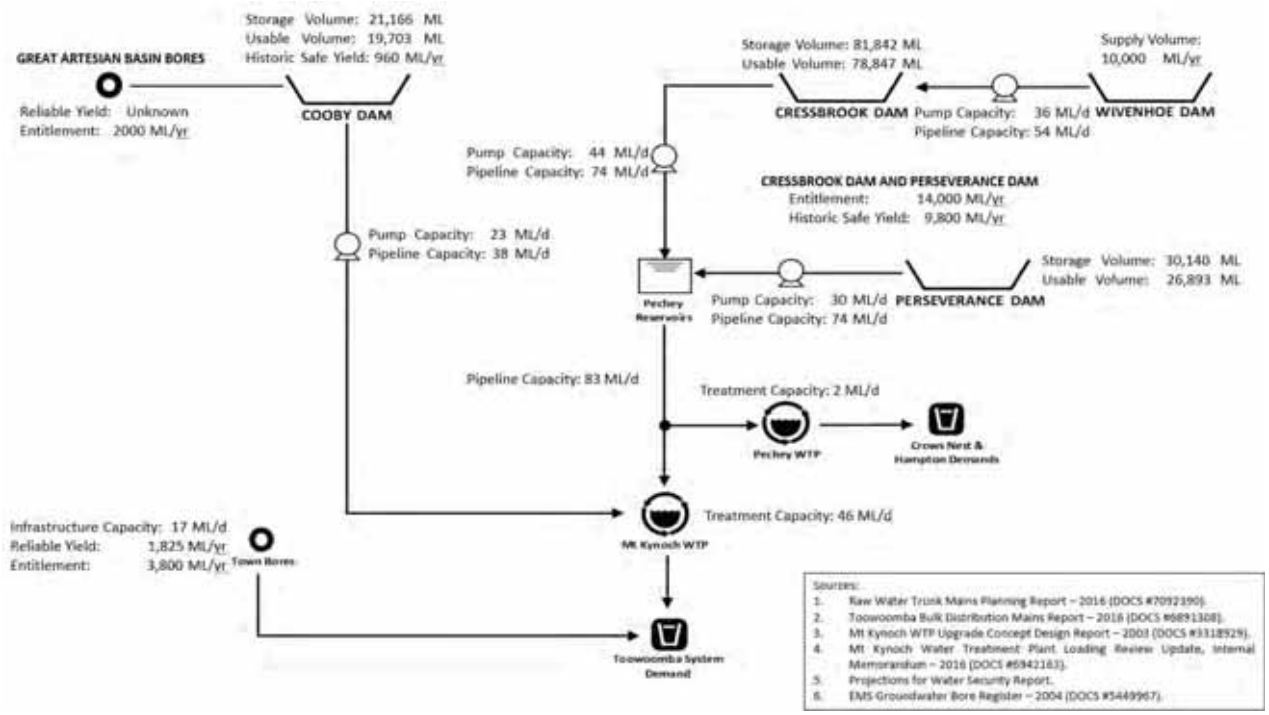


Figure 4.2 Capability of Major Assets for the Bulk Water Supply System

Table 4.1 Summary of Key Water Infrastructure Capability

Asset	Parameters		
	Size	Useable Volume/Capacity	Entitlement
Raw Water			
Perseverance Dam	30,140 ML	26,893 ML	14,000 ML/a
Cressbrook Dam	81,842 ML	78,847 ML	
Cooby Dam	21,166 ML	19,703 ML	930 ML/a [a]
Town Bores (Toowoomba City Basalts)	-	2,800 ML/a infrastructure capacity 1,825ML/a reliable yield [b]	3,800 ML/a
Cooby Dam Bores (Great Artesian Basin) Currently not operational.	-	Unknown	2,000 ML/a
Raw Water Transfer			
Wivenhoe to Cressbrook Raw Water Pipeline	38 km, DN750 500 L/s	13,100 ML/a	10,000 ML/a
Cressbrook Dam to Pechey Reservoirs	15.7 km, DN760 C1: 560 L/s C2: 650 L/s	44.1 ML/d	N/A
Perseverance Dam to Pechey Reservoirs	4.7 km, DN760. 414 L/s	29.8 ML/d	
Pechey Reservoirs to Mount Kynoch WTP	2 x 27.6.7 km, DN690.	Years 2020-2025: 55 ML/d-63 ML/d[c] Post Year 2025: 83 ML/d[d]	
Cooby Dam to Mount Kynoch WTP	15km, DN500. 318L/s pump	22.9 ML/d	

Asset	Parameters		
	Size	Useable Volume/Capacity	Entitlement
Treatment			
Mount Kynoch WTP		55 ML/d (conventional filtration) based on 24 hr operation. 20 Hour operation 46 ML/d	N/A
Pechey WTP		2 ML/d	N/A

[a] *Represents Historical No Failure Yield, not entitlement*
[b] *Based on previous maximum extracted*
[c] *Note that capacity above 55ML/d is untested*
[d] *-Based on planned TRC renewals of the Pechey main*

Sources:

1. Raw Water Trunk Mains Planning Report – 2016 (DOCS #7092390).
2. Toowoomba Bulk Distribution Mains Report – 2016 (DOCS #6891308).
3. Mt Kynoch WTP Upgrade Concept Design Report – 2003 (DOCS #3318929).
4. Mt Kynoch Water Treatment Plant Loading Review Update, Internal Memorandum – 2016 (DOCS #6942163).
5. Projections for Water Security Report.
6. EMS Groundwater Bore Register – 2004 (DOCS #5449967).

4.2.3 Operating Strategy

The TRC existing water supply sources are generally operated as follows:

- Utilise the town bores at a fixed production rate of 1,825 ML/annum (a) (or 5ML/d), with maximum extraction rates based on historical use.
- Drawdown the three (3) surface dams at similar rate to maximise water security.
- Commence utilisation of Wivenhoe Pipeline when Cressbrook Dam level falls below 40% Full Supply Volume (FSV). This trigger has not been reviewed as part of this assessment.

As outlined in the *Cressbrook Creek Water Supply Scheme Operations Manual* (DNRME, 2018), environmental releases from Cressbrook Dam are not required when the Wivenhoe pipeline is in operation. The Cressbrook and Perseverance dams are considered a single system for the purposes of the operating manual and entitlements, with both sources supplying raw water to Pechey Reservoirs then on to Mount Kynoch WTP.

Raw water from Cooby Dam has a lower transfer cost to Mount Kynoch WTP. However, to maintain water security and meet peak demand, water needs to be sourced from both Pechey Reservoirs (Cressbrook Dam and Perseverance Dam) and Cooby Dam.

Cooby Dam is the smallest storage in the Toowoomba water supply network and has a relatively small yield with the raw water transfer infrastructure capacity from Cooby Dam to Mount Kynoch WTP far exceeding the safe hydrological yield of the dam. That means that water from Cooby Dam needs to be balanced to maximise use (thereby minimising cost), while keeping water available for periods of high demand.

The Toowoomba bulk water supply system also includes groundwater sourced from the Toowoomba City Basalts. Limited treatment is required for the groundwater sources with only disinfection provided at each location. Toowoomba has a total allocation of 3,800ML/a from the City Basalts. There has not been conclusive investigation on the reliable yield from the City Basalts as part of the Water Vision project; however, conservatively, a volume of 5ML/d represents an extraction volume with no known limitations.

The bores sourcing groundwater from the Great Artesian Basin (GAB) are located in proximity to Cooby Dam and have not been used to supplement supply since commissioning. The GAB allocation includes an additional 2,000ML/a which may be suitable for supply augmentation. While still subject to further assessment, there are plans to reinstate the GAB water supply as a drought response to augment Cooby Dam as and when required.

4.3 Rural Towns

The rural towns in the TRC region that have independent water supplies are:

- Cambooya.
- Cecil Plains.
- Clifton.
- Greenmount.
- Haden.
- Kulpi.
- Millmerran.
- Nobby.
- Pittsworth.
- Vale View.
- Yarraman.

TRC has two surface water supply storages for rural towns. These include the Ted Pukallus Weir which services the Yarraman township and the Cecil Plains Weir which services the Cecil Plains township and is owned by SunWater. TRC uses groundwater across several regional townships which in many cases is the only source of drinking water supply.

Figure 4.3 shows the reticulation infrastructure for each rural town.

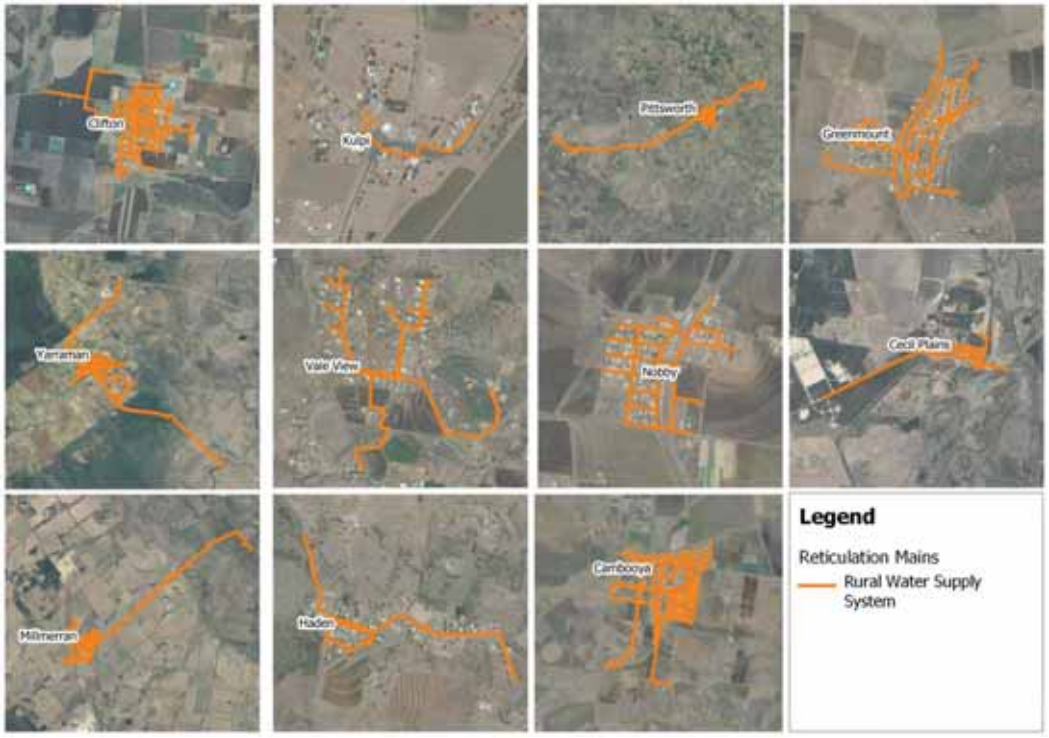


Figure 4.3 Rural Town Water Reticulation Systems

4.3.1 Catchments

Land use within the catchments for the surface water and aquifer storages is predominantly cultivation and stock use with minimal urban impacts. The Ted Pukallus Weir catchment also includes a National Park and a power station.

The aquifers that supply water for the townships are set within a combination of geological stratum including Main Range Volcanics, Kings Creek Alluvium, Marburg Sandstone, Condamine River Alluvium and Hutton Sandstone.

4.3.2 Asset Capability and Operating Strategy

Rural towns are operated independently on a supply-demand basis. Table 4.2 provides a summary of key asset capability for rural town water supplies and the current operational preferences.

It is noted that the rural town of Yarraman is currently supplied via the Nukku Pipeline as per a bulk supply agreement with South Burnett Council which expired in 2018. TRC is currently renegotiating this arrangement to ensure future supply.

Table 4.2 Summary of Rural Towns Key Water Infrastructure and Operational Preferences

Rural Town	Water Source	Infrastructure Capacity (ML/d)	Raw Water Sources	Operational Preference	Entitlement (ML/a)
Cambooya	Bores	4.3	Two bores (John Street and George Street)	John Street is the only operational bore at the present time. The George Street bore is offline due to water quality issues.	155
Cecil Plains	Cecil Plains Weir (supplementary supply from bores)	0.8	Weir and one bore	Primary source is the weir. The bore is a contingency drought supply and has significant water quality issues.	480 (GAB Bores) (combined with Millmerran) + 143 (Cecil Plains Weir) (Usable supply for Priority A entitlement)

Rural Town	Water Source	Infrastructure Capacity (ML/d)	Raw Water Sources	Operational Preference	Entitlement (ML/a)
Clifton	Bores	0.8	Four bores	Generally, Bores 4 and 5 are both used, with Bores 2A and 3A offline. At present, all water is being tankered into the town.	350
Greenmount	Bores	0.1	Three bores	Bore 4 primary water source due to greatest water security. Bore 1 supplements supply when necessary. Bore 3 currently offline due to supply issues.	180
Haden	Bores	Unknown	Single bore	Primary source is single bore.	250 (combined with Highfields)
Kulpi	Bores	Unknown	Single bore	Primary source is single bore.	50
Millmerran	Bores	3.3	6 bores	Bores 7 and 8 are lower priority due to water quality issues.	450 (Alluvial Bores) + 480 (GAB) (Combined with Cecil Plains)
Nobby	Bores	0.8	2 bores	The bores are located close to each other and can only be operated in a duty standby arrangement. Currently Bore 2 is the preferred supply source.	60

Rural Town	Water Source	Infrastructure Capacity (ML/d)	Raw Water Sources	Operational Preference	Entitlement (ML/a)
Pittsworth	Bores	2.3	3 bores	Brookstead bores (2 no.) are the primary sources, due to fluoride levels in the Yarranlea bore. Brookstead bores also have a higher entitlement.	510 (Alluvial Bores) + 480 (GAB)
Vale View	Bores	0.9	2 bores	Stark Drive bore is the sole supply source, the Smiths Creek Road bore has been taken offline.	256
Yarraman	Ted Pukallus Weir	0.9	Weir and additional supply pipeline (Nukku) from outside council supply zone.	Nukku pipeline is currently the primary source, due to water quality issues within the weir. This is more expensive ($2.25/kL) than treating the weir water ($0.6/kL).	200 (Ted Pukallus Weir) + 100 (Nukku Pipeline)

5. BULK WATER DEMANDS

5.1 Projected Average Day Demands

The projected Average Day (AD) demand on the Toowoomba bulk water supply system is expected to increase over the next 30 years, primarily driven by population growth. Low, medium and high series population forecasts have been used as inputs into the water demand forecast. The forecasts illustrated on Figure 5.1 and used for *Water Vision 2050* are specific to the reticulated water supply consumers connected to the bulk water supply system and are based on TRC internally developed forecast growth. Water demand for rural towns is addressed in Section 13.

The populations of the rural towns of Crows Nest, Hampton and Hodgson Vale are included in the bulk water supply system demand forecast, as follows:

- Crows Nest and Hampton are supplied by the Pechey WTP which sources raw water from the Cressbrook/Perseverance Dam system.
- The rural town of Hodgson Vale has been connected to the bulk water supply system.

A comparison against the Queensland Government Statistician's Office (QGSO) was undertaken as part of the *Water Futures Planning Basis Report* (Engeny, 2020). Although the QGSO data is likely to include some non-reticulated areas, the two data sets demonstrate a similar growth rate. Therefore, as TRC population projections are more specific this data set has been used to calculate the demand forecast.

As shown in Figure 5.1, the population connected to the Toowoomba bulk water supply system is projected to grow by approximately 80,000 Equivalent Persons (EP) to around 270,000 EP by the Year 2050. Equivalent Persons accounts for residential water usage, and non-residential water usage such as industrial and commercial demands.

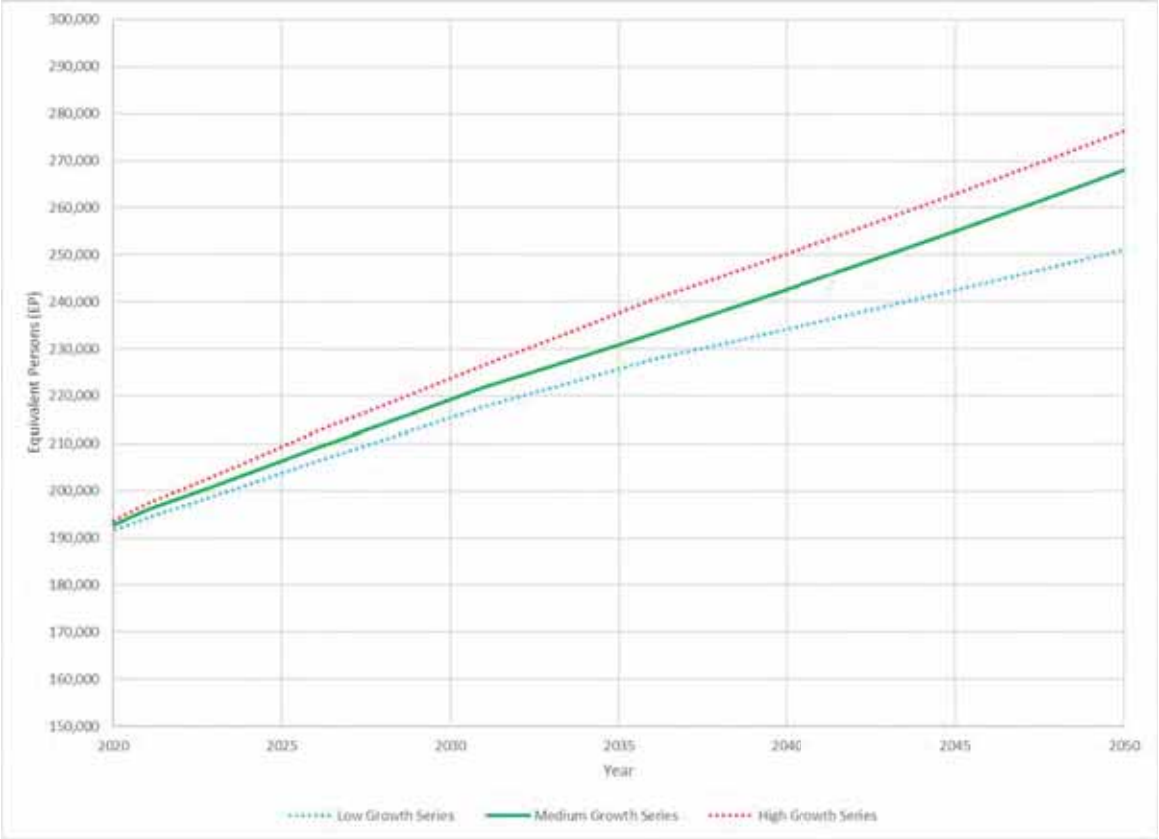


Figure 5.1 Toowoomba Bulk Water Supply System Population Growth Projections

Forecast water demands are a key planning input and can be the largest single determining factor on the timing of new infrastructure. The medium growth series demand forecast, EP and consumption rate have been adopted as the base case for the planning assessments. The medium growth series represents the most likely projection based on current observation, tracking and correlation with QGSO. Low and high series demand forecasts are used for sensitivity testing on the timing of supply constraints.

Table 5.1 provides a summary of the inputs to the demand forecast.

Table 5.1 Summary of Key Inputs for Low, Medium and High Demand Forecasts

Demand Forecast	Inputs	
	Year 2050 Population projection (EP)	Consumption Rate
Low Series	251,114	Assumed to remain at 175L/EP/d.
Medium Series	268,070	175L/EP/d @ Year 2019, increasing by 1.5% per year to reach 200L/EP/d in 2028. Then remains at 200L/EP/d.
High Series	276,397	175L/EP/d @ Year 2019, increasing by 3% per year to reach 230L/EP/d in 2028. Then remains at 230L/EP/d.

Table 5.2 and Figure 5.2 show current Average Day (AD) consumption and projected 30-year demands, including an allowance of 13% non-revenue water as per current TRC bulk water planning criteria (refer Section 6).

Table 5.2 Projected Population and Demand

Demand Forecast	Year 2020		Year 2050	
	Population (Equivalent Population)	Average Day Demand (ML/d)	Population (Equivalent Population)	Average Day Demand (ML/d)
Low Series	193,000	39	251,114	50
Medium Series			268,070	61
High Series			276,397	71

Demand growth has been broken down into residential and non-residential usage. The proportion of non-residential usage has been assumed to increase as population increases.

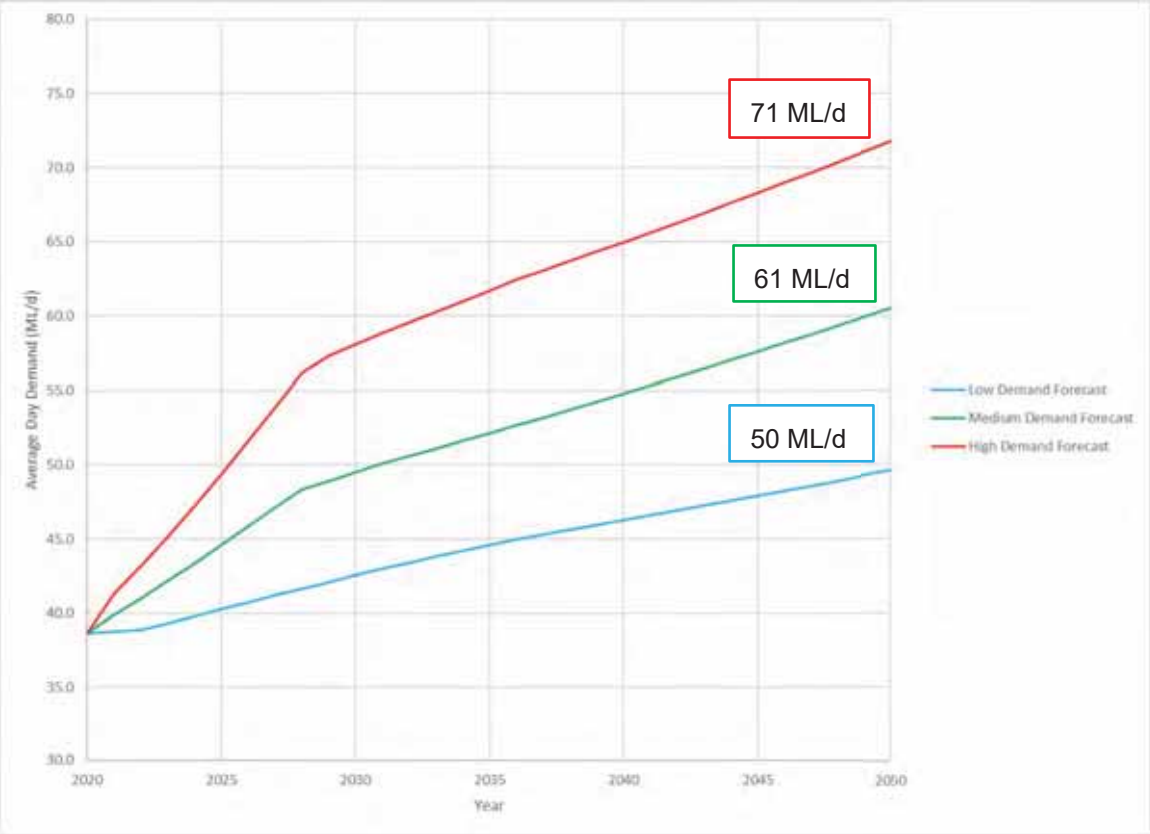


Figure 5.2 Projected Average Day Demands

5.2 Projected Peak Demands

Water Vision 2050 represents an integrated assessment of supply sources to meet long-term AD demands as well as reviewing infrastructure capacity to meet sustained peak demand, such as during a period of extended high summer demand. TRC planning criteria adopts a Mean Day of a Maximum Month (MDMM) for defining the capacity of the bulk water supply system (including treated water capacity; refer Section 6).

The projected sustained peak (MDMM demands) for the TRC bulk water supply system for infrastructure planning for *Water Vision 2050* is provided in Figure 5.3. TRC planning criteria excludes peaking on non-revenue water.

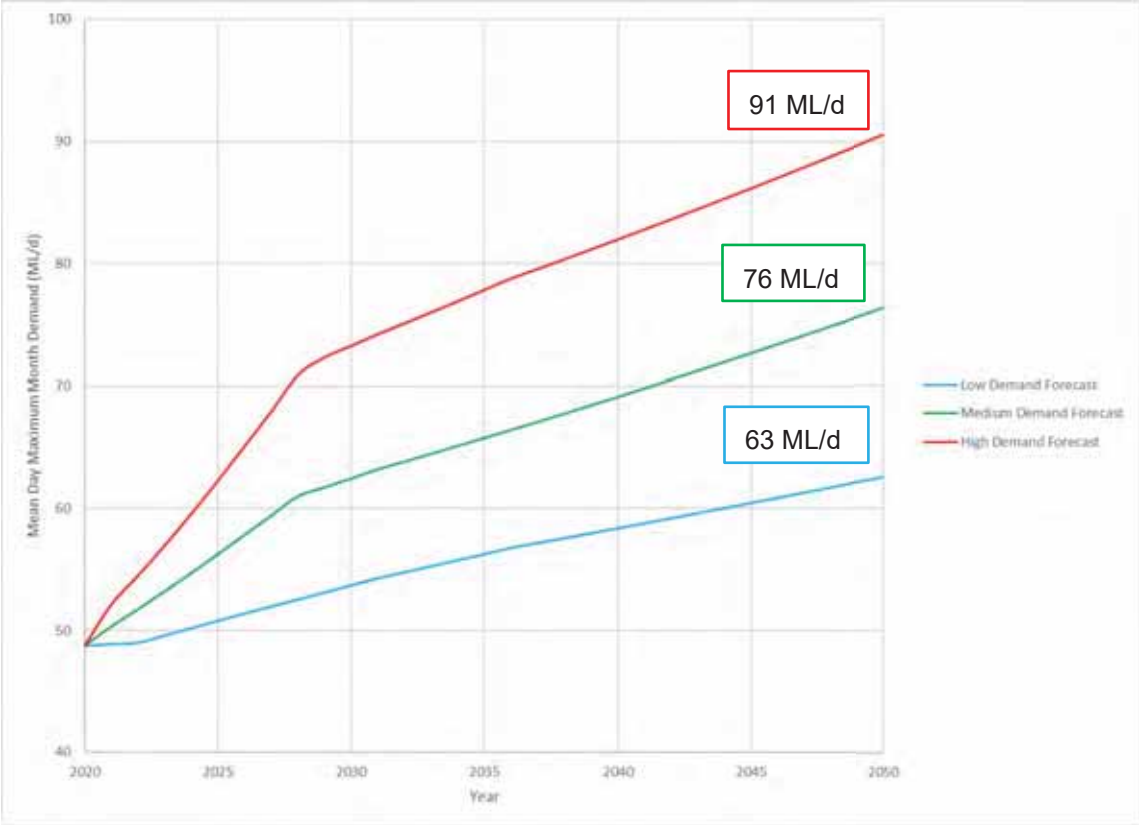


Figure 5.3 Projected MDMM Demands

5.3 Summary

The adopted medium series forecasts including residential and non-residential demand that underpin all assessments for the TRC bulk water supply system and form the basis of *Water Vision 2050* are provided in Table 5.3.

Table 5.3 Summary of Bulk Water Supply Medium Series Demand

Demand Forecast	Year 2020	Year 2050
Average Day (AD) (ML/d)	39	61
Peak Demand (MDMM) (ML/d)	49	76

.

6. SERVICE STANDARDS

6.1 Overview

Service standards are a set of planning criteria that water assets should meet to maintain the desired standards of service over time. Service standards may be comprised of industry standard guidelines and bespoke standards that reflect performance expectations.

6.2 Water Supply Infrastructure Capacity

The current TRC planning criteria for water supply infrastructure that underpin the adopted service standards are presented Table 6.1. These values are referenced in all recent network planning reports.

Table 6.1 Toowoomba Regional Council Water Supply Design Criteria

Item	Planning Criteria	Notes
Sustained peak persistence demands – Peak Day (PD) Mean Day Maximum Month (MDMM)	PD: 1.5 x AD MDMM: 1.3 x AD	Source: DM#7092390 Toowoomba Raw Water Trunk Mains Analysis Planning Report June 2016. This is the adopted default, but is superseded by DM#7947835v2, by date.
Unaccounted for Water (UFW)	13% of AD	Peaking factor not applied to UFW.
Large WTPs (i.e. Mount Kynoch WTP)	20 hours/day availability for production	Note previous planning has considered Mount Kynoch WTP operating at MDMM for 24 hours. This assumes 100% reliability and does not allow for suitable downtime for a plant that is critical asset for maintaining the region's treated water supply. It is recommended that the plant be assessed against 20hr MDMM for future planning.
Raw water main sizing (pumped)	20 hr MDMM	Source: DM#7092390 Toowoomba Raw Water Trunk Mains Analysis Planning Report June 2016.
Raw water trunk main sizing (gravity)	MDMM	Source: DM#7092390 Toowoomba Raw Water Trunk Mains Analysis Planning Report June 2016.
Pump Sizing – Raw Water	20 hr MDMM	Source: DM#7092390 Toowoomba Raw Water Trunk Mains Analysis Planning Report June 2016.

TRC has an existing standard for the reliability of raw water supply to Mount Kynoch WTP, which requires that raw water needed to meet MDMM demand can be supplied from any two of the three surface water storages. However, options considered for *Water Vision 2050* could result in significantly changed asset configurations, operating modes and available water sources. As such, the existing reliability standard has not been used to identify gaps in asset capability. Instead, reliability has been included as a comparative criterion as part of the options assessment framework.

6.3 Level of Service Objectives

Level of Service (LOS) characterise the long-term drought security performance of the bulk water supply system by defining the frequency, severity and duration that the community will be subjected to water restrictions. For this assessment, the following LOS objectives have been adopted. These standards have been generally based on the LOS objectives prescribed for South East Queensland (SEQ) as administered by Seqwater for the SEQ Water Grid. However, due to the local hydrology of the Toowoomba bulk water supply system and the performance of the existing surface water dams; an average duration of medium level water restrictions of two years has been agreed with TRC (compared to one year for SEQ as noted in Table 6.2).

Table 6.2 Adopted Level of Service Objectives for the Toowoomba Bulk Water Supply System

LOS Objective Type	Description	Measure/Application
Water demand	Ensure that the water supply system will be able to supply the expected average volume of water that will be used by the community into the future.	Supply meets total urban treated water demand. • Includes residential and non-residential water use. • Excludes agricultural use.
Water restrictions	The acceptable maximum frequency, severity and duration of restrictions for a community.	Combined storage reaching minimum storage volume less than once every 10,000 years on average. Medium level restrictions will target residential demand of 175 L/p/d. Non-residential demand is set on an individual basis. Medium level water restrictions will not happen more than once every 10 years on average. Medium level water restrictions will not last for more than 2 years on average.
Emergency measures (contingency measures)	The acceptable likelihood for a community to require emergency measures when demands cannot be met by the local supply sources due to climatic conditions (i.e. when a supply shortfall occurs due to drought).	Commence utilisation of Wivenhoe Pipeline when Cressbrook Dam level falls below 40% (per Section 8 *Operating Protocol Between Seqwater and Toowoomba Regional Council: For the Toowoomba Pipeline – Wivenhoe Dam to Cressbrook Dam*).

Community engagement, including an understanding of willingness to pay, has not yet been undertaken to seek feedback on these objectives. Community endorsement will ultimately be critical to their successful adoption. TRC is currently reviewing the trigger points for water restrictions, with an intent to trigger Medium level restrictions at a higher combined water storage level than currently adopted (refer Figure 6.1). This change would have a significant impact on the duration of Medium level restrictions; and as such LOS objectives should be reviewed if a change is implemented. The economic impacts of water restrictions will also vary for each level of severity and duration.

6.4 Demand Management

TRC has an established water restrictions schedule, which is currently being implemented due to decreased surface water levels. Figure 6.1 shows the Toowoomba water restriction targets. When the storages are above 30%, low level restrictions are part of everyday water conservation measures.

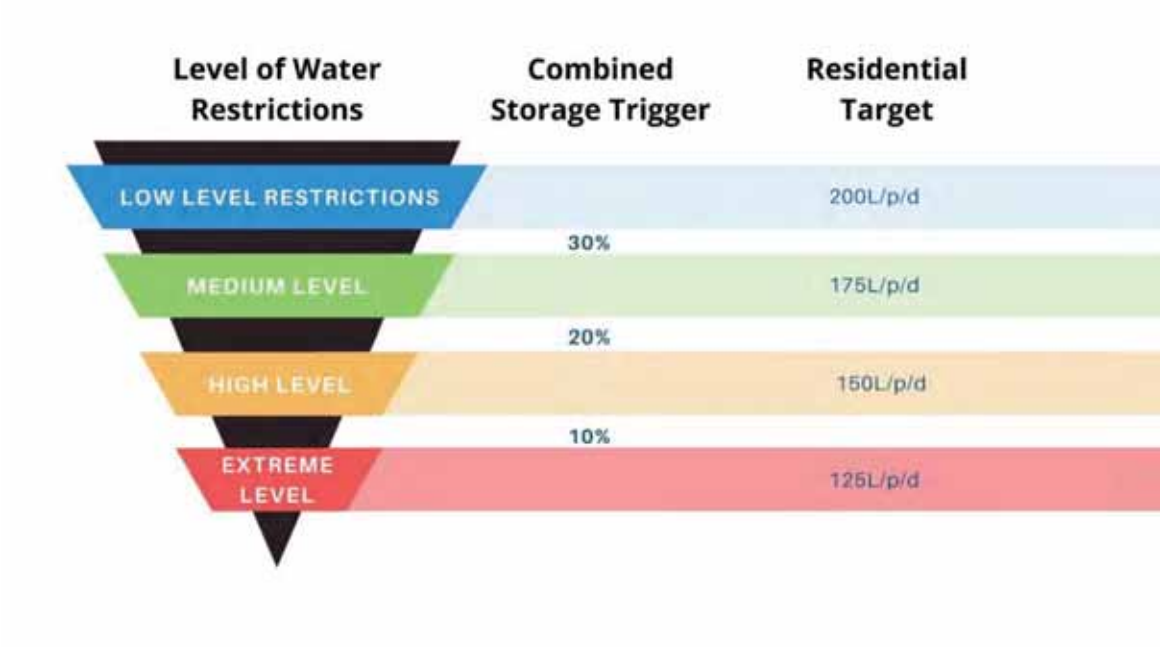


Figure 6.1 Toowoomba Regional Council Water Restrictions Target

It is noted that the Restrictions Schedule provided by TRC is presented in L/person/day for residential use, and that non-residential restrictions are assessed on a case by case basis. The water security assessments which inform the LOS performance of the TRC bulk water supply system undertaken for this assessment uses a L/EP/day set, applied as a percentage reduction to the demand being assessed. It is assumed that demand management initiatives implemented during a drought and the targeted combined reduction in residential and non-residential demand during drought conditions can achieve the percentage reduction to total demand assumed in the assessment.

7. PERFORMANCE ASSESSMENT

7.1 Overview

This section outlines the results of the performance assessment undertaken for the TRC bulk water supply system infrastructure, by comparing the existing asset capability against the service standards and demand forecast for the duration of the planning horizon (Year 2020 to Year 2050).

Inputs to the performance assessment of the bulk water supply system include:

- Existing asset capability:
  - Bulk supply system.
- Demand forecast:
  - Medium series demand forecast for the bulk supply system.
- Service standards:
  - Long-term yield (supply sources).
  - Level of Service objectives (drought performance).
  - Peak demand (infrastructure capacity).

The performance assessment for rural towns is included in Section 13.

7.2 Long-Term Yield (Water Supply Sources)

Long-term yield is the ability of a system to supply water under historical climatic conditions and is generally prescribed by water extraction entitlement limits defined from hydrological assessments for the respective water Resource Operating Plans. When average annual demand exceeds the total available annual volume of the water entitlement, the long-term yield of the system becomes a supply constraint and a new source of supply is required. In some cases, entitlements are not prescribed for a system, and the reliable/safe yield based on historical data is used.

Long-term yield was assessed using the total entitlement from Cressbrook and Perseverance Dams, safe yield from Cooby Dam plus the nominal safe yield from the City Basalt bores. Based on these sources, the bulk water supply system has a long-term yield of 16,755 ML/a or 46 ML/d.

Long-term yield is the ability of a system to supply water under historical climatic conditions and therefore does not include supply from the Wivenhoe pipeline, as this is currently operated as a drought security measure.

The performance assessment of the bulk supply system for long-term yield is outlined in Table 7.1 and shown in Figure 7.1. Based on the projected medium series demand forecast (AD) and the existing bulk water supply assets, a supply deficit is likely to occur under normal (non-drought) operating conditions around Year 2026 with the deficit being 15ML/d by Year 2050 without augmentation. Under drought conditions, the long-term yield limits of Toowoomba's surface water supplies do not apply as the Wivenhoe to Cressbrook raw water pipeline will be used to supply the Toowoomba bulk water supply system.

It is noted that the high series growth would bring forward the deficit to Year 2023. Understanding the behaviour of TRC's demand is critical to the identified triggers. While TRC is currently operating in a demand management mode, any increase in demand would escalate the need to resolve the supply constraint.

Table 7.1 Bulk Water Supply System Performance Assessment – Long-Term Yield

Water Supply Sources	Indicative Year of Long-Term Yield Constraint			Year 2050 Deficit
	Medium Demand Series	High Demand Series	Low Demand Series	(Medium Demand Series) (ML/d)
Surface water sources plus City Basalt bores	2026	-3 years (2023)	+ 13 years (2039)	15

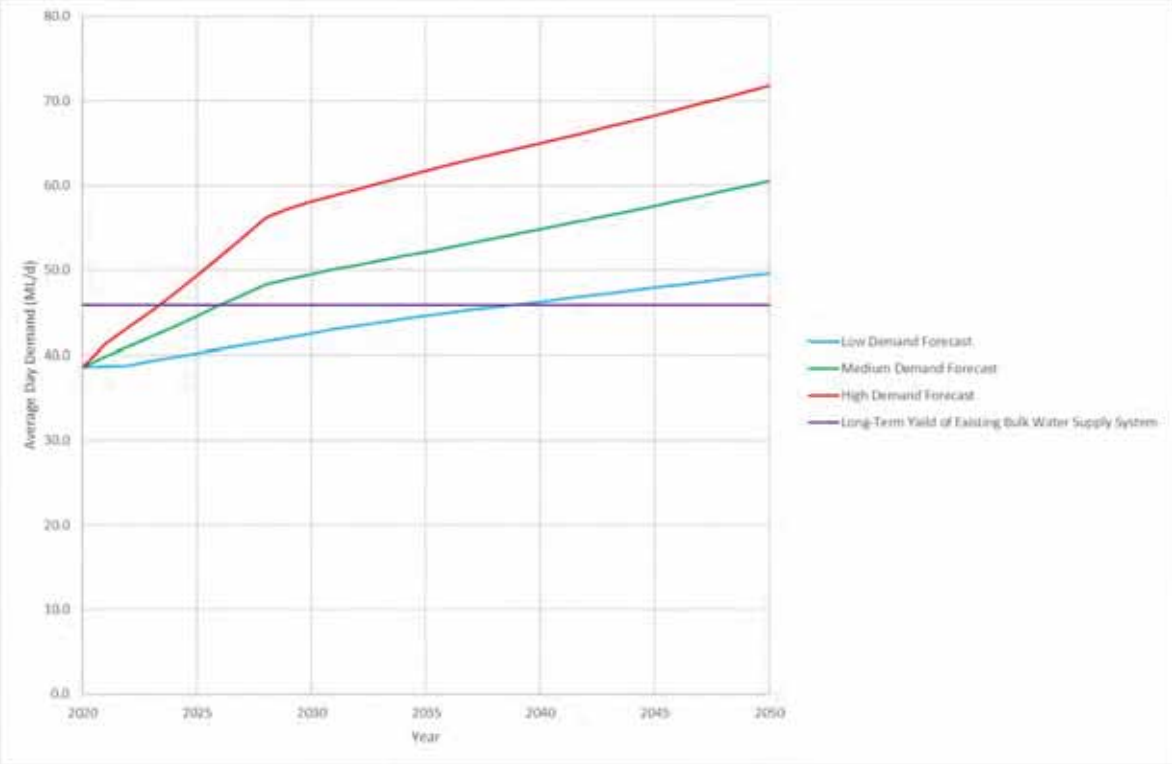


Figure 7.1 Bulk Water Supply System Performance Assessment – Long-Term Yield

7.3 Level of Service Objectives

Performance assessment against the LOS objectives was undertaken using the *Toowoomba Region Water Security Model (*Engeny, 2019). The Toowoomba Region Water Security Model assesses the performance of the TRC system against the LOS objectives by running one-thousand (1,000) stochastically generated long-term hydrological climate sequences of 121 years in duration to assess the system against climate variability and reports against the frequency, severity and duration of water restrictions.

Based on the LOS objectives outlined in Section 6.3, the existing Toowoomba bulk water system meets all LOS objectives up to the Year 2050, as outlined in Table 7.2. The demand shortfalls experienced from the Year 2030 related to the TRC system exceeding the licensed water entitlement and the current capacity of the Cressbrook Dam to Mount Kynoch WTP pipeline such that while raw water is generally in the dams it may not be able to be supplied.

At the present time Toowoomba is reliant on the Wivenhoe to Cressbrook raw water pipeline to meet its LOS objectives. In the event of a major drought affecting South East Queensland, Seqwater may reduce or remove the supplied volume as per Clause 22 (Force Majeure) of the *Bulk Water Supply Agreement*, 2012. The removal of supply from the Wivenhoe pipeline would increase drought severity and community impact. This should be taken into consideration when TRC renegotiate the conditions of this arrangement to ensure continued supply when South East Queensland is in a drought.

These results are based on using the Wivenhoe to Cressbrook raw water pipeline under the current operating conditions and emphasise the criticality of this supply as a drought response measure and the importance of the connection to the SEQ system as part of Toowoomba's drought response plan. A detailed assessment of water security in the Toowoomba Region undertaken by Engeny highlighted that reliable utilisation of the Wivenhoe Pipeline is critical in maintaining water security (*Toowoomba Region Water Security: Stage 2 Model Build and Water Security Assessment;* Engeny, 2019).

Table 7.2 Bulk Supply System Performance Assessment – Level of Service Objectives

	Year 2020	Year 2030	Year 2040	Year 2050
Combined storage reaching minimum storage volume less than once every 10,000 years on average	Did not occur	Did not occur	Did not occur	Did not occur
Medium level water restrictions will not happen more than once every 10 years on average	Once every 877 years	Once every 94 years	Once every 49 years	Once every 29 years
Medium level water restrictions will not last for more than two years on average	1.4 years	1.4 years	1.5 years	1.6 years
No demand shortfall	No demand shortfalls	With demand shortfalls	With demand shortfalls	With demand shortfalls

7.4 Peak Demand (Infrastructure Capacity)

System performance for peak demand is assessed by comparing the projected Mean Day Maximum Month (MDMM) forecast against the current infrastructure capacity. It is understood TRC is committed to renewing the Pechey trunk mains to address asset condition and capacity issues. The capacity of the Pechey trunk mains has been taken as the expected capacity of 83ML/d at the end of the pipeline renewal program (Year 2025).

Performance assessment of the grid system for peak demand is summarised below.

Raw Water Pumps and Mains

The raw water mains for the TRC bulk water supply system include four distinct pipeline sections, Cressbrook Dam to Pechey Reservoirs (pumped), Perseverance Dam to Pechey Reservoirs (pumped), Pechey Reservoirs to Mount Kynoch WTP (the Pechey Main) (gravity) and Cooby Dam to Mount Kynoch WTP (pumped).

It is noted that some aspects of capacity are limited by downstream infrastructure rather than the individual asset (i.e. the Pechey Reservoirs to Mount Kynoch WTP gravity main is limited by the treatment capacity at the Mount Kynoch WTP). As with the pump stations assessment, the trunk raw water transport system is not configured for each element to have complete redundancy (e.g. the Cooby Dam trunk main cannot support the Year 2020 MDMM demand in isolation).

Pump station capacity for the raw water system is generally not a constraint, when considering current operating modes. The current capacity of each pump station has sufficient capacity to meet demands up to the long-term yield constraint. In this instance augmentation of the pumps has not been considered a base case and is only required pending the selected preferred future augmentation options under the Water Vision strategy.

It is noted that the Pechey main is limited by the filtration system at the Mount Kynoch WTP. This pipeline had a nominal capacity ranging between 55ML/d and 63ML/d, but the pipeline is untested at capacities greater than Mount Kynoch WTP treatment capacity (55ML/d). It is understood that TRC is currently undertaking an ongoing program to replace this main to address asset condition and capacity concerns. Once this replacement is complete (around the Year 2025) this will increase the gravity capacity of the Pechey main to approximately 83ML/d. Therefore, the main has not been considered a constraint in this analysis.

Similarly, the capacity of the Cooby Dam to Mount Kynoch WTP pipeline system (pump and trunk main), has sufficient capacity to accommodate the current safe yield volume from Cooby Dam. It is noted that the Cooby system does not have capacity alone to be a sole supply source. The Cooby system has not been identified as constraint, with any augmentation of the Cooby Dam to Mount Kynoch WTP pipeline system contingent on the selected *Water Vision 2050* strategy. When combined with the Pechey Reservoirs to Mount Kynoch WTP pipeline system, there is sufficient capacity in the existing raw water transfer infrastructure to accommodate demands consistent with the adopted planning criteria until the Year 2050.

Table 7.3 shows the infrastructure constraints for the raw water network.

Table 7.3 Summary of Infrastructure Constraints for Raw Water Pumps and Mains

Bulk Water Supply Asset	Rated Capacity (ML/d)	Indicative Year of Infrastructure Constraint		
		Medium Demand Series	High Demand Series	Low Demand Series
All raw water pumps	92.3	2069	-17 years (2052)	+ 13 years (2082)
Pechey Main (post 2025 renewal of Perseverance Dam to Pechey Reservoirs gravity main)	83	2058	-15 years (2043)	+ 17 years (2075)
Cooby and Pechey Trunk Mains	121.1	2096	-17 years (2079)	+ 9 years (2105)

Water Supply – Treatment

There are two WTPs connected to the bulk water supply system (Mount Kynoch WTP and Pechey WTP) as well as a series of treatment facilities connected to the Town Bores (Toowoomba City Basalts).

The Mount Kynoch WTP as a conventional (sand filter media) filtration facility has previously been identified as an emerging capacity constraint for the TRC bulk water supply system. It is noted that an upgrade to include a contact filtration system was proposed previously and $4.5M has been allocated to the 2020/2021 budget to begin the upgrade. The current capacity of the plant is rated as 55ML/d when operating at 24 hours a day, however this does not provide any downtime or capacity redundancy for planned or unplanned outages at the WTP or across the bulk water supply system. To provide for some resilience and a more conservative level of infrastructure availability; a maximum of 20 hour/day operation has been adopted in *Water Vision 2050*. This reduces the planning capacity of the Mount Kynoch WTP to approximately 46ML/d.

The Pechey WTP draws raw water from the Cressbrook/Perseverance system and has a capacity of 2ML/d. Demand on the WTP is expected to reach 1.3 ML/d in 2050 based on the projected population growth for the region. In addition, the Toowoomba City Basalts bores provides a proven additional source of bulk treated water with an adopted, combined capacity of 5ML/d.

The performance assessment of the bulk supply system for treatment capacity is outlined in Table 7.4. Based on the projected medium series demand forecast (MDMM) and the existing bulk water supply assets, a treatment deficit will occur in Year 2022 and will reach 23ML/d by Year 2050. This assessment is based on the planning criteria and demand forecasts. Actual treatment deficits may occur sooner if actual conditions differ from these planning factors. It is understood that demand has exceeded Mount Kynoch WTP treatment capacity during the most recent seasonal peak demand periods.

Table 7.4 Infrastructure Constraints for Bulk Water Supply - Treatment

Infrastructure Constraint	Indicative Year of Infrastructure Constraint			Year 2050 Treatment Capacity Deficit
	Medium Demand Series	High Demand Series	Low Demand Series	(Medium Demand Series) (ML/d)
Treatment Capacity – 20 hr MDMM	2022	-1 year (2021)	+8 years (2030)	24

7.5 Summary

A summary of the system constraints is detailed below in Table 7.5. The assessments of future capacity constraints adopt the medium series demand forecast, however, results for the low and high series demand forecasts are also shown to indicate potential variation to these dates.

These results indicate that securing additional treated water production capacity and resolving the emerging water entitlement constraint through a new supply source are critical to Toowoomba's Water Future in the next 10 years.

Table 7.5 Summary of Bulk Water Supply Constraints

Service Standard	Constraint	Deficit at Year 2050	Year		
			Medium Series Demand	Low Series Demand	High Series Demand
Water Treatment Capacity	Peak Demand (MDMM)	23ML/d	2022	2032	2022
Long-Term Yield	Supply sources (AD)	15ML/d	2026	2039	2023
LOS Objectives	Nil		Nil during planning horizon.		

8. OPTIONS ASSESSMENT FRAMEWORK

8.1 Overview

Best practice water supply planning means having all options on the table for consideration at the outset of the planning process. This introduces complex variations of possible solutions and means that a structured approach to options assessment, supported by robust data, is required to develop an effective and efficient investment strategy.

This project has taken an “all options on the table” approach to identify new water supply options, starting with the development of a “Blue Sky” list of possible supply sources. Separately, additional options were identified to resolve the infrastructure capacity constraints defined as part of the performance assessment.

Additionally, Building Queensland and the Queensland State Infrastructure Plan (SIP) have clear priorities to consider when developing initiatives. These priorities align with the opportunity for TRC to seek regulatory and contractual changes and augmentation of existing assets as a preference to the increased capital investment required for alternative supply options.

"These priority categories, from highest to lowest, are:

- Reform—typically non-asset initiatives.
- Better use—typically improving service performance.
- Improve existing—typically augmentations.
- New—typically new assets."

The options assessment process follows the intent of the SIP priorities.

As shown in Figure 3.1,sewerage networks (including treatment) and rural towns were considered separately to the Toowoomba bulk water supply system assessment and have been integrated into the assessment process where relevant interfaces exist.

For the Toowoomba bulk water supply system, the implementation of effective demand management measures will change the time when new supply options are needed but are unlikely to change the preferred supply options. Typically, to have a material effect on lowering the demand forecast a range of demand management measures need to be implemented as a program of work (i.e. a single demand management measure is unlikely to materially change the demand forecast).

For *Water Vision 2050*, it is proposed to reserve demand management options for inclusion in the existing restriction schedules, or to be used to manage demand if consumption is trending higher than predicted. Therefore, demand management options are not included as part of this options assessment.

Figure 8.1 provides an overview of the options assessment framework.

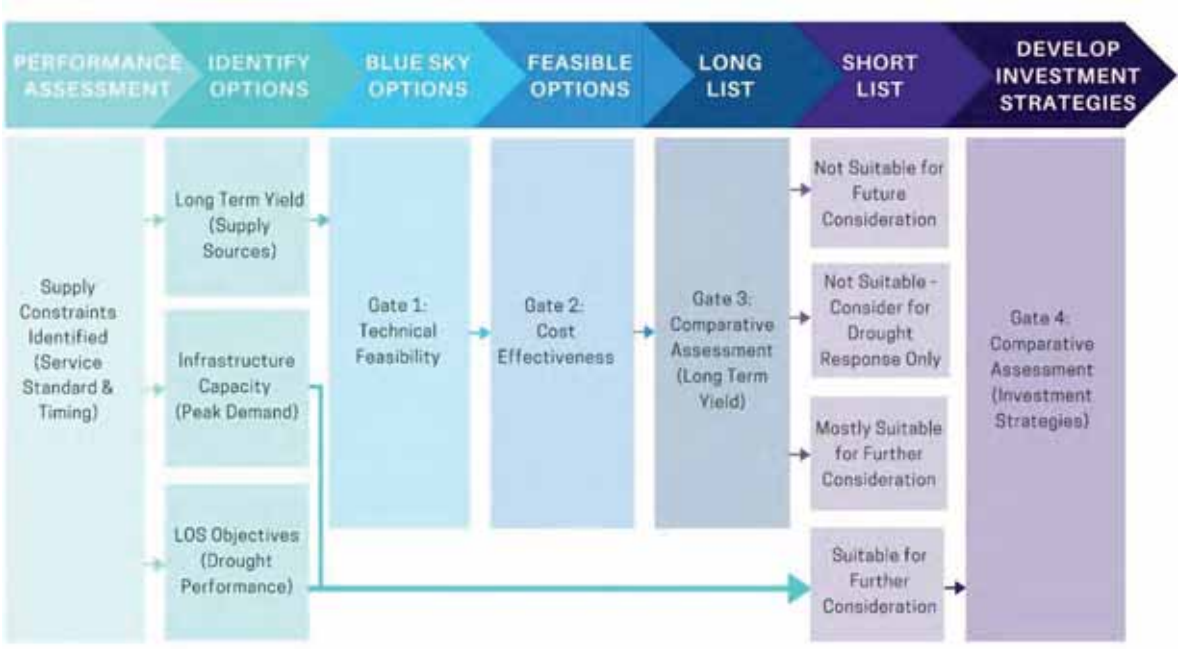


Figure 8.1 Overview of the Options Assessment Framework

Table 8.1 provides an overview of the assessment criteria used to shortlist options.

Table 8.1 Overview of Assessment Criteria

Gate	Gate Criteria
1	Can the option be costed (+/- 100%)? Can a yield be estimated?
2	Is the option cost effective compared to other options (capital cost)? Does the option fall outside a "logical cost threshold" (levelized cost)?
3	Comparative assessment of new source options, aligned with TRC's Corporate Goals, with additional specific water strategy considerations.
4	Comparative assessment of investment strategies, aligned with TRC's Corporate Goals, with additional specific water strategy considerations.

8.2 Shortlisting Water Supply Options

Future water treatment options and other infrastructure requirements are dependent on the proposed new bulk water supply source. Therefore, it was important to shortlist potential supply options to then identify and assemble complementary water treatment and other infrastructure options into defined investment strategies. Table 8.2 provides an overview of the criteria used to assess supply options (Gates 1-3) with a full breakdown provided in Appendix B.

Table 8.2 Options Assessment Framework – Supply Options Assessment Criteria

Gate	Purpose	Criteria	
1	SUPPLY OPTIONS: Technical Feasibility	a	Can the option be costed to ±100%; and
		b	Can a yield be estimated for the option
2	SUPPLY OPTIONS: Cost Effectiveness	a	Is the option cost effective compared to other options (capital cost)? IF YES: Undertake preliminary costing of options; and
		b	Does the option fall outside "logical cost threshold" based on levelized cost ($/ML)]
3	SUPPLY OPTIONS: Comparative Assessment Aligned with TRC's Corporate Goals, with specific water strategy considerations.	People	General
		Place	General
			Catchments and Water Quality
			Source Water
		Sustainability	General
			Environment
		Prosperity	General
			Financial performance
			Funding arrangements
		Performance	Drought resilience
			Regulatory
			Reliability

The Gate 3 assessment categorised supply options as:

1. Suitable for further consideration (shortlist).
2. Mostly suitable for further consideration but some improvements required.
3. Not suitable for further consideration.
4. Not suitable – consider for drought response only.

Options that were categorised as suitable for further consideration were retained for further assessment and inclusion in investment strategies. Where an identified option did not have sufficient data to conclusively rule it out at any of the assessment gates, it has been deferred for further assessment rather than removed. Deferred options should be revaluated during the next revision of Water Vision.

Treatment and other options to increase infrastructure capacity to meet the service standards to the Year 2050 were also identified to complement shortlisted supply options.

8.3 Developing Investment Strategies

The shortlisted supply sources and infrastructure capacity options were assembled into investment strategies designed to meet TRC's water supply needs to Year 2050. The investment strategies identified potential infrastructure upgrades to existing assets such as Mount Kynoch WTP and raw water supply pipelines for each of the shortlisted supply options. The following were calculated for each of the investment strategies:

- Cost – Net Present Cost (NPC) and initial capital investments.
- Performance against LOS and service objectives.
- Residual asset value.

Based on the assessment results, a comparative assessment between investment strategies was undertaken using the criteria summarised in Table 8.3.

Table 8.3 Options Assessment Framework – Investment Strategies Assessment Criteria

Gate	Purpose	Criteria	
4	**INVESTMENT STRATEGIES:** **Comparative Assessment** **Aligned with TRC's Corporate Goals, with specific water strategy considerations.**	People	General
		Place	General
			Catchments and Water Quality
			Source Water
		Sustainability	General
			Environment
		Prosperity	General
			Financial performance
			Funding arrangements
		Performance	Drought resilience
			Regulatory
			Reliability
			System performance
			Implementation/Deliverability

Analysis of the Gate 4 comparative assessment of investment strategies enables the selection of an effective and efficient set of options for Toowoomba's Water Future.

9. WATER SUPPLY OPTIONS

The performance assessment has identified that, based on available bulk water entitlements and safe yields, a new bulk water supply source is required for the Toowoomba bulk water system by the Year 2026, with a supply deficit at Year 2050 of approximately 15 ML/d. The methodology and results to assess water supply options are outlined below.

Options summaries have been prepared for all supply options (*Water Vision 2050 Supporting Document*, Engeny 2020).

9.1 Water Supply Options Assessment

9.1.1 Gate One – Technical Feasibility

A "Blue Sky" list of supply options was developed to identify all possible options, including those identified by TRC in previous assessments, historical and current State Government strategies along with emerging technologies. A total of 48 options were identified for the "Blue Sky" list. The options included the following broad categories to resolve the projected supply deficit:

- Surface water.
- Groundwater.
- Dam Replenishment using Purified Recycled Water
- Desalination.
- Atmospheric water.

The result of the Gate One assessment is presented in Table 9.1. Where an identified option does not have sufficient data to conclusively rule it out, it has been deferred rather than removed. Deferred options should be re-evaluated during future revisions of the Water Vision project. Both deferred and removed options have not been considered in further analysis of this assessment. Where an option has been identified with a low implementation cost, but a low or unknown available yield, it has been deferred and included for consideration in a Low Volume Low Cost strategy.

Table 9.1 Summary of Gate 1 Assessment Results

Gate Criteria	Number of Options			
	Considered	Removed	Deferred	Passed
A) Can the option be costed (+/- 100%)? B) Can a yield be estimated?	48	8	13	27

The options that have been deferred or removed at this stage are detailed in Table 9.2.

Table 9.2 Supply Options Deferred or Removed at Gate 1

Option	Removed/ Deferred	Reason
15. Supply Pipeline from Leslie Dam (Upper Condamine Water Supply Scheme)	Deferred	QBWOS shows supply available within the Upper Condamine Water Supply Scheme, however the allocation remaining is insufficient to service the demand needs of Toowoomba City. (210 ML/a, or 0.6 ML/d). Further consideration of this option would require legislative and funding mechanisms to be investigated
20. Modified Bradfield scheme	Deferred	Insufficient information available. Consideration of the Bradfield Scheme would be deferred to the State or Federal Governments.
29. Stormwater harvesting	Deferred	Insufficient information available. Further investigation to identify flows from each catchment and the infrastructure to deliver where required should be undertaken in the future.
30. Cloud Seeding	Removed	The technology is variable, and results are dependent on environmental factors such that a reliable yield and cost cannot be determined at this stage.
33. Aquifer Recharge (recycled water)	Deferred	Insufficient information available. Further investigation into the logistical, environmental, and operational considerations unique to the Toowoomba Region and its aquifer systems is required before further assessment can be undertaken. Further investigation regarding the water quality implication of mixing sources is required.
34. Aquifer Recharge (raw water)	Deferred	
35. Aquifer Recharge (stormwater)	Deferred	
36. Sewer Mining	Deferred	Insufficient information available Further investigation of the available yield and integration into the network is required.
42. Raise the Perseverance dam walls	Deferred	Insufficient information available. Further investigation to determine the increase in available yield and costs to raise the dam wall(s). Should additional
43. Raise the Cressbrook dam walls	Deferred	

Option	Removed/ Deferred	Reason
44. Raise the Cooby dam walls	Deferred	yield be available modification to the existing allocation and licence limits would be required.
45. Desilt dams (increase available storage volume)	Deferred	Further investigation of the available yield and costs to desilt are required.
25. Great Artesian Basin Bores (new bores, increased allocation over existing entitlements)	Deferred	Analysis of the water allocations in the Eastern Downs Marburg sub-area has shown that currently no additional allocation is available for use by TRC. Consideration of purchasing allocations may be investigated if required.
21. Oakey groundwater	Deferred	This option was included in the Future Water Supply Options for Toowoomba City and Customer Shires Pre-feasibility Study (PB, 2006) and recommended not to proceed due to existing environmental issues and allocation. Advancements in treatment technology may provide an opportunity to utilise this source. Further investigation is required.
2. Linville Dam - Configuration 1	Removed	It is noted that the Linville Dam configurations are intended for use for flood mitigation rather than as an urban water supply and would operate as part of the Wivenhoe-Somerset system.
3. Linville Dam - Configuration 2		
4. Linville Dam - Configuration 3		
22. Access Upper Condamine basalts	Removed	This option was included in the Future Water Supply Options for Toowoomba City and Customer Shires Pre-feasibility Study (PB, 2006) and recommended not to proceed due to existing environmental issues and allocation.
31. Fog/Dew collection	Removed	The technology is variable, and results are dependent on environmental factors as such a reliable yield and cost cannot be determined at this stage.
32. A coastal desalination plant	Removed	Proximity to a high yield saline resource is limited.
37. Coal seam gas water	Removed	This option was included in the Future Water Supply Options for Toowoomba City and Customer Shires Pre-feasibility Study (PB, 2006) and recommended not to proceed on the basis of cost, regulatory and environmental issues.

9.1.2 Gate Two – Cost Effectiveness

Options that passed Gate 1 were further developed, including estimation of capital and operating costs, as well as levelized costs ($/ML) to Year 2050. Levelized cost provides a comparative assessment of the relative investment required for a particular option based on the 30-year NPC divided by the volumetric contribution of the option.

For this assessment, a levelized cost of $2,000/ML was an agreed threshold that differentiated groups of options. It is noted that the options removed or deferred at this gate are typically the larger regional transfer options which involve significant investment to bring bulk water from outside of the TRC region.

The results of this assessment are provided in Table 9.3.

Table 9.3 Summary of Gate 2 Assessment Results

Gate Criteria	Number of Options			
	Considered	Removed	Deferred	Passed
Is the option cost effective compared to other options (capital cost)? Does the option fall outside a "logical cost threshold" (levelized cost)?	27	2	14	11

The 11 options that passed the levelized cost threshold are detailed in Table 9.4 and Figure 9.1. The approach to interregional transfers as part of this assessment process is outlined further below.

Table 9.4 Supply Option Levelized Costs (Less Than $2,000/ML)

Option	Levelized Cost ($/ML)
26. City Basalt Bores	$69
23. Toowoomba City Basalt Bores - AD current.	$75
24. GAB Bores	$199
46. Evaporation reduction (15% dam coverage)	$429
38. Wivenhoe Pipeline - AD supply.	$493
40. Wivenhoe Pipeline - AD full.	$693
39. New Wivenhoe Pipeline	$1,034

Option	Levelized Cost ($/ML)
47. Evaporation reduction (35% dam coverage)	$1,096
27. Direct Potable Reuse	$1,453
48. Evaporation reduction (50% dam coverage)	$1,550
28. Dam Replenishment using Purified Recycled Water	$1,744

Inter-Regional Transfers

No inter-regional transfer options fall below a levelized cost of $2,000ML/a. The options that have been deferred rather than removed represent options that could be demonstrated to have a wider regional benefit. As currently identified, as a dedicated supply to TRC, they are not cost effective. However, if the project was expanded to include other beneficiaries, the cost may be justified. In this arrangement, they could proceed if funding from State or Federal Governments was secured as part of a broader regional water security strategy. It is recommended that inter-regional transfer options are deferred for further investigation, while funding mechanisms and a regional assessment of water security benefits are investigated. It should be noted that any inter-regional transfer option is expected to take up to 10 years to implement and is therefore unlikely to be available within the timeframes required by Toowoomba to augment water supply sources (Year 2026).

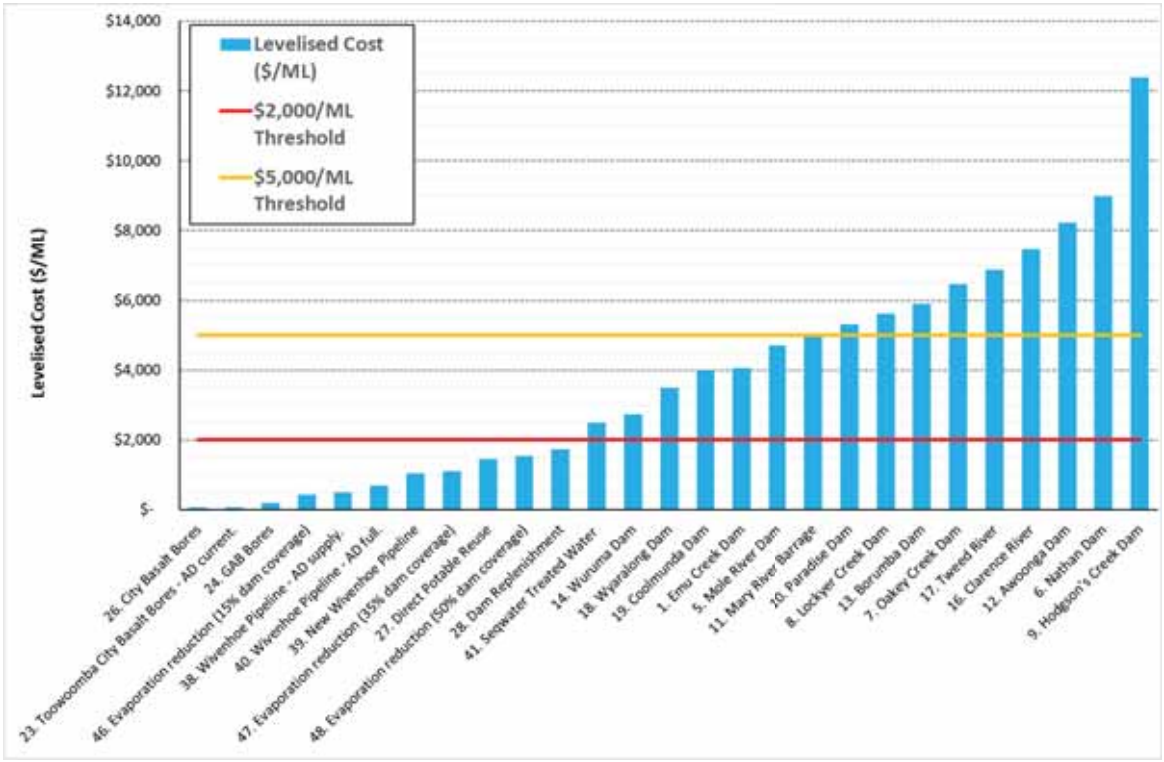


Figure 9.1 Levelized Cost of Supply Options

The options that have been deferred or removed as part of the Gate 2 assessment are detailed in Table 9.5.

Table 9.5 Supply Options Deferred or Removed at Gate 2

Option	Gate 2 Assessment Result
1. Emu Creek Dam	Deferred. The levelized cost is significantly higher in magnitude than the remaining options. These options relate to inter-regional transfers of raw water, and there could be broader regional benefits if implemented. The cost of these options is prohibitive for TRC to wholly fund. Any further consideration of these options would require funding from State and/or Federal sources.
5. Mole River Dam	
6. Nathan Dam	
7. Oakey Creek Dam	
8. Lockyer Creek Dam	
9. Hodgson's Creek Dam	
10. Supply Pipeline from Paradise Dam (Bundaberg Water Supply Scheme)	
11. Supply Pipeline from Mary River Barrage (Lower Mary River Water Supply Scheme)	
12. Supply Pipeline from Awoonga Dam (Awoonga Supply Scheme)	
13. Supply Pipeline from Borumba Dam (Mary Valley Supply Scheme)	
14. Supply Pipeline from Wuruma Dam (Upper Burnett Supply Scheme)	
16. Interstate Supply Pipeline from Clarence River (interstate transfer from NSW)	

Option	Gate 2 Assessment Result
17. Interstate Supply Pipeline from Tweed River (interstate transfer from NSW)	
19. Supply Pipeline from Coolmunda Dam	
18. Supply Pipeline from Wyaralong Dam (Seqwater)	Removed.
41. Seqwater Treated Water Bulk Supply Connection to Cameron's Hill	This option has not been considered further as there are other more cost-effective options available for integration with the Seqwater water grid.

9.1.3 Gate Three – Comparative Assessment

Eleven supply options proceeded to Gate 3 for a comparative assessment against criteria aligned with TRC's corporate objectives (refer Table 9.7). The results of this assessment are provided in Table 9.6, with a full breakdown of the criteria used provided in Appendix B.

Table 9.6 Summary of Gate 3 Assessment Results

Gate Criteria	Number of Options			
	Considered	Removed	Deferred	Passed
Comparative assessment aligned with TRC's Corporate Goals, with additional specific water strategy considerations	11	0	7	4

Table 9.7 Overview of Gate 3 Comparative Assessment

Option	People	Place		Sustainability		Prosperity	Performance					
	General	General	Catchments	Source Water	General	Environment	General	Financial Performance	Funding Arrangements	Drought Resilience	Regulatory	System Performance	Implementation/Deliverability
23. Toowoomba City Basalt Bores to 3,800ML/a	◆	✓	✗	◆	✗	✗	✓	✓	TRC	✗	✓	✗	✓
24. Great Artesian Basin Bores (reactivate)	✓	◆	✗	◆	✗	✗	✓	✓	TRC	✗	✓	✗	✓
26. Toowoomba City Basalt Bores to 6,040ML/a	◆	✓	✗	◆	✗	✗	✗	✓	TRC	✗	✗	✗	✓
27. Direct Potable Reuse	✗✗	✗✗	◆	◆	✓	✗	✓	✗	TRC	✓	✗✗	✓	✗
28. Dam Replenishment using Purified Recycled Water to Cooby	✗✗	◆	✗	◆	✓	✗	✓	✗	TRC	✓	✗	✓	✗
38. Wivenhoe to Cressbrook Raw Water Pipeline – AD Supply	✓	◆	◆	◆	◆	✗	✓	✓	TRC	✗	✗	✓	✓
39. New Wivenhoe to Cressbrook Raw Water Pipeline sized only to transfer the supply deficit to 2050	✓	◆	◆	◆	◆	✗✗	✓	✗	TRC	✗	✗	✓	✓
40. Wivenhoe to Cressbrook Raw Water Pipeline - Permanent use of existing infrastructure to full capacity	✓	◆	◆	◆	✗	✗	✓	✓	TRC	✗	✗	✓	✓
46. Advanced evaporation reduction (15% coverage)	✗	✗✗	✗	✗	✓	✗	✗	✓	TRC	✗✗	✗	✓	✓
47. Advanced evaporation reduction (35% coverage)	✗	✗✗	✗	✗	✓	✗	✗	✓	TRC	✗✗	✗	✗	✓
48. Advanced evaporation reduction (50% coverage)	✗	✗✗	✗	✗	✓	✗	✗	✓	TRC	✗✗	✗	✗	✓
Legend	Positive influence on Criteria	✓	No influence on Criteria	◆	Minor Negative influence on criteria	✗	Major Negative influence on criteria	✗✗					

Following the assessment of each option, a review including levelised cost and the performance against the *Options Assessment Framework* was considered. Criteria that include multiple positives (green) and neutral scores are prioritised, then options where there a minor (amber) scores. Options that have scored a major negative (red) may be carried forward, however it is noted that some major negative scores indicate the identification of showstoppers that would make the option not suitable to be continued to be assessed.

The options that have been deferred or removed at this stage are detailed in Table 9.8.

Table 9.8 Supply Options Deferred or Removed at Gate 3

Option	Reason
23. Toowoomba City Basalt Bores - increase supply by 5 ML/d to match existing water supply allocation.	Deferred These bores are currently operated 5ML/d below their regulated extraction volume. This option requires further investigation regarding reliability of increasing the extraction rate. Given the small increase to yield, this option should only be further considered if required as part of a drought response.
24. Great Artesian Basin Bores (reactivate existing to augment Cooby Dam)	Deferred TRC have indicated that this option is currently being evaluated to use as a drought contingency supply; however, current water quality concerns prevent its use as a viable permanent water source. This option should be reconsidered if water quality investigations show it is viable for permanent usage.
26. Toowoomba City Basalt Bores to 6,040ML/a.	Deferred. This option requires further investigation regarding the reliability of the bores to continually deliver the entitlement volume. The total entitlement for the City Basalts is 6,040ML/a (16.5ML/d). TRC are currently entitled to 3,800ML/a. The remaining entitlement would need to be purchased or transferred to TRC from existing license holders. Given the uncertainty (at this stage) of the safe reliable yield and water quality. This source should be investigated further as a drought contingency option.
27. Direct Potable Reuse	Removed. Direct Potable Reuse is not permitted by current legislation. Community acceptance of this option is assumed to be very low.

Option	Reason
46. Advanced evaporation reduction technologies (15% coverage)	Removed. These options have been considered in the past and not implemented. Logistical and environmental issues are foreseen with the use of any physical or chemical barrier over existing surface water storages.
47. Advanced evaporation reduction technologies (35% coverage)	
48. Advanced evaporation reduction technologies (50% coverage)	

9.2 Low Cost-Low Volume Strategy

Identified above are options that would secure Toowoomba's water future with an increased reliability through to Year 2050. However, it is noted that the identified timing for both supply sources and treatment capacity are immediate, within the next five years.

It is noted that options identified above have a timeframe of at least two to five years to implement. These timeframes may result in TRC adopting sub-optimal outcomes to maintain supply (i.e. further stages or interim augmentation to existing assets that have not been allowed for in this assessment). In addition, it is possible that the entitlements and yields adopted for this assessment may reduce as works progress.

There is the potential to optimise the use of existing assets and sources to ensure the preferred Year 2050 strategy can be implemented. This would include expanding the use of the Toowoomba City Basalts and the Great Artesian Basin (GAB) bores. Both options have been considered but not progressed as the preferred supply source, as alone they do not resolve the Year 2050 supply deficiency and there is insufficient information to determine their long-term sustainability as a supply source.

It is also understood that TRC currently has bore water allocations outside of Toowoomba City which are not being utilised. The recommissioning of some of these bores could be undertaken at minimal cost to TRC. Further investigation into reliable yield and required infrastructure for these assets is required.

The use of these assets could potentially offer TRC redundancy to allow the preferred supply option to be delivered within more reasonable timeframes. It is noted that activation of the GAB bores is currently being investigated by TRC as a response to the current drought conditions. Similarly, works to determine the viability of the continued and increase usage of the Toowoomba City Basalt groundwater source should be undertaken as a priority.

TRC is currently operating the Toowoomba City Basalt bores at 5ML/d but have an entitlement of up to 10.4ML/d. The GAB bores have an entitlement of 5.5ML/d. If the additional supply from the GAB bores can be added to the system, the supply constraint could be deferred by up to seven years to Year 2033. If the full entitlement of the basalt

bores can be realised this would further extend the supply by up to Year 2043. Figure 9.2 illustrates the benefit of both.

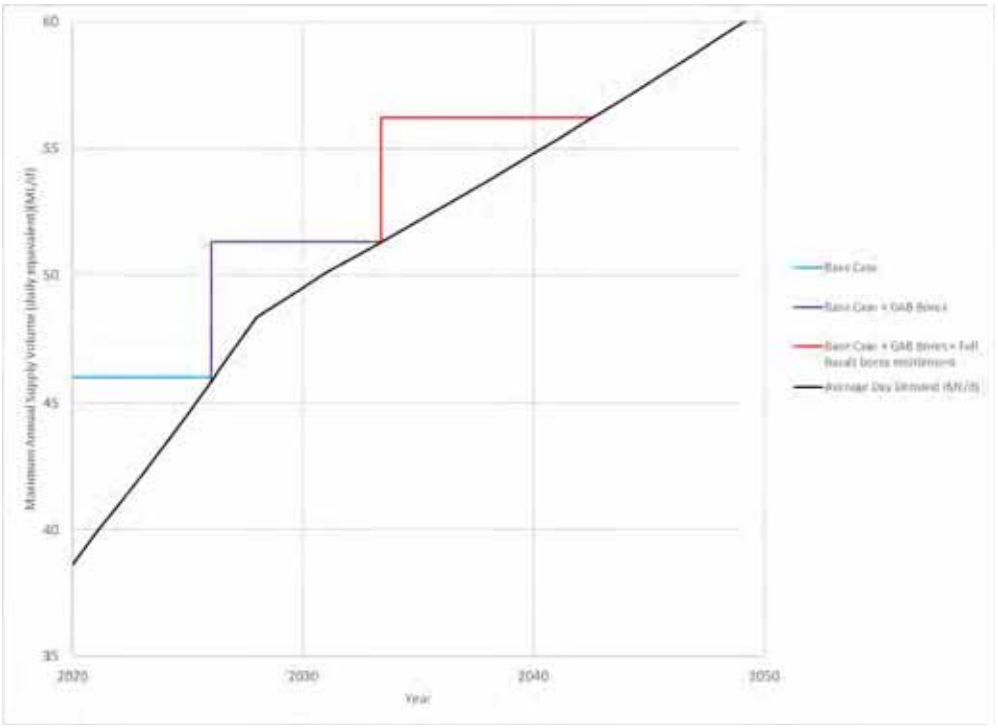


Figure 9.2 Low Cost Low Volume Supply Options

Both options have been costed as part of the assessment. Reactivation of the GAB bores has been estimated at $4.8M and the increase supply from the Toowoomba City Basalts at $4.4M. The identified capital costs for each are presented in Table 9.9.

Table 9.9 Overview of GAB Bores and Toowoomba City Basalt Bores Capital Costs

Investment Strategy	Capital Cost ($2020M)
24. GAB Activation	4.8
26. Toowoomba City Basalt Bores full entitlement	4.4

While the reliability of these supply sources at these increased volumes is currently uncertain, any increase in yield achieved would assist to defer timing and capital investment required for a new supply source. Pursuing these options should be a priority for TRC.

9.3 Shortlisted Water Supply Options

9.3.1 Overview

As a result of the supply options assessment using the options assessment framework outlined in Section 9, there are four shortlisted options to consider further as part of this version of Toowoomba's *Water Vision 2050*:

- Dam Replenishment using Purified Recycled Water to Cooby.
- Wivenhoe to Cressbrook Raw Water Pipeline - Permanent use, limited to cover annual supply deficits.
- New Wivenhoe to Cressbrook Raw Water Pipeline sized only to transfer the supply deficit to Year 2050, operated as required.
- Wivenhoe to Cressbrook Raw Water Pipeline - Permanent use of existing infrastructure to full design capacity.

The supply deficit for the bulk water supply system is 15ML/d at Year 2050. The identified options have the capacity to cover this deficit. The maximisation of the Wivenhoe Raw Water Pipeline has the potential to deliver volumes in excess of the Year 2050 deficit. A summary of the shortlisted supply sources is provided in Table 9.10.

As noted in Section 9.1.2, an inter-regional transfer could be a viable supply option for the Toowoomba region if alternative funding can be secured. A regional water security assessment would be required to confirm the feasibility of such an option.

Table 9.10 Summary of Shortlisted Options - Supply Sources

Asset	Description	Year 2050 Contribution to TRC Supply (ML/d)	Potential Maximum Supply (ML/d)	Maximum Supply Year
28. Dam Replenishment using Purified Recycled Water	This supply sources considers the addition of flows from an upgraded Wetalla Advanced Water Reclamation Facility (AWRF) to Cooby Dam. This option is expected to have the ability to provide an additional 28ML/d at Year 2050 to Cooby Dam. This volume is required to ensure the 15ML/d is available at Year 2050. The total volume available for this option is dependent on the growth of inflows to Wetalla Water Reclamation Facility (WRF) and AWRF. This source would operate as a supplementary supply to the existing bulk water supply sources. Modification to the existing operating rules would be required to access the increased yield from Cooby Dam.	28	75	2071
38. Wivenhoe to Cressbrook Raw Water Pipeline –– Permanent Use, Limited to cover annual supply deficits	This option is for the use of the existing Wivenhoe to Cressbrook Raw Water Pipeline operating to supplement supply as required to Year 2050. This option considers the increased usage of the pipeline outside of the current drought contingency mode. Augmentation to the existing entitlement and operating rules would be required to access the increased yield from Cressbrook Dam. Reaching acceptable contractual terms with Seqwater is essential to this option proceeding.	15	60	2050
39. Augment Wivenhoe to Cressbrook Raw Water Pipeline – New pipeline sized to transfer up to the supply deficit in 2050; operated as required.	This option includes the same operating conditions as above. However, an allowance for a new main dedicated for this supply volume has been allowed. Reaching acceptable contractual terms with Seqwater is essential to this option proceeding.	15	60	2050

Asset	Description	Year 2050 Contribution to TRC Supply (ML/d)	Potential Maximum Supply (ML/d)	Maximum Supply Year
40. Wivenhoe to Cressbrook Raw Water Pipeline – use of existing infrastructure, delivering full design volume each year.	This option considers the use of the existing Wivenhoe pipeline, operating as a permanent daily supply to Cressbrook operating up to its peak design flow. Augmentation to the existing entitlement and operating rules would be required to access the increased yield from Cressbrook Dam. Reaching acceptable contractual terms with Seqwater is essential to this option proceeding.	36	84	2083

The relative contribution that each identified source can add to Toowoomba's water security is presented in Figure 9.3.

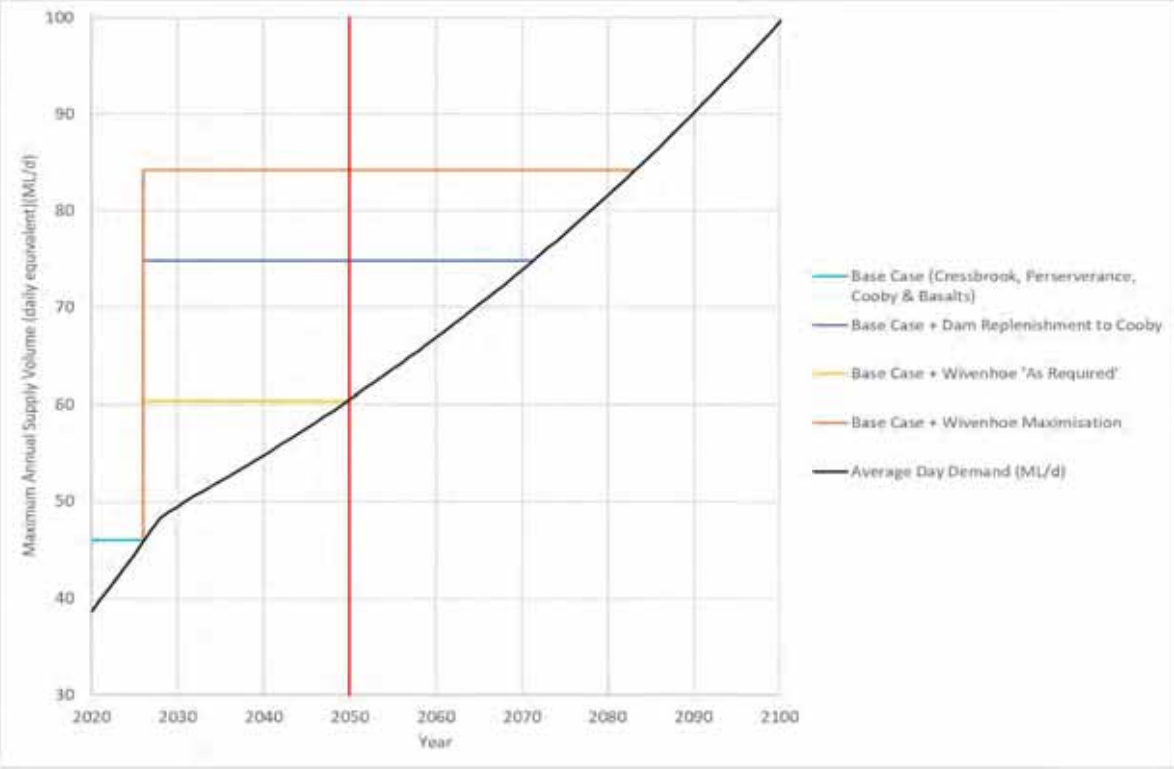


Figure 9.3 New Supply Sources – Maximum Supply Volumes

9.3.2 Options Summaries

Detailed options summaries have been prepared for all supply options considered as part of *Water Vision 2050* and are provided in *Water Vision Supporting Document* (Engeny, 2020). An overview of the shortlisted supply options is provided below.

The LOS assessments presented below have been undertaken using an AD demand of 60 ML/d (refer Section 5.1) assessed using 1,000 potential climate cycles (rainfall and evaporation) each with a 121 year duration to determine how robust the proposed option is to climate variability and its ability to meet the LOS objectives.

Any changes to the demand projections or infrastructure capacity would require a review of this assessment.

Dam Replenishment using Purified Recycled Water

The Dam Replenishment using Purified Recycled Water supply option includes the discharge of treated water from an upgraded Wetalla WRF and Wetalla AWRF to Cooby Dam.

This option is expected to have the ability to provide an additional 28 ML/d to Cooby Dam at Year 2050. The total volume available for this option is dependent on the growth of inflows to Wetalla WRF. This option would require all treated outflows from the Wetalla WRF to be conveyed to the AWRF. The LOS assessment shows that an additional 28 ML/d into Cooby Dam is sufficient to meet the 15 ML/d supply deficit accounting for evaporation and system losses.

This source would provide a supplementary water supply to the existing sources. Amendment to the existing operating rules would be required to access the increased availability of bulk water from Cooby Dam.

This option would involve Cooby Dam being used as the primary source of water, supplying up to half of the raw water for the bulk water supply system by the Year 2050 (30 ML/d), with Cressbrook and Perseverance Dams supplying the other half.

Of note is that any options utilising Recycled Water will need to include significant community engagement as these options will require public feedback prior to being considered for implementation.

This option was tested for performance against the LOS objectives, with results outlined Table 9.11 below.

Table 9.11 Dam Replenishment using Purified Recycled Water LOS Results

Levels of Service Compliance		
Criteria	**Complying Value Criteria**	**Value Simulated**
Combined storage reaching minimum storage	Less than once every 10,000 years on average	Did not occur
Medium level water restrictions	Will not occur more than once every 10 years on average	Once in every 812 years
Medium level water restrictions	Will not last for more than two years on average	1.0 yr
Demand shortfalls (when supply is unable to meet demand)	No demand shortfalls	No demand shortfalls

Utilising the Dam Replenishment using Purified Recycled Water supply option to supplement the existing system by up to 28 ML/d is compliant with the LOS Objectives over the 30-year planning horizon.

The significant reduction in the duration of medium level water restrictions is attributed to the change in dam drawdown procedure. By prioritising the use of Cooby and reducing the usage of the other storages, higher combined storage levels are maintained; thereby reducing the duration and severity of drought conditions.

This option is dependent on approvals through an extensive regulatory framework. Community engagement will be critical to its successful implementation.

No allocation increases are required to make this option serviceable, but recycled water approvals and community engagement are required.

- Operating Strategy.

The selection of this option would see changes to the current bulk water supply operations for TRC, particularly under non-drought conditions. The current strategy where dams are drawn down at an equal rate is not viable to meet AD demands in 2050 if Dam Replenishment using Purified Recycled Water is selected. Under non drought conditions, Cooby Dam would be relied on to deliver approximately half of AD demand requirements; utilising the additional water provided by the Dam Replenishment using Purified Recycled Water scheme to maintain dam levels. It is important to note that this operational philosophy will see Cooby Dam levels reduce faster relative to other surface water storages.

Under drought conditions, this strategy utilises the Wivenhoe Pipeline as per the current operational plan. Once the Wivenhoe Pipeline is triggered, supply from the

Cressbrook/Perseverance system will be prioritised, with supply from Cooby Dam only filling the necessary supply deficit.

Wivenhoe to Cressbrook Raw Water Pipeline

The Wivenhoe to Cressbrook Raw Water Pipeline is an existing large diameter trunk main operated by TRC that connects Wivenhoe Dam and Cressbrook Dam. Seqwater owns and operates Wivenhoe Dam, as well as holding the water entitlements that allow the extraction of raw water from Wivenhoe Dam. TRC has a contract with Seqwater that sets out operating rules for the transfer of raw water.

The pipeline was built in 2010 and has recently been operating to supplement supply to Toowoomba in accordance with the operating rules, which trigger raw water transfer from Wivenhoe Dam when Cressbrook Dam level falls below 40% FSV.

This pipeline includes 38km 762mm pipeline and a 1,750kW pump station and has a design capacity of 13,100ML/a. Current bulk water agreement limits transfer to 10,000ML/a.

The three variations of supply options using the Wivenhoe to Cressbrook raw water pipeline were tested for performance against the LOS objectives. As part of this assessment, a modified option was identified that combined aspects of each of the three options and resulted in improved performance. This modified option supersedes the three previously shortlisted Wivenhoe to Cressbrook Raw Water Pipeline options. A summary of the modified supply option is provided in Table 9.12.

Table 9.12 Modified Option: Wivenhoe to Cressbrook Raw Water Pipeline

Stage	Timeframe	Operating Strategy	Supply from Wivenhoe	Prerequisites
Stage 1	2020-2026	Business as Usual	Up to 10,000ML/a (existing contractual arrangement with Seqwater)	Nil
Stage 2	2026-2031	Business as Usual	Up to 10,000ML/a	Increase the entitlement from Cressbrook Dam (14,000ML/a to 20,000ML/a)
Stage 3	2031-2034	Business as Usual	Up to 13,100 ML/a Trigger point to operate pipeline increased to 50% (from 40%)	Modify contract with Seqwater to increase volume extracted from Wivenhoe Dam to 13,100 ML/a and modify operating rules

Stage	Timeframe	Operating Strategy	Supply from Wivenhoe	Prerequisites
Stage 4	2034-2044	Prioritise supply from Cressbrook Dam, supplemented by Cooby and Perseverance Dams	Up to 13,100 ML/a Trigger point to operate pipeline 50%	Increase capacity of Cressbrook pumps to 53ML/d.
Stage 5	2044-2050	Prioritise supply from Cressbrook Dam, supplemented by Cooby and Perseverance Dams.	Up to 16,400 ML/a	Increase capacity of Wivenhoe pumps to 45 ML/d. Modify contract with Seqwater to increase volume extracted from Wivenhoe Dam to 16,400 ML/a.

In order to meet the 2026 supply constraint, an increase in entitlement from the Cressbrook and Perseverance dams is required from DNRME. This increase is to ensure demands can be met when the Wivenhoe Pipeline is not in use (e.g. Supply Volume >40%). Water from the pipeline does not count towards entitlement limits so demands can be met when the pipeline is operational. In addition, negotiations with Seqwater are required to increase allocation for the pipeline, as well as increase the trigger points.

As stated in Section 6.3 above, the current bulk water agreement allows Seqwater to suspend provision of water to Cressbrook under Force Majeure conditions such as a drought. This supply option increases the reliance on this pipeline and increases the impact of restricted supply conditions. It is imperative therefore, should this option be selected, that the conditions of the current agreement are renegotiated to ensure supply is not discontinued under drought conditions.

This option was tested for performance against the LOS objectives, with results outlined Table 9.13 below.

Table 9.13 Modified Wivenhoe to Cressbrook Raw Water Pipeline LOS Results

Levels of Service Compliance		
Criteria	**Complying Value Criteria**	**Value Simulated**
Combined storage reaching minimum storage	Less than once every 10,000 years on average	Did not occur
Medium level water restrictions	Will not occur more than once every 10 years on average	Once in every 85 years

Levels of Service Compliance		
Criteria	**Complying Value Criteria**	**Value Simulated**
Medium level water restrictions	Will not last for more than two years on average	1.7 yr
Demand shortfalls (when supply is unable to meet demand)	No demand shortfalls	No demand shortfalls

The modified Wivenhoe to Cressbrook raw water pipeline option meets all the LOS objectives in Year 2050. This is achieved through a reliance on supply from Cressbrook Dam (supplemented by Wivenhoe Dam) to service most of Toowoomba's water demand, with Cooby and Perseverance Dams filling the gaps. This option requires upgrades to the Cressbrook pumps to 53 ML/d in Year 2034 to be viable.

- Operating Strategy.

The selection of this option would see no changes to the current operational strategy. It is important to note that while the overall strategy of reducing all dams at an equal rate does not change; this option represents an increase in reliance on both the Wivenhoe Pipeline and the Cressbrook supply system.

9.4 Summary

Four supply options were shortlisted through the comparative assessment of Gate 3 of the *Options Assessment Framework*. Further assessment of these options was undertaken, and the three variations of the Wivenhoe to Cressbrook raw water pipeline option were optimised to one staged option.

The options that passed through Gate 3 have different levelised cost and NPC. The Wivenhoe to Cressbrook Raw Water Pipeline has the levelised cost at $426/ML, and the lowest NPC of $31M. This is followed by Dam Replenishment using Purified Recycled Water with a levelised cost $1,743/ML and NPC of $143M. The Wivenhoe pipeline requires minimal capital expenditure as the majority of required infrastructure already exists; thus, its net present cost is driven primarily by operational expenditure. Dam Replenishment using Purified Recycled Water requires significant capital expenditure to become viable, despite having lower operational costs. Table 9.14 provides an overview of the shortlisted supply options and the updated results from the Gate 3 comparative assessment, with further detail provided in Appendix B. These options will be central to the assembly of investment strategies to meet the needs of the bulk water supply system for the next 30 years.

Table 9.14 Shortlisted Supply Options - Overview of Gate 3 Comparative Assessment

Option	Costs		Total Available Contribution*	Gate 3: Comparative Assessment Criteria				
	Levelised Costs ($/ML)	NPC ($M)	(ML/d)	People	Place	Sustainability	Prosperity	Performance
Dam Replenishment using Purified Recycled Water#	1,480	106	28	✗✗	✗	✗	✗	✗
Wivenhoe to Cressbrook Raw Water Pipeline	481	125	36	✓	◆	✗	✗	✗
Legend	Positive influence on Criteria	✓	No influence on Criteria	◆	Minor Negative influence on criteria	✗	Major Negative influence on criteria	✗✗

* 15ML/d required at Year 2050

It is critical that any options utilising Recycled Water include significant community engagement as these options will require public feedback prior to being considered for implementation.

10. WATER TREATMENT OPTIONS

10.1 Overview

The performance assessment has identified that additional treatment capacity is required for the bulk water system by Year 2022, and the supply deficit at Year 2050 is 23ML/d.

Due to these imminent supply constraints, an interim upgrade to Mount Kynoch WTP to extend the treatment capacity to the nominal design capacity of 55ML/d is proposed, enabling the existing plant to meet the expected Year 2028 peak demand.

This will allow the preferred new source of supply to drive the long-term investment strategy, leading to a more effective and efficient solution. Subsequent upgrades to Mount Kynoch WTP will be dependent on the chosen investment strategy.

It is noted in the *Mt Kynoch WTP Upgrade Concept Design Report – 85 ML/d* (Hunter Water Australia, 2003) report, there is sufficient capacity at the existing Mount Kynoch WTP site to accommodate further upgrades in the order of an additional 23ML/d. This is a fundamental assumption and will need to be confirmed through further investigation.

10.2 Shortlisted Water Treatment Options

There are three variations of options to add treatment capacity to Toowoomba's bulk supply system:

1. Continue to utilise Mount Kynoch WTP as the central treatment facility.
2. Construct an alternative treatment facility and maintain Mount Kynoch WTP at 55ML/d.
3. Construct an alternative treatment facility and decommission Mount Kynoch WTP after Year 2028.

Common to all investment strategies is the interim upgrade of Mount Kynoch WTP to treat projected peak demand up to Year 2028. This is the assumed base case for treatment capacity and is discussed further in Section 11.2. Alternative treatment facilities will be dependent on the new supply source, and include the following options:

- Upgrade existing Mount Kynoch WTP.
- New WTP in vicinity of Mount Kynoch WTP (Site B).
- New Pechey WTP.
- New Cooby WTP.

Table 10.1 outlines the variations of augmentation options available to increase water treatment capacity. Where possible infrastructure has been staged, with the total capacity

of each stage presented (i.e. to transition Mt Kynoch WTP from Stage 1 to Stage 2 a 14 ML/d upgrade is required).

It is noted that TRC also operate a small WTP servicing the Crows Nest and Hampton area, at Pechey. The Pechey WTP currently has a capacity of 2ML/d. The assessment of the Pechey WTP has been excluded from this assessment. However, where the option to relocate a primary WTP for the bulk water supply system at Pechey is proposed, the inclusion of the Crows Nest and Hampton demands should be considered to optimise the plant and network operation. The decommissioning of the Pechey WTP has not been considered for any other WTP option.

Table 10.1 Bulk Water Supply System Treatment Augmentation Options

Asset	Description	Stage(s)	Current Capacity (ML/d)	Stage 1 Upgrade – Total Capacity (ML/d)	Stage 2 Upgrade – Total Capacity (ML/d)
Mount Kynoch WTP	This option uses the existing Mount Kynoch WTP site and retains the small Pechey WTP. A TRC report notes that the existing plant has sufficient capacity to accommodate augmentation up to the Year 2050 demand. A condition assessment of the Mount Kynoch WTP should be completed to confirm previous planning assumptions and determine its suitability for on-going use to Year 2050.	2	46	55	69
Mount Kynoch WTP (Site B)	This considers a new WTP to be constructed in the vicinity of the existing raw water distribution system between the Mount Kynoch and Pechey WTPs. Further investigation would be required to confirm the final location of this site and if Pechey WTP would be retained or decommissioned.	1	46	69	
Pechey WTP	This option considers the same site as the existing Pechey WTP, which currently services Crows Nest and Hampton. This new WTP will be sized to service the bulk water supply system and will include the decommissioning of the existing Pechey WTP.	1	2	69 (71, when considering Crows Nest and Hampton)	

Asset	Description	Stage(s)	Current Capacity (ML/d)	Stage 1 Upgrade – Total Capacity (ML/d)	Stage 2 Upgrade – Total Capacity (ML/d)
Cooby WTP	This considers a new WTP built in the vicinity of Cooby Dam, sized to match the increased yield from Cooby Dam as a result of the Dam Replenishment using Purified Recycled Water supply option. Due to limitations of supply volumes, an additional WTP or the continuation of the existing Mount Kynoch WTP would be required.	1		10	30
Mt Kynoch Replacement WTP – Cooby WTP Scenarios	This assumes a new WTP (irrespective of location) to replace a decommissioned Mount Kynoch WTP and provide additional treatment capacity where the Cooby WTP is proposed.	1		39	
Wetalla AWRF	This assumes an advanced water reclamation facility, sized to meet the Year 2050 demand.	1		29	

10.3 Summary

An interim upgrade at Mount Kynoch WTP is required to increase capacity of the WTP to 55ML/d. Beyond this, the water treatment options are dependent on the new supply option, and will be assessed further as part of the development of investment strategies to meet the water supply needs of the bulk water supply system for the next 30 years.

11. WATER VISION – BULK WATER SUPPLY

11.1 Overview

As outlined in Section 9 there are a number of bulk water supply constraints within the 30-year planning horizon, which have been summarised in Table 11.1 below.

Table 11.1 Summary of Supply Constraints

Year	Supply Constraint	Deficit to Year 2050
2022	Water Treatment Infrastructure capacity	23ML/d
2026	Long-term yield – water supply	15ML/d

This section details how the shortlisted options for bulk water supply sources and treatment capacity can be combined to meet the supply needs of the Toowoomba bulk water system over the next 30 years. These combinations of complementary options are called investment strategies.

Key inputs to developing water supply investment strategies for Toowoomba include:

- Base case investment plan.
- Supply constraints identified by the performance assessment.
- Shortlisted supply sources.
- Shortlisted treatment options.

Options that have been shortlisted for consideration in the investment strategies are provided below:

- Bulk water supply sources:
  - Dam Replenishment using Purified Recycled Water.
  - Wivenhoe to Cressbrook raw water pipeline.
- Water Treatment:
  - Upgrade existing Mount Kynoch WTP.
  - New WTP in vicinity of Mount Kynoch and Pechey (Site B).
  - New Pechey WTP.
  - New Cooby WTP.

Of note is that any options utilising Recycled Water will need to include significant community engagement as these options will require public feedback prior to being considered for implementation.

The investment strategies consider the combination of bulk water source, treatment, and associated infrastructure to resolve all supply constraints. Each investment strategy includes a single source option. Combinations of source options have not been considered as they are not expected to be as cost effective due to the relatively small volume of the supply deficit. Furthermore, the strategies proposed do not represent an exhaustive list of available options but are representative of particular investment pathways.

11.2 Base Case

The base case is a range of actions that are common to all investment strategies and are recommended to be undertaken regardless of which investment strategy is delivered.

As outlined below, an interim upgrade to Mount Kynoch WTP to extend the treatment capacity to the nominal design capacity of 55ML/d is recommended regardless of the new supply option selected. This interim upgrade will be common to all future investment strategies, and as such, is considered as part of the base case. Figure 11.1 presents the base case investment for treatment capacity.

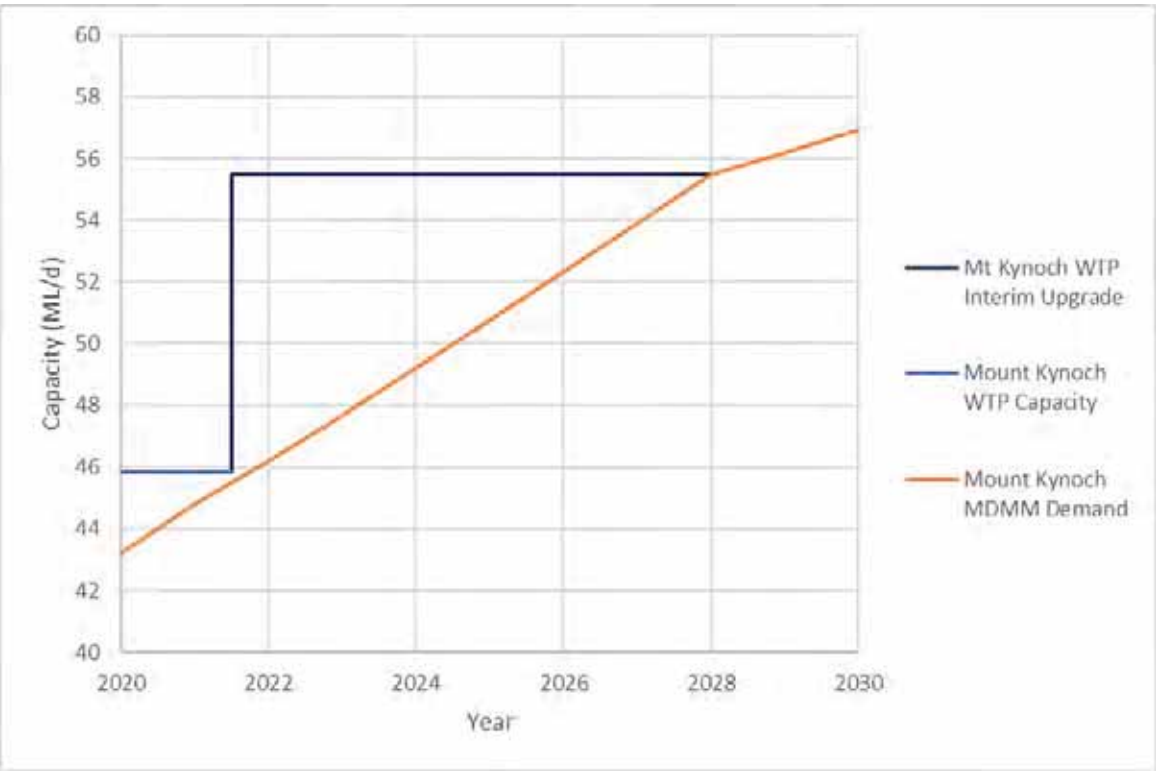


Figure 11.1 Mount Kynoch WTP – Base Case Treatment Capacity

As noted in Section 7.4, upgrades to the Pechey main are currently being undertaken by TRC and will be delivered in stages (completed by Year 2025) to increase transfer capacity

to accommodate MDMM demands to the Year 2050. This investment is considered as part of the base case (Figure 11.2).

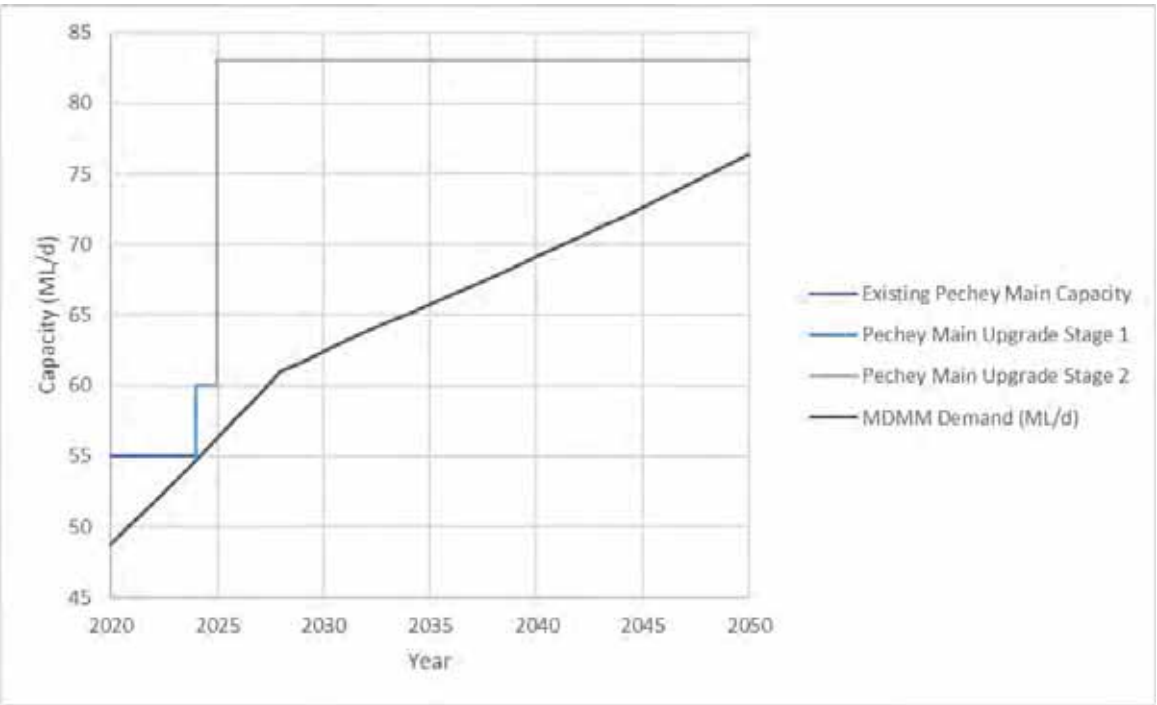


Figure 11.2 Base Case – Raw Water Transfer

11.3 Investment Strategies – Cost Analysis

The three short-listed bulk water supply options were compiled into investment strategies using appropriate combinations of water treatment options and the associated supporting infrastructure.

All investment strategies include the base case infrastructure (Mount Kynoch WTP Stage 1, Pechey trunk mains, and Wetalla WRF augmentations) with the additional supporting infrastructure dependent on the strategy (e.g. Wetalla AWRF upgrades).

The cost analysis considers Net Present Cost (NPC), 30-Year Total Costs (CAPEX and OPEX), and the 5-year and 10-year outlay of total costs. Capital Costs are accrued 1 year prior to the constraint trigger (ie Costs to meet the initial Mt Kynoch Constraint in 2022 occur in 2021).

Appendix C contains indicative maps for each of the investment strategies.

11.3.1 Dam Replenishment using Purified Recycled Water

The Dam Replenishment using Purified Recycled Water investment strategies include three water treatment combinations, as outlined below.

Dam Replenishment using Purified Recycled Water – 1 (DR-1) includes the continued use of the Mount Kynoch WTP, with upgrades in Year 2021 and Year 2027, ahead of the identified capacity trigger. In addition, in 2025, an upgrade to the Wetalla AWRF (including a discharge main to Cooby dam) and the existing Cooby pumps are required.

Dam Replenishment using Purified Recycled Water – 2 (DR-2) adopts the base case upgrade at Mount Kynoch WTP but includes a new 30ML/d WTP located at Cooby Dam. The Cooby Dam WTP is a two stage WTP with an initial stage (10ML/d) identified in 2027, to resolve the capacity deficiency at Mt Kynoch and a second stage (20ML/d) in Year 2043 to ensure the full 30ML/d supply can be achieved from Cooby. The upgrades to the Cooby pumps remain the same from DR1.

Dam Replenishment using Purified Recycled Water-3 (DR-3) includes the base case and Cooby pump upgrades from DR1 and DR2. However, this option further considers the decommissioning of the Mount Kynoch WTP. As a result, in addition to the treatment plants identified at Cooby Dam (per DR2), a new treatment plant in 2027 is also required to replace the existing Mount Kynoch WTP, which has been assumed to be decommissioned for this option. Decommissioning and salvage costs, including potential revenue from land sales has been excluded at this stage.

Table 11.2 details the investment strategies for this option.

Table 11.2 Overview of Dam Replenishment using Purified Recycled Water Investment Strategies

Investment Strategy	Supply Source	WTP Location	Cooby Infrastructure	Cressbrook Infrastructure	Other
Dam Replenishment using Purified Recycled Water-1	Dam Replenishment using Purified Recycled Water	Mount Kynoch	Raw water pump upgrade	Not Required (N/R)	Requires upgrade of Wetalla AWRF
Dam Replenishment using Purified Recycled Water-2	Dam Replenishment using Purified Recycled Water	Cooby + Mount Kynoch	Raw water pump upgrade	N/R	Requires upgrade of Wetalla AWRF
Dam Replenishment using Purified Recycled Water-3	Dam Replenishment using Purified Recycled Water	Cooby + New WTP	Raw water pump upgrade	N/R	Requires upgrade of Wetalla AWRF

The three investment strategies result in a varied capital expenditure profile. Strategy DR1 presents as the lowest overall capital and NPC combination for these strategies. The remaining combinations, DR2 and DR3 represent an additional 5% and almost 40% increase in NPC, respectively. The increasing cost profile is a result of the addition of new

infrastructure, including new treatment plants and additional mains from Cooby. This is evident when comparing the capital costs over 10 years. At this point DR3 represents a significant increase (over 40%) when compared to DR1 and DR2. The inclusion of new treatment plants for DR2 and DR3 at Year 2027, compared to the single upgrade at Mount Kynoch WTP for DR1 are the largest contributing factor to the cost differentials.

Of note is that any options utilising Recycled Water will need to include significant community engagement as these options will require public feedback prior to being considered for implementation.

A summary of the capital costs and NPVs for each investment strategy is presented in Table 11.3 and Figure 11.3 and Figure 11.4.

Table 11.3 Overview of Dam Replenishment using Purified Recycled Water Investment Costs

Investment Strategy	NPC ($2020M)	30-Year Total Outlay Costs ($2020M)	5-Year Total Outlay Costs ($2020M)	10-Year Total Outlay Costs ($2020M)
Dam Replenishment using Purified Recycled Water- 1	$523	$1,213	$380	$574
Dam Replenishment using Purified Recycled Water- 2	$548	$1,347	$380	$582
Dam Replenishment using Purified Recycled Water- 3	$726	$1,805	$380	$805

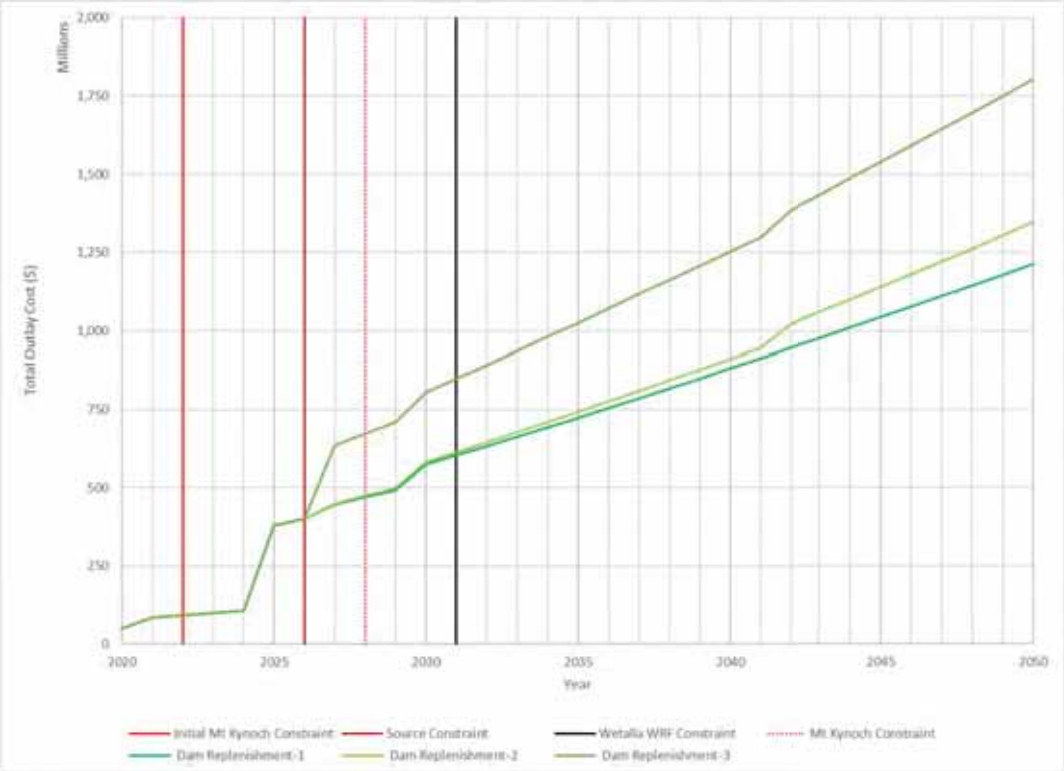


Figure 11.3 Summary of Total Cost - Dam Replenishment using Purified Recycled Water

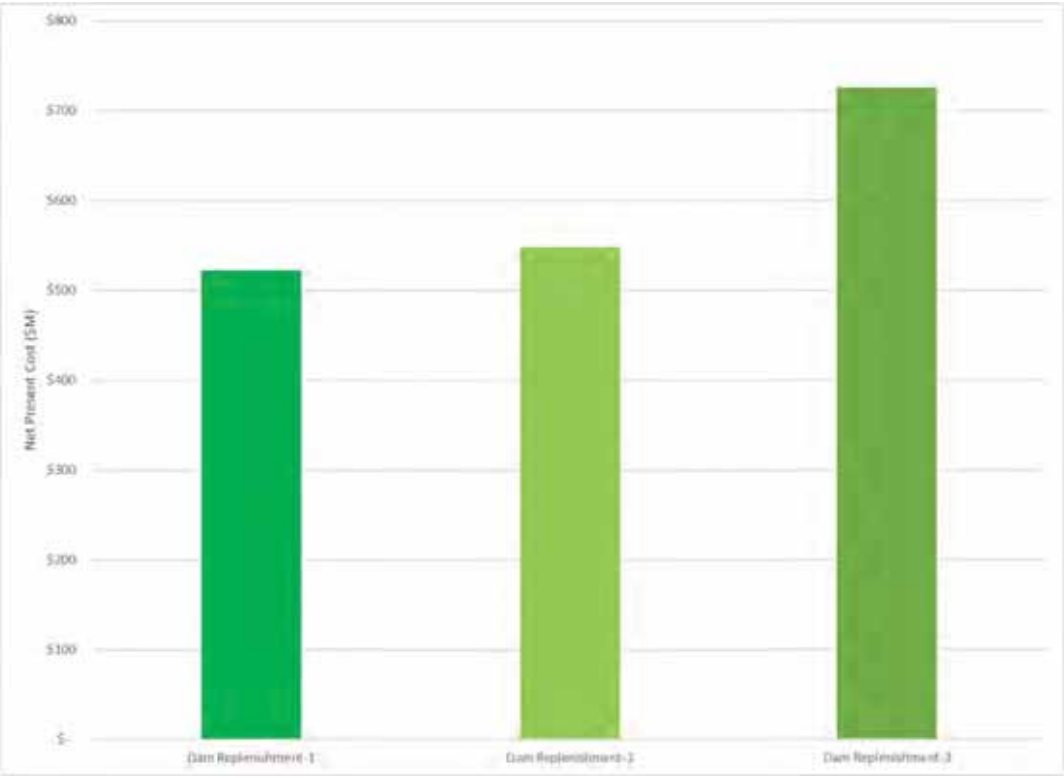


Figure 11.4 Summary of NPCs – Dam Replenishment using Purified Recycled Water

Figure 11.5 and Figure 11.6 provide an overview of the locality of infrastructure for the Dam Replenishment using Purified Recycled Water investment strategies.

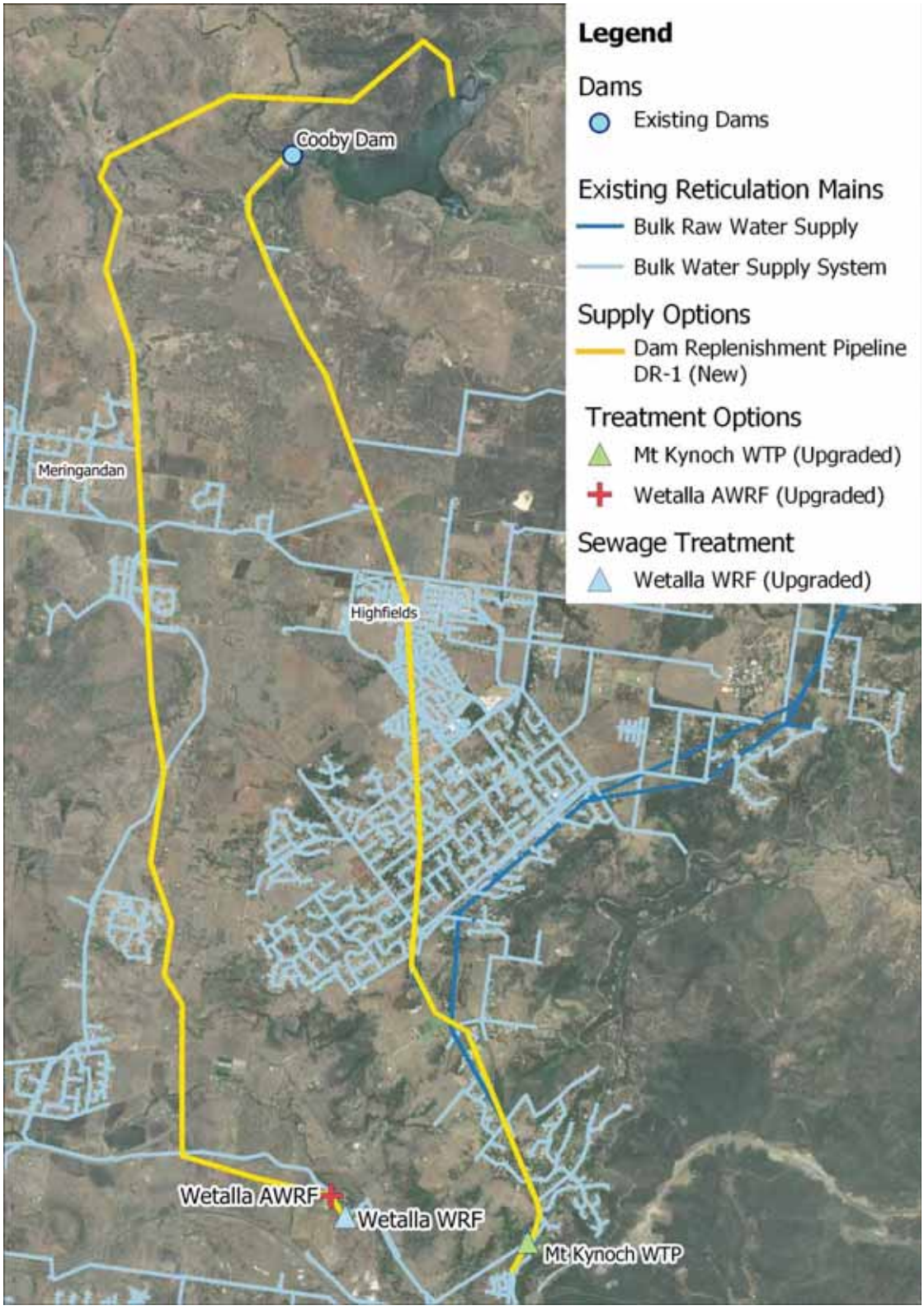


Figure 11.5 Dam Replenishment using Purified Recycled Water 1

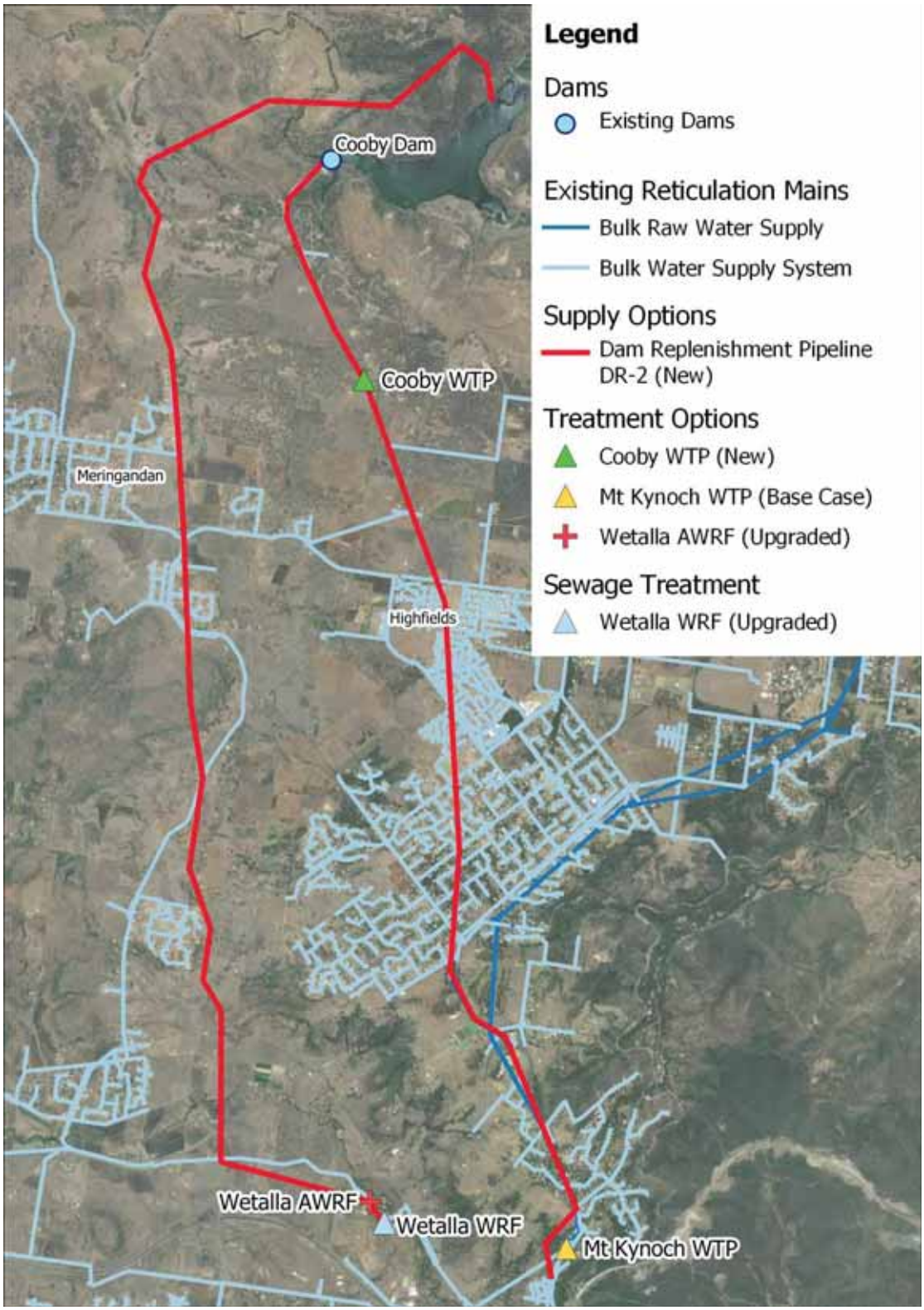


Figure 11.6 Dam Replenishment using Purified Recycled Water 2

11.3.2 Wivenhoe to Cressbrook Raw Water Pipeline

The Wivenhoe to Cressbrook Raw Water Pipeline investment strategies consists of two water treatment combinations, which are detailed in Table 11.4.

The water treatment combinations for this bulk water supply option are very similar with the primary differentiator being the location of the treatment plant.

Wivenhoe 1 considers the continued use of the Mount Kynoch WTP through to Year 2050. While Wivenhoe 2 allows for a new WTP (constructed at the existing Pechey site) to be constructed after the initial upgrade capacity at Mount Kynoch WTP is exhausted (Year 2027). For all investment strategies the base case is included, with additional augmentation to the Cressbrook to Pechey Reservoirs pump station required to accommodate the additional volumes.

Table 11.4 Overview of Wivenhoe to Cressbrook Raw Water Pipeline Investment Strategies

Investment Strategy	Supply Source	WTP Location	Cooby Infrastructure	Cressbrook Infrastructure
Wivenhoe-1	Wivenhoe to Cressbrook raw water pipeline	Mount Kynoch	N/R	Raw water pump upgrade
Wivenhoe-2	Wivenhoe to Cressbrook Raw Water Pipeline	Pechey	N/R	Raw water pump upgrade

The cost profiles are very similar varying by 20% in terms of NPC and total cost. W2 sees capital being brought forward triggered by the new WTP required in Year 2027, resulting in the 10-year capital expenditure being approximately 30% higher than W1.

A summary of the capital costs and NPVs for each investment strategy is presented in Table 11.5 and Figure 11.7 and Figure 11.8. Figure 11.9 and Figure 11.10 provide an overview of the locality of infrastructure for the Wivenhoe to Cressbrook Raw Water Pipeline investment strategies.

Table 11.5 Overview of Wivenhoe to Cressbrook Raw Water Pipeline Investment Costs

Investment Strategy	NPC ($2020M)	30-Year Total Outlay Costs ($2020M)	5-Year Total Outlay Costs ($2020M)	10-Year Total Outlay Costs ($2020M)
Wivenhoe-1	$390	$996	$163	$349
Wivenhoe-2	$471	$1,193	$163	$460

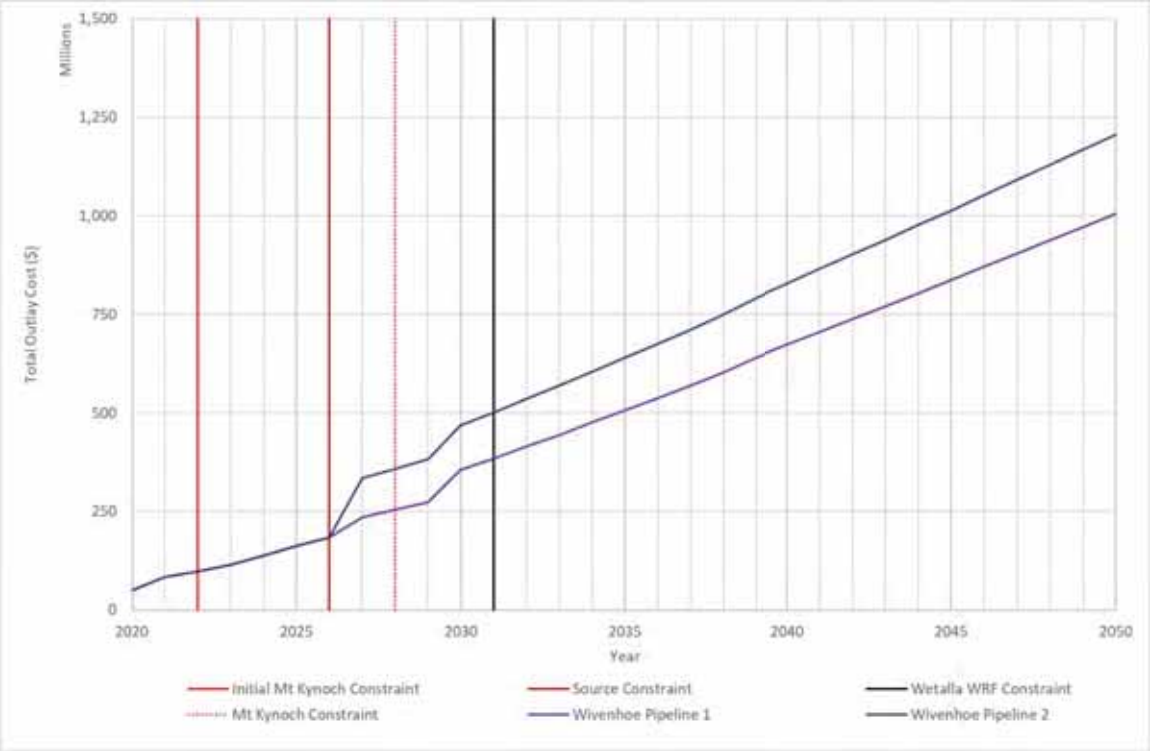


Figure 11.7 Summary of Total Cost – Wivenhoe to Cressbrook Raw Water Pipeline

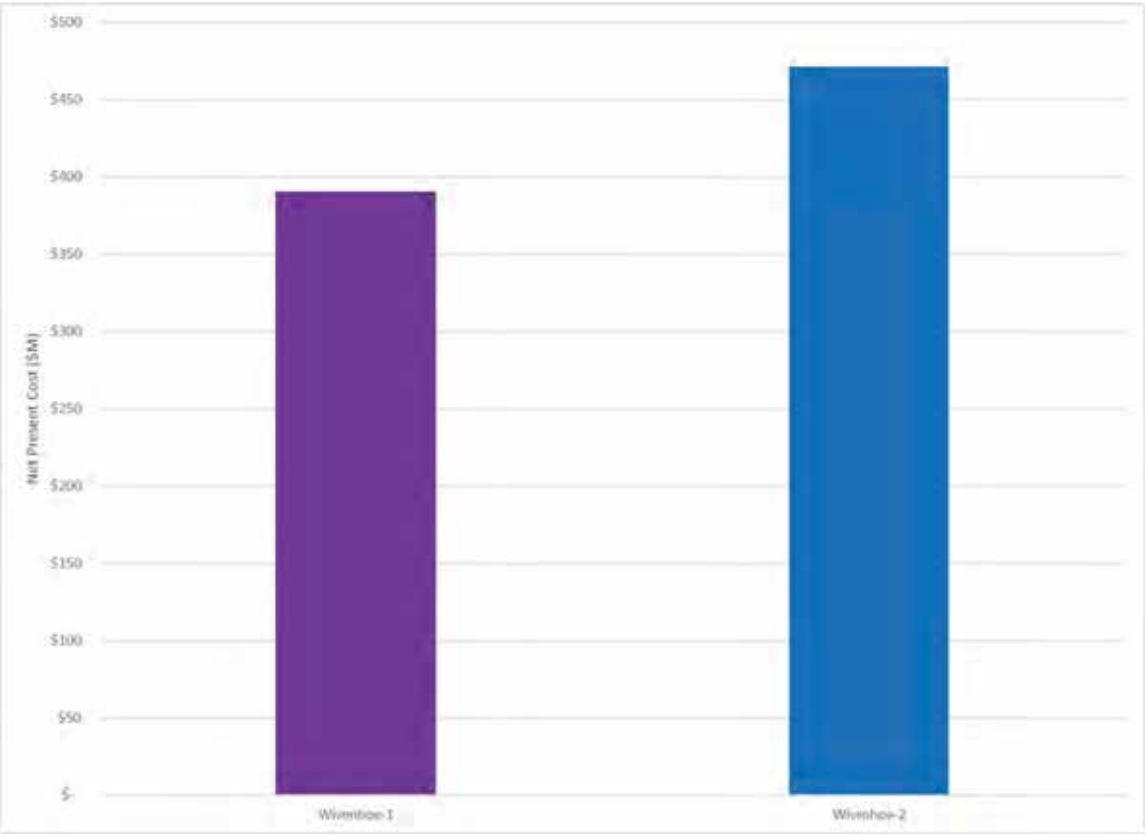


Figure 11.8 Summary of NPCs – Wivenhoe to Cressbrook Raw Water Pipeline

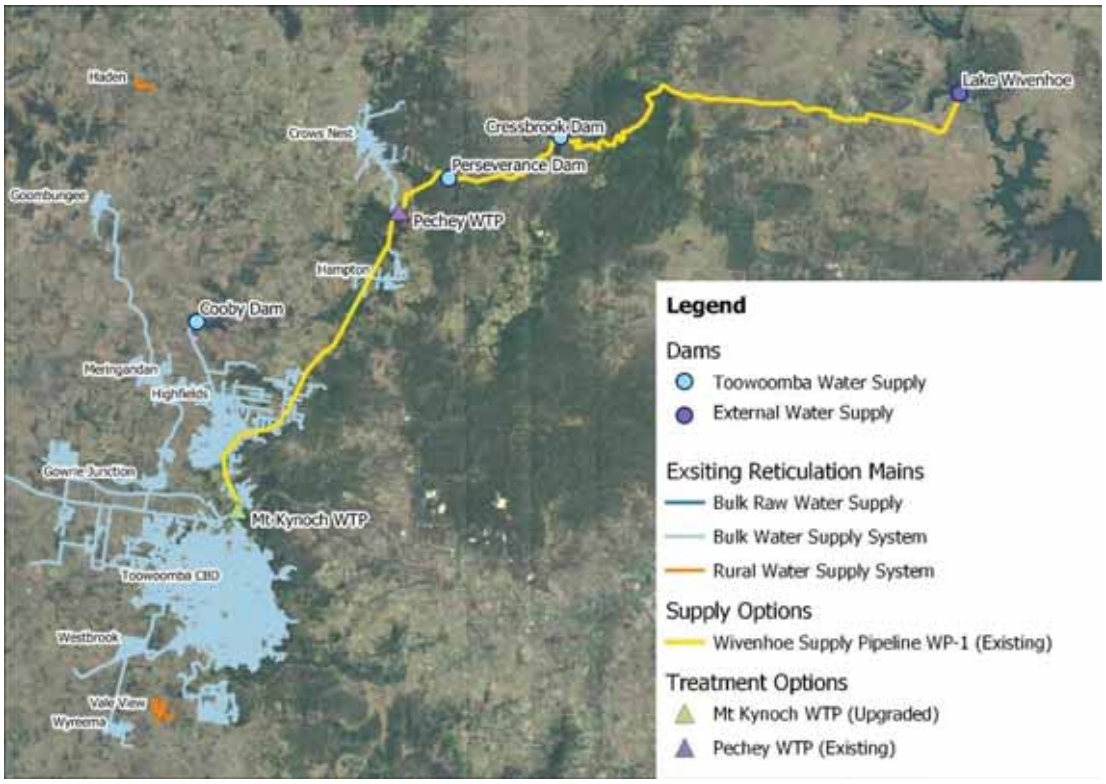


Figure 11.9 Wivenhoe Pipeline 1

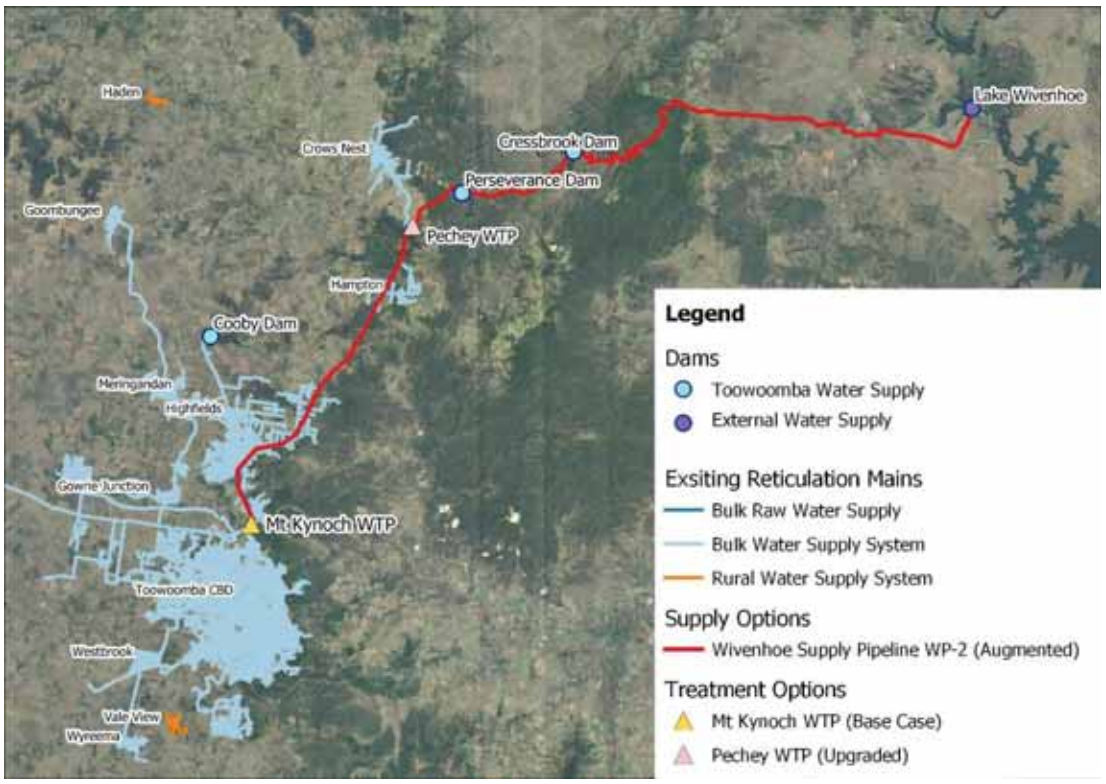


Figure 11.10 Wivenhoe Pipeline 2

11.4 Investment Strategies - Comparative Assessment

When assessing all investment strategies; the Wivenhoe to Cressbrook raw water pipeline as the bulk water supply source presents as the lowest cost investment strategies, followed by the Dam Replenishment using Purified Recycled Water options. In all investment strategies there is a clear advantage to continue using the Mt Kynoch WTP over the creation of a new WTP and associated assets. However, an asset condition and suitability assessment of the Mount Kynoch WTP is required before this strategy is adopted.

The capital costs of all options are presented in Table 11.6 and Figure 11.11.

Table 11.6 Overview of Investment Costs

Investment Strategy	NPC ($2020M)	Total Cost ($2020M)
Dam Replenishment using Purified Recycled Water-1	$523	$1,213
Dam Replenishment using Purified Recycled Water-2	$548	$1,347
Dam Replenishment using Purified Recycled Water-3	$726	$1,805
Wivenhoe-1	$390	$996
Wivenhoe-2	$471	$1,193

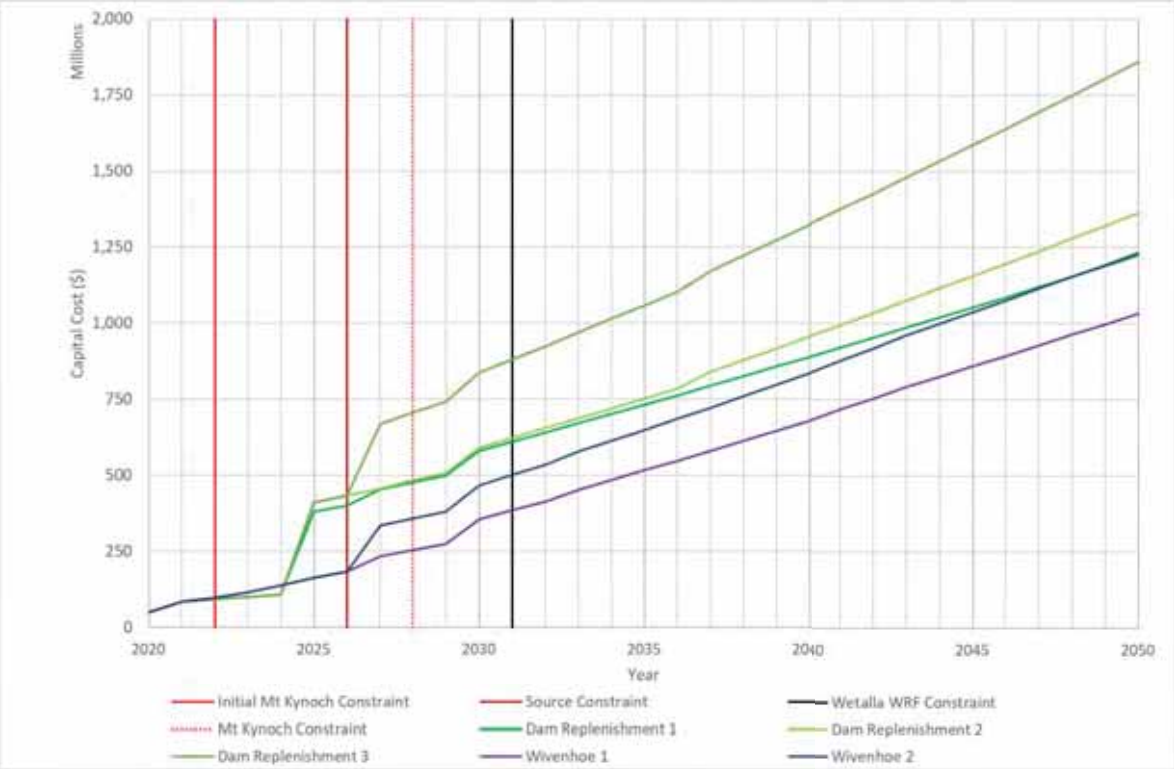


Figure 11.11 Summary of Total Cost – All Options

11.4.1 Dam Replenishment using Purified Recycled Water

These investment strategies require many new major infrastructure components as outlined below (refer Figure 11.11):

- Upgrades to the Wetalla WRF and Wetalla AWRF.
- Conveyance of flow from the Wetalla AWRF to Cooby Dam.
- New WTP at Cooby Dam (for some).
- Transfer pipelines.

There is a history of community opposition to similar schemes, and an extensive community engagement program would be required to gain community acceptance.

The option to replenish inflows to Cooby Dam does enhance the operation of Cooby Dam and ensures it remains a functional water storage with water available. Detailed investigations regarding the effect of discharging additional inflows to Cooby Dam would be needed.

This option adds a new climate resilient supply source to the bulk water supply system and therefore provides a degree of drought resilience. Additionally, this strategy passes all criteria for the LOS objectives.

It is expected that this option would need to be funded directly by TRC. Liaison with the State Government will be required to meet all legislative requirements, including the discharge of treated inflows to Cooby Dam, the increased extraction and entitlements (up to 11,000ML/a from a nominal 930ML/a) and all public health and environmental requirements are met.

Of note is that any options utilising Recycled Water will need to include significant community engagement as these options will require public feedback prior to being considered for implementation. It is expected that this option would require more than 24 months of further investigation and consultation.

11.4.2 Wivenhoe to Cressbrook Raw Water Pipeline

These investment strategies plan to use existing assets to their full capacity, and therefore have a reduced capital investment and represent the lowest capital cost and NPC of all supply sources.

- The Wivenhoe to Cressbrook Raw Water Pipeline is currently used as a drought response asset. These investment strategies would use the asset as a new source of long-term supply, which would mean that amendment to the current operating protocols with Seqwater would be required. It is noted that this option increases the reliance on a third party to meet the supply needs of the Toowoomba bulk water supply system. A new negotiated supply contract would need to ensure that TRC's interests are maintained and supply is available. The current agreement allows Seqwater to cancel supply should South East Queensland be in drought. In addition, increased supply from the Wivenhoe system outside of drought conditions may require TRC to be subject to the same LOS and service standards as South East Queensland.

Changes to allow an increased allocation from Cressbrook and Perseverance Dams would be required (from 14,000ML/a to approximately 20,000ML/a). Consideration to Environmental Flow Objectives would be required to maintain compliance during increased operation of the pipeline. It is worth noting that this increase in allocation would have to be renegotiated to meet demand needs beyond the 2050 planning horizon.

These investment strategies pass all criteria in the LOS objectives, however do not diversify the existing supply sources, rely largely on existing surface water supplies and do not add any climate resilient water supplies to the bulk water supply system.

It is expected that this option would require up to 24 months of further investigation and consultation to resolve.

11.5 Summary

Given the similarity in options and configurations and the consistency of cost attributes within the investment strategies for each supply source, one representative investment strategy from each bulk water supply source has been evaluated further against Gate 4 of the Options Assessment Framework (refer Section 9).

Table 11.7 provides an overview of each representative investment strategy, including a summary of assessment against the Gate 4 Options Assessment Framework criteria.

Appendices B and D provide the full breakdown of criteria and assessment results.

Table 11.7 Summary of Gate 4 Assessment Results

Investment Strategy	People	Place	Sustainability	Prosperity	Performance
Dam Replenishment using Purified Recycled Water	✗✗	✗	✗	✓	✓
Wivenhoe	✓	◆	✗	✓	✗

Legend:

✓ - Positive influence on Criteria

◆ - No influence on Criteria

✗ - Minor Negative influence on criteria

✗✗ - Major Negative influence on criteria

Following the assessment of investment strategies against Gate 4 criteria from the Options Assessment Framework, the investment strategies based on the Wivenhoe to Cressbrook Raw Water Pipeline supply option present as the preferred option.

The investment strategies with the Wivenhoe to Cressbrook Raw Water Pipeline as the supply source have the lowest capital and NPC with the advantage of these investment strategies being that existing assets are utilised as much as possible. While these investment strategies achieve all of the LOS objectives, Toowoomba's water supply remains heavily dependent on surface water sources and will therefore be vulnerable to the impacts of climate change. The ability to respond to drought would continue to be an issue.

This strategy would require amendment to the existing *Cressbrook Creek Water Supply Scheme Operations Manual* with modification to the resource entitlement volumes (up to 20,000ML/a from 14,000ML/a) as well upgrades to the Cressbrook raw water pump station and changes to the operating rules for the Wivenhoe to Cressbrook Raw Water Pipeline to allow operation of the pipeline at a higher initial level in Cressbrook Dam.

Further consideration of the Environmental Flow Objectives would be required, which may modify the results presented here. This option relies on agreement of operational protocol with a third party, and further negotiation with Seqwater would be required to ensure the increase extraction volumes from Wivenhoe (up to a total of 16,400ML/a from 10,000ML/a) are available.

Investment strategies that include Dam Replenishment using Purified Recycled Water as a supply option would create a diverse supply strategy for Toowoomba and would improve drought contingency; however, these options have costs that are more expensive than the investment strategies that include the Wivenhoe to Cressbrook Raw Water Pipeline.

Community acceptance of this option is critical to its successful implementation and an extensive community engagement program would be required.

Critical to all strategies is the future treatment plant location. Regardless of the supply option, the strategy to utilise the existing Mount Kynoch WTP is preferred based on NPC, followed by options that continue to use Mount Kynoch WTP in a limited capacity. A condition assessment of the Mount Kynoch WTP should be undertaken to determine the viability of continuing to operate the plant. If the plant does not have capacity or is incompatible with TRC's future planning, a new site should be investigated.

12. WATER VISION - SEWERAGE

12.1 Overview

The TRC grid connected sewerage network consists of a geographically large catchment which includes multiple pumped catchments discharging to a central gravity conveyance network that discharges all flows to the Wetalla WRF. This facility also includes the Wetalla AWRF that provides high quality recycled water for industrial use. Figure 12.1 provides an overview of the sewerage network for the TRC area. Similar to the bulk water supply system, TRC has a centralised sewage treatment and sewerage system as well as independent systems for rural towns.

As with the demand for bulk water, the population serviced by the TRC grid connected sewerage network is projected to increase over the next 30-years, primarily driven by population growth over this period. Bulk sewage treatment assets have been considered as part of *Water Vision 2050* for alignment and consistency with the water security strategy.

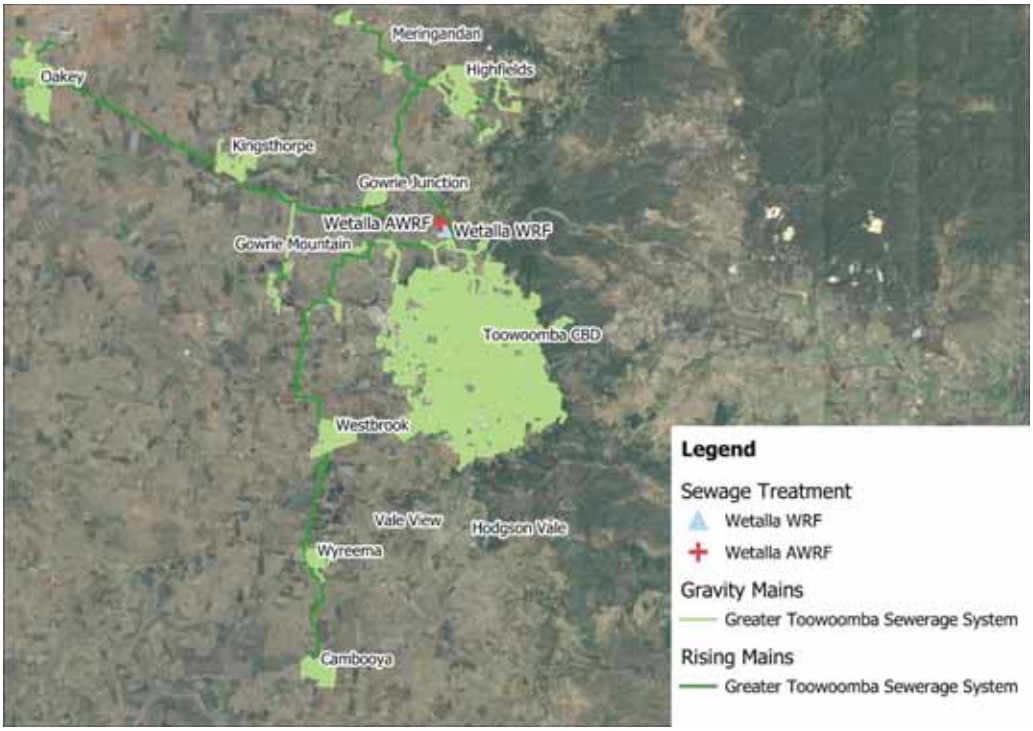


Figure 12.1 Toowoomba Grid Connected Sewerage Network

12.2 Sewerage Assets and Operation

The Wetalla WRF is sized to treat Average Dry Weather Flow (ADWF) with the existing facility having a capacity of 30ML/d. The Wetalla AWRF treats effluent to Class A+ for distribution to the New Acland Coal (NAC) site. The Wetalla AWRF is operated to meet recycled water demands and has a current operational capacity of 9ML/d with NAC receiving 8ML/d. There is the potential to increase the capacity of the Wetalla AWRF to 15ML/d with minor modification to the existing process trains. A summary of the key capacity parameters of the sewerage system is provided in Table 12.1.

Table 12.1 Summary of Key Sewerage Infrastructure Elements

Asset	Parameters	
	Size	Capacity
Sewerage		
Gowrie Creek Trunk Sewer (GCTS) conveyance mains	DN1100/DN1200	1,850L/s
Water Reclamation Facility (WRF) (Sewage Treatment)		
Wetalla WRF	N/A	30ML/d
Advanced Water Reclamation Facility (AWRF) (Recycled Water)		
Wetalla AWRF	N/A	9ML/d

12.3 Sewage Inflows and Flow Projections

A review of the Wetalla WRF has indicated that inflows have remained relatively constant over the last five years (Year 2015 to Year 2019) with an ADWF of 21ML/d (refer Figure 12.2.) against a rated capacity of 30ML/d. The recorded inflows indicate that wet weather events can result in inflows being up to five times larger than the average day inflows.

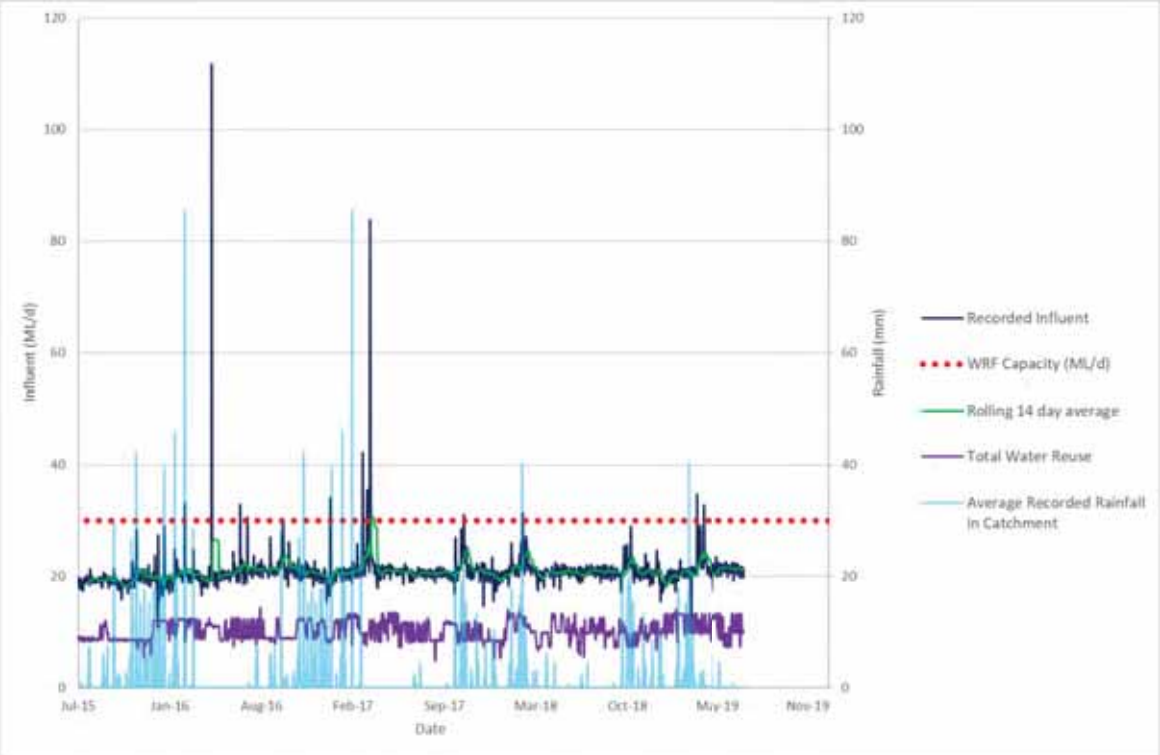


Figure 12.2 Summary of Wetalla WRF Inflows

It is noted that the sewage flows are significantly less than water demand with no corresponding growth over the same period. It is assumed this is attributed to the larger reticulated network for water supply compared to sewerage, with the population not connected to sewerage being serviced by septic systems. TRC has indicated that 10% of the community currently supplied with reticulated water do not have a sewerage connection.

The consistent inflows into the Wetalla WRF during a period of increased water demand is difficult to quantify. A comparison between the water production rates and inflows indicates that inflows to the Wetalla WRF during the period Year 2015 to Year 2019 are approximately 50% of the recorded water production, as illustrated on Figure 12.3. This differential is greater than expected, even when considering factors such as UFW being all leakage (TRC assumes 13% UFW), and the number of un-sewered properties within the Toowoomba bulk water supply network (approximately 10%). A review of past planning reports undertaken by TRC has indicated that inflows are subject to variability, linked to climatic conditions and directed water saving initiatives

Several factors may attribute to the recorded Wetalla WRF inflows being significantly lower than treated water production, including but not limited to; increased outdoor usage, reduction in non-residential flows being matched by residential growth, and metering error. It is recommended that further analysis be undertaken to better understand the inflows and increase confidence in future inflow projections for the Wetalla WRF.

This study has adopted an ADWF of 26 ML/d as a conservative approach, based on the TRC planning loading of 150 L/EP/d and assuming 10% of properties are unsewered. This approach has been taken due to the significant unknowns within the TRC sewerage system,

Based on the medium series population growth and the planning parameters outlined above, ADWF is projected to increase from 26ML/d in Year 2020 to 36 ML/d in Year 2050. The adopted projections for this assessment are detailed in Figure 12.4**.** Based on the medium series growth, capacity at the Wetalla WRF is expected to be exhausted by around the Year 2031.

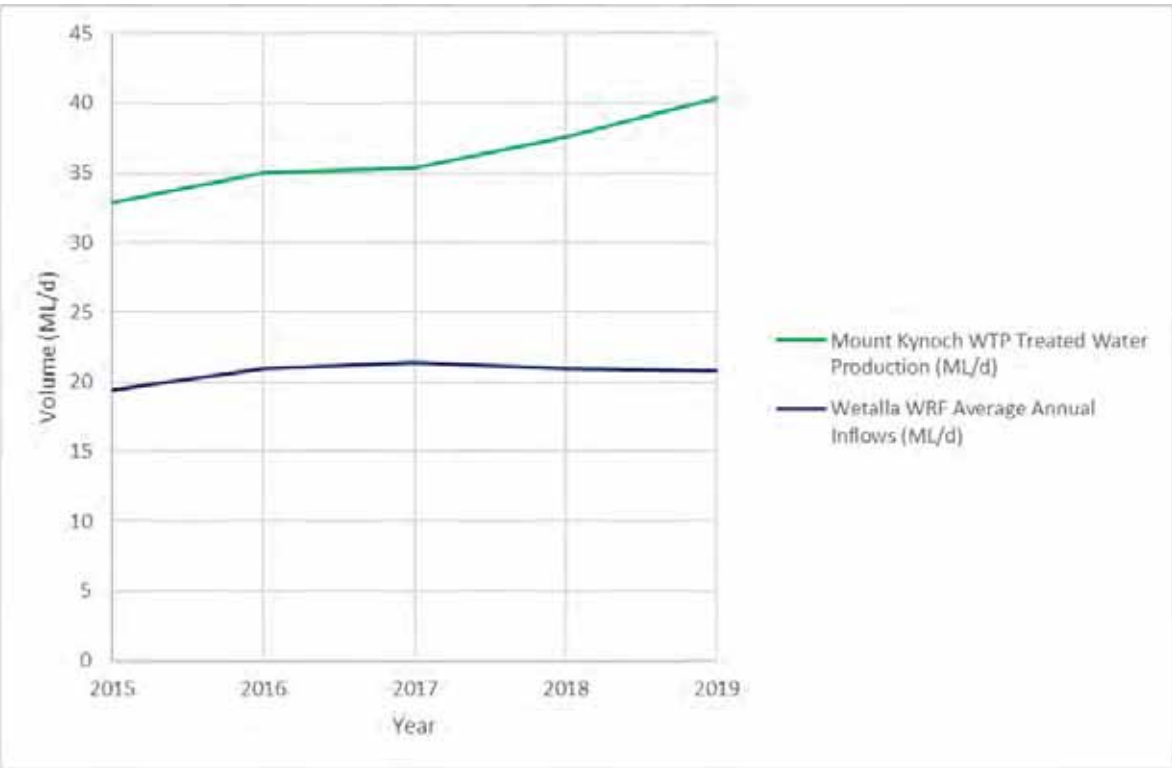


Figure 12.3 Sewage Inflow compared to Treated Water Production

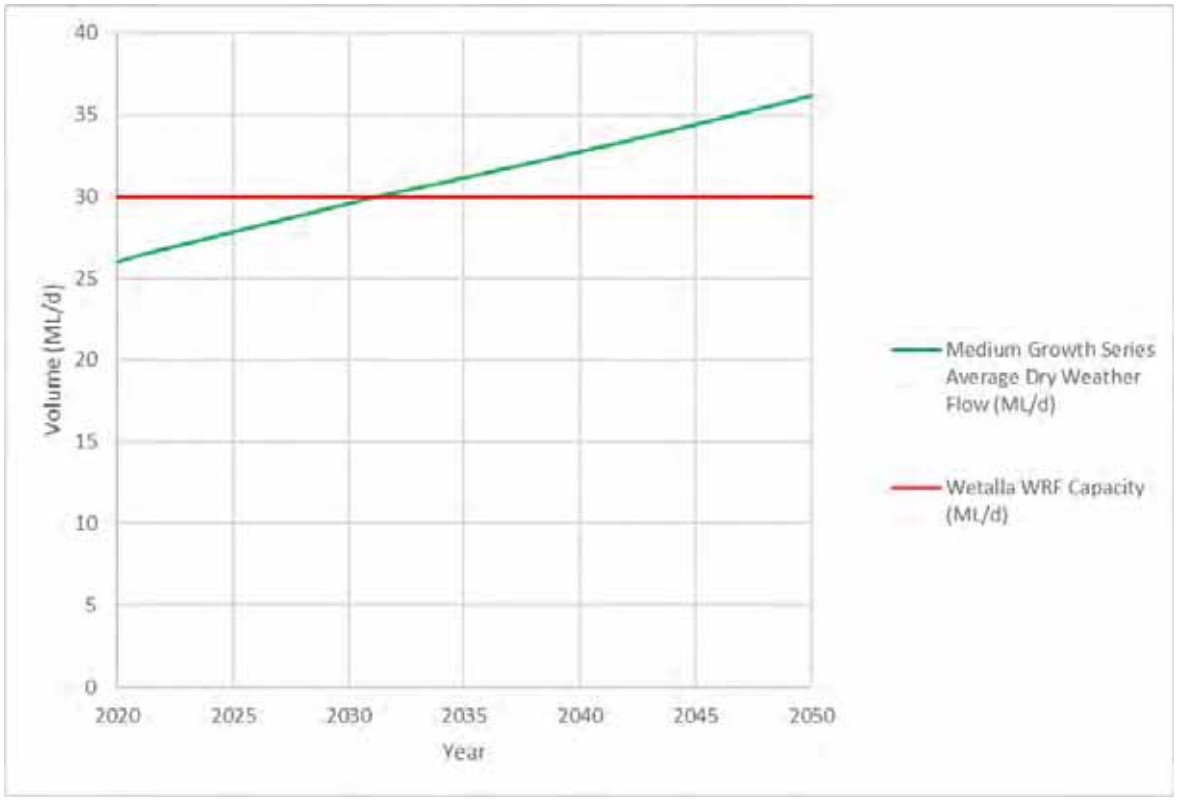


Figure 12.4 Wetalla WRF Sewage Inflow Projections

12.4 Service Standards - Sewerage Infrastructure

The current planning criteria for sewerage infrastructure adopted by TRC that underpin the adopted service standards are presented in Table 12.2. These values are referenced in all recent network planning reports.

Table 12.2 Planning Criteria for Sewerage Assets

Item	Planning Criteria	Notes
Average Dry Weather Flow – Residential	150L/EP/d	DM#7400639v2 ADDENDUM TO GRAVITY SEWERAGE CODE OF AUSTRALIA WSA 02 – 2014 Version 3.1 (9/10/2018)
Average Dry Weather Flow – Commercial/Industrial	180L/EP/d	
Peak Wet Weather Flow	5 x ADWF	

12.5 Performance Assessment

12.5.1 Sewage Treatment

The Wetalla WRF is sized to accommodate ADWF. Based on the medium series population growth, ADWF is projected to increase from 26ML/d in Year 2020 to 36ML/d in Year 2050. Based on the medium series growth, capacity at the Wetalla WRF is expected to be exhausted by around the Year 2031.

Table 12.3 Summary of Sewage Treatment Constraints

Year	Supply Constraint	Deficit to Year 2050
2031	Sewage Treatment Infrastructure capacity (ADWF)	6ML/d

12.5.2 Recycled Water

Analysis of the Wetalla AWRF is limited at this time as capacity is matched to production; however, preliminary flow records provided by TRC indicate that there is approximately 1ML/d surplus recycled water and that there is the potential to increase the capacity of the facility up to 15ML/d with minor modification to the existing process trains.

It is expected that the Wetalla AWRF will continue to supply the NAC site for all future supply strategies except for those involving Dam Replenishment using Purified Recycled Water.

12.6 Water Vision - Sewerage

This section outlines the options available for the Wetalla WRF in relation to the Bulk Supply options identified in Section 11. The options available for the Wetalla WRF differ from those identified for the water supply network.

Based on the adopted medium series population projections, there is a need to provide additional sewage treatment capacity for the TRC grid connected sewerage network. This assessment has identified that the existing capacity of the Wetalla WRF (30ML/d) is sufficient to meet the average dry weather flows to Year 2031. The projected flows for the Wetalla WRF catchment reach an ADWF of 36ML/d by Year 2050 resulting in a sewage treatment deficit of around 6ML/d.

A sewerage strategy prepared in Year 2009 (*Toowoomba Regional Sewerage Strategy 2008-2050*, GHD, 2009) proposed a decentralised strategy for the TRC grid connected sewerage network with a new Southern Regional WRF at Wyreema in the south west of the reticulated service area. The new Wyreema WRF would divert flows from the southern sewerage catchments from the Wetalla WRF. This would extend the timeframe that the Wetalla WRF would be able to maintain treatment capacity.

This strategy was amended due to damage to sewerage assets during the Year 2011 flood event. In particular, the Year 2011 flood event destroyed the Oakey WRF, which was replaced by the Oakey Sewage Pump Station in Year 2012, which diverts all sewage to the Wetalla WRF. Subsequent capital investment in sewerage assets has instead focused on either upgrading and/or installing new pump stations and rising mains to continue conveying flows to the Wetalla WRF.

Due to the capital invested over recent years as part of the pump station program, the Year 2009 decentralised strategy has not been delivered, and is no longer likely to represent the most cost-effective strategy for TRC

Subsequent capital investment for sewerage assets has instead focussed on either upgrading and/or installing new pump stations and rising mains to continue conveying flows to the Wetalla WRF. Based on the existing asset performance and capacity, alternate strategies, and locations for a new WRF has not been considered as part of this strategy.

Therefore, all sewage treatment investment strategies presented in this report include a 6ML/d ADWF treatment capacity upgrade at the Wetalla WRF only (see Figure 12.5). The sewage treatment capacity deficiency (6ML/d) has not been quantified beyond the typical ADWF inflow requirements. This upgrade would need to consider both the biological and hydraulic loading of the existing plant to determine the optimal augmentation strategy.

It is noted that the *Wetalla Loading Review Investigation Report* (TRC, 2012) identifies that the existing treatment plant was designed to accommodate significant biological loads from non-residential flows. The reduction in the biological loading from these non-residential sources has reduced, potentially increasing the process capacity of the plant. In addition, the Year 2012 report notes that the clarifiers on site have capacity to accommodate flows up to 40ML/d, however process performance is reduced.

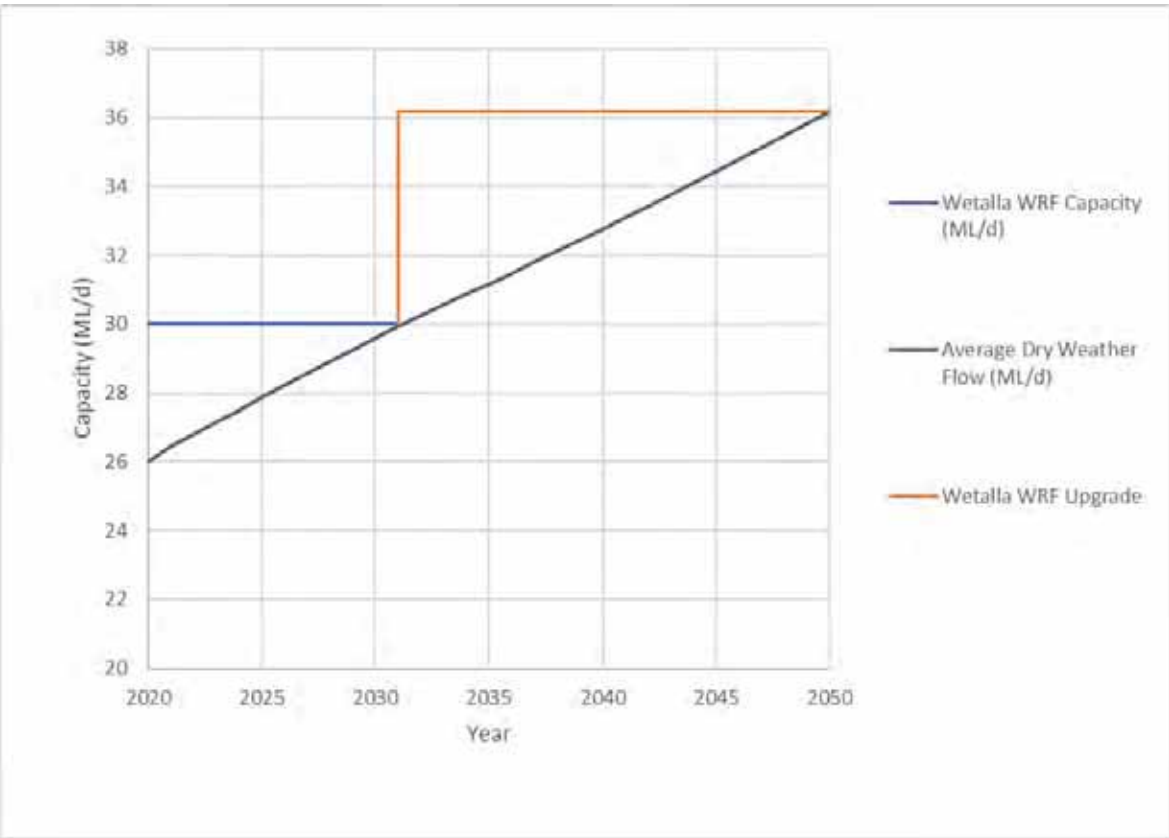


Figure 12.5 Base Case – Sewage Treatment

Of note is that the Wetalla WRF is a critical asset for the investment strategies that include Dam Replenishment using Purified Recycled Water as a source of bulk water supply. Assessment of Dam Replenishment using Purified Recycled Water has based the inflows to Cooby Dam based on a percentage loss from the Wetalla AWRF and the Wetalla AWRF. Where losses can be minimised across both plants a greater availability of bulk water would be available improving the performance of this investment strategy. Table 12.4 shows the sewage treatment solutions identified. As previously stated, upgrades to the Wetalla AWRF are only required if a Dam Replenishment using Purified Recycled Water bulk water supply option is selected.

Table 12.4 Sewage Treatment Options

Asset	Description	Stage(s)	Stage 1 Capacity (ML/d)	Stage 2 Capacity (ML/d)
Wetalla WRF	This assumes a single upgrade to meet Year 2050 ADWF	1	36	
Wetalla AWRF	This assumes an advanced water reclamation facility, sized to meet the Year 2050 demand.	1	29	

12.7 Summary

This assessment has indicated that the existing capacity at Wetalla WRF is insufficient to treat projected flows to the Year 2050 and that an additional 6 ML/d of sewage treatment capacity is required. This deficiency has been resolved via an upgrade to the Wetalla WRF. Alternate strategies and locations have not been considered by this Water Vision program, however, should be considered in future versions.

This proposed solution has been adopted for all investment strategies and is critical to strategies utilising the Dam Replenishment using Purified Recycled Water supply option.

The current operational strategy of the Wetalla AWRF is unexpected to change for all investment strategies except for strategies relying on the Dam Replenishment using Purified Recycled Water supply option.

13. WATER VISION – RURAL TOWNS

13.1 Overview

TRC is responsible for the supply of drinking water to 11 townships that are not connected to the bulk water supply system (rural towns). The population of these towns range from 77 in Kulpi to 3,100 in Pittsworth. The locations of these rural towns are shown in Figure 4-1.

Section 4.3 provides an overview of the existing asset capability and operating strategies for each of the rural towns. This section presents the results of the performance assessment as well as the long-term water supply strategies.

13.2 Service Standards

Section 6.2 outlines the service standards adopted by TRC for water supply planning. These service standards also apply to rural towns.

LOS objectives have not been defined for rural towns, as the available data is not sufficient to use for the modelling required to demonstrate compliance. TRC may choose to develop simpler LOS objectives for rural towns in future versions of the Water Vision.

13.3 Water Demand

Growth in demand for water on the bulk water supply system is primarily due to population growth. Conversely, the populations of rural towns are relatively stable and therefore there is no significant growth in water demand expected. The exceptions to this are Cambooya, Clifton and Greenmount which are all projected to grow by 80% by Year 2050. Despite this significant population growth, the demand increase is relatively small, being 0.4 ML/d, 0.3 ML/d and 0.07 ML/d respectively.

Water consumption rates for rural towns vary, but are assumed to be between 200 and 280 L/EP/d.

13.4 Options Assessment

Similar to the bulk water supply system infrastructure, a performance assessment has been undertaken by comparing the existing asset capability against the service standards and demand forecast for the duration of the planning horizon (Year 2020 to Year 2050). This assessment has been completed for each of the rural towns to identify any supply constraints associated with peak demand or long-term yield. Reliability standards for rural towns were not available, however known water quality issues have been highlighted.

It is known that for some townships such as Clifton, supply reliability is a concern particularly in drought conditions.

The feasibility of connecting to the bulk water supply system has been considered for each rural town.

Table 13.1 presents the recommended options for each rural town.

Table 13.1 Summary of Key Water Infrastructure Capability – Rural Towns

Rural Town	Constraint Identified			Recommended Option	Comments
	Supply Source Yield	Infrastructure Capacity	Water Quality		
Cambooya	Yes	Yes	No	Connection to TRC Bulk Supply via Southern Regional Pipeline	
Cecil Plains	No	No	Yes	Continue BAU (Mixing)	
Clifton	Yes	Yes	Yes	Connection to TRC Bulk Supply via Southern Regional Pipeline	
Greenmount	No	Yes	No	Connection to TRC Bulk Supply via Southern Regional Pipeline	No ability to undertake maintenance on assets and continue supply.
Haden	Unknown	Yes	Unknown		Deferred, pending investigation
Kulpi	Unknown	Unknown	Unknown		Deferred, pending investigation
Millmerran	No	No	Yes	BAU (Mixing, Hypochlorite Treatment and Selective Bore Usage)	
Nobby	No	No	No	Connection to TRC Bulk Supply via Southern Regional Pipeline	Recommended connection due to proximity to Southern Regional Pipeline preferred route.
Pittsworth	No	Yes	Yes	Construct 2 alluvial bores and continue BAU treatment and mixing	
Vale View	Yes	No	No	Planned Connection to TRC Bulk Supply in Year 2020	Advised by TRC that this is in the current Capex Budget
Yarraman	Yes	No	Yes	Continue BAU (Mixing)	Seek additional allocation with South Burnett Regional Council

13.5 Investment Strategies

Connection to the bulk water supply system is considered feasible for the southern towns such as Clifton and Cambooya via the Southern Regional Pipeline (SRP) as proposed in the *Southern Regional Pipeline Route Investigation* (DOCS 8565630 v2, 2018). This option remains the most effective way to address the constraints identified within the southern rural towns. The impact to the timing of augmentations for the bulk water supply system due to the planned connections of the rural towns is not significant due to the relatively low demands. An indicative alignment for the proposed pipeline is shown in Figure 13.1.

For the western towns of Cecil Plains, Millmerran and Pittsworth an investigation was undertaken to determine the viability of a similar long-distance supply pipeline from the Toowoomba bulk water supply system to service these towns. The cost of such a pipeline was found to cost-prohibitive in comparison with local alternatives as shown in Table 13.2.

Table 13.2 Cost Estimates for Rural Town Solutions

Solution	Infrastructure Requirements	Capital Cost
Southern Regional Pipeline	As per Southern Regional Pipeline Route Investigation Option 1-A	$ 24,124,000
Western Regional Pipeline	27 km DN300 main, 42 km DN 200 main, 20 kW pump.	$49,478,000
Pittsworth-Millmerran Water Treatment	22 km DN 200 Main, 3.5 ML WTP, 10 kW pump	$34,085,000
Pittsworth Bore field Expansion, Millmerran BAU	2 Alluvium Bores in or near Pittsworth	$800,000

Given that at the present time, the water quality concerns at Millmerran and Pittsworth can be addressed through mixing, treatment and selective bore usage (*Pittsworth Water Source Investigation*, 2018*; Millmerran Water Source Investigation*, 2018), it is recommended that the supply constraints at Pittsworth be handled through the construction of two new Alluvial bores.

Current water quality constraints at Yarraman are being addressed via supply from the Nukku Pipeline and through water treatment of the water sourced from Ted Pukallus Weir. No changes to current operations are recommended. It is noted however that the current water supply agreement with South Burnett Council requires renegotiation as it is currently out of date. An alternate supply will be required if the agreement cannot be renewed.

No constraints have been identified for Kulpi, as there is insufficient information on the servicing and supply infrastructure for assessment to be undertaken. Similarly, insufficient information regarding supply and servicing infrastructure for Haden is available to identify a solution to the infrastructure capacity constraint identified for the town. Detailed assessments of the Haden and Kulpi water networks are recommended to determine the

nature of potential supply, infrastructure and water quality constraints so solutions can be identified.

13.6 Summary

This review has indicated that for most towns the groundwater supply volume from the bore fields is enough to meet future demand; however, there are some deficiencies relating to treatment capability for water quality issues and infrastructure capacity for peak demand. In particular, the towns of Clifton, Greenmount, Cambooya and Vale View require solutions to address current supply and infrastructure constraints.

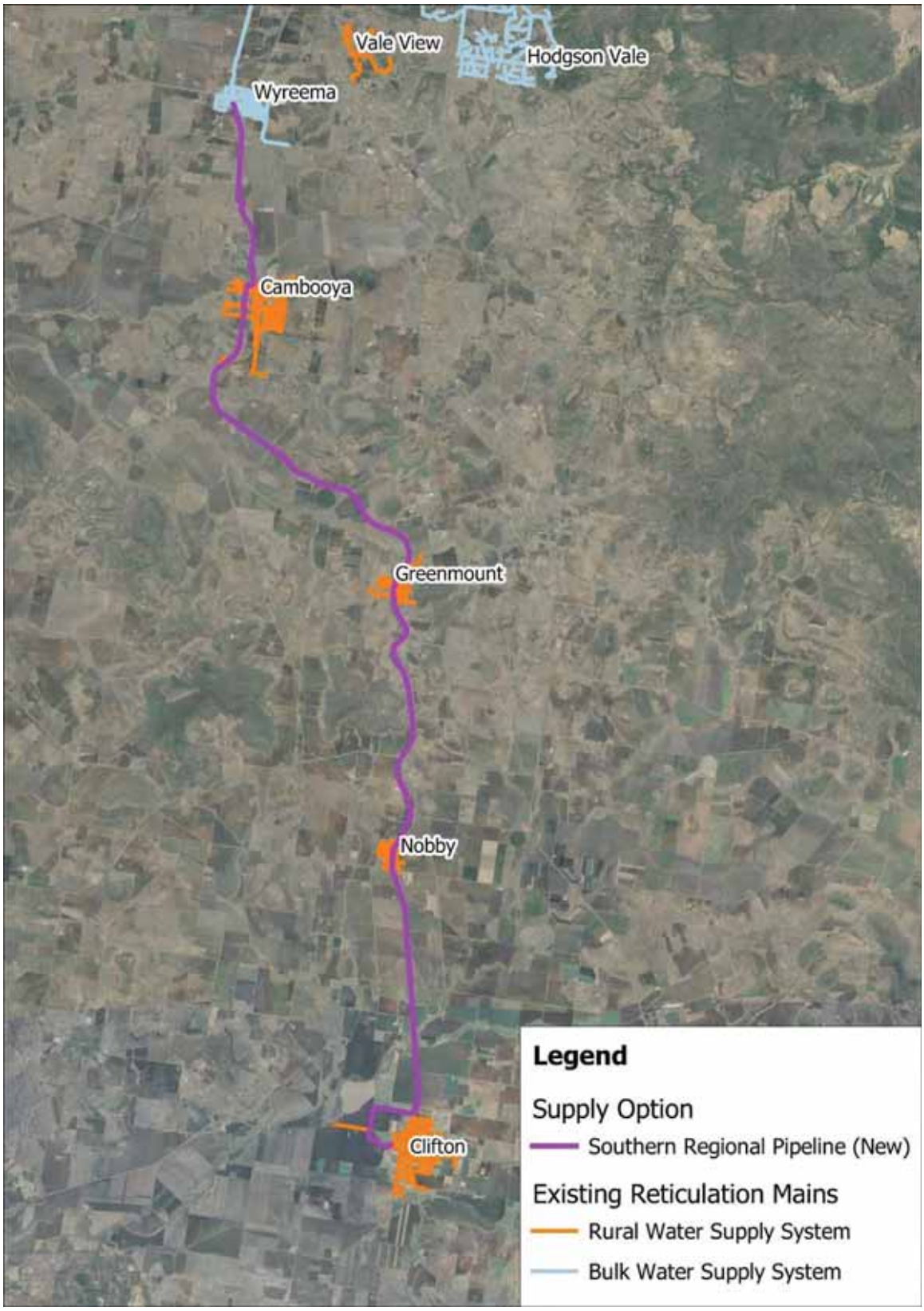


Figure 13.1 Southern Regional Pipeline Preferred Alignment

14. NEXT STEPS

This is the first integrated water security strategy for TRC incorporating the needs of peak demand, Level of Service (LOS) objectives and long-term yield into a single strategy. It is expected that as the strategy evolves with future revisions, the scope will also expand. An example of this is the planning horizon, with 30 years considered appropriate for this first integrated assessment. Future versions of Water Vision should extend the planning horizon to at least 50 years.

This assessment is the first step in the process of developing a contemporary water security strategy for the Toowoomba region. Further iterations of Water Vision will be required to evolve and improve the strategy, with the maturity and scope of assessment improving with each revision. The Water Vision strategy needs to be updated and improved on a regular cycle. It is recommended that the next version of Water Vision targets completion in 2022. This is to allow time to undertake high priority further investigations but still have sufficient time to refine the strategy before major capital investment is required. Water Vision should then move to a typical five-year review timeframe. Figure 14.1 shows a road map for the evolution of the Water Vision strategy.

Figure 14.1 Water Vision Road Map

Overall, options to utilise and upgrade existing assets are preferred. The investment strategy of the Wivenhoe to Cressbrook Raw Water Supply Pipeline combined with upgrades to Mount Kynoch WTP performed most favourably when assessed against other investment strategies using the options assessment framework criteria. This assessment is based on available information and as such key assumptions have been made. It is critical that the following items are confirmed prior to committing to this investment strategy:

- This strategy would require amendment to the existing *Cressbrook Creek Water Supply Scheme Operations Manual* with modification to the resource entitlement volumes (up to 20,000ML/a from 14,000ML/a) as well upgrades to the Cressbrook raw water pump station and changes to the operating rules for the Wivenhoe to Cressbrook Raw Water Pipeline to allow operation of the pipeline at a higher initial level in Cressbrook Dam. Further consideration of the Environmental Flow Objectives would be required, which may modify the results presented here.

- This option relies on agreement of operational protocol with a third party, and negotiation with Seqwater would be required to ensure the increase extraction volumes from Wivenhoe (up to 16,300ML/a from 10,000ML/a) are available. The current agreement allows Seqwater to cancel supply should South East Queensland be in drought. In addition, increased supply from the Wivenhoe system outside of drought conditions may require TRC to be subject to the same LOS and service standards as South East Queensland.

- Continuing to utilise Mount Kynoch WTP as the central treatment facility requires a condition assessment of this existing plant to confirm its suitability to continue operation to Year 2050.

Identified above are options that would secure Toowoomba's water future with an increased reliability through to Year 2050. However, it is noted that the identified constraints for both supply sources and treatment capacity are immediate, within the next five years.

There is the potential to optimise the use of existing assets to ensure the preferred Year 2050 strategy can be implemented. This would include expanding the use of the Toowoomba City Basalts and the Great Artesian Basin (GAB) bores. Both options have been considered but not progressed as the preferred supply source, as alone they do not resolve the Year 2050 supply deficiency and there is insufficient information to determine their long-term sustainability as a supply source.

However, they potentially offer TRC redundancy to allow the preferred supply option to be delivered within more reasonable timeframes. It is noted that activation of the GAB bores is currently being investigated by TRC as a response to the current drought conditions. Similarly, works to determine the viability of the continued and increase usage of the Toowoomba City Basalt groundwater source should be undertaken as a priority.

TRC is currently operating the Toowoomba City Basalt bores at 5ML/d but have an entitlement of up to 10.4ML/d. The GAB bores have an entitlement of 5.5ML/d. If the additional supply from the GAB bores can be added to the system, the supply constraint

could be deferred by up to seven years to Year 2033. If the full entitlement of the basalt bores can be realised this would further extend the supply by up to Year 2043.

While the reliability of these supply sources at these increased volumes is currently uncertain, any increase in yield achieved would assist to defer timing and capital investment required for a new supply source. Pursuing these options should be a priority for TRC.

Actions have been identified by this strategy, including high priority items relating to technical investigations of deferred options and stakeholder and community engagement. Table 14.1 outlines these actions.

Table 14.1 List of Further Actions

Action Type	Item	Details	Relates to	Priority and Reason
Hydrological assessments	Review potential to increase yield from surface water storages.	Potential to increase yield from the existing surface water storages through the dam safety upgrade projects.	Supply Option	High Due to the high cost associated with dam upgrades, these supply options would only be feasible if implemented as part of the dam safety upgrade program.
Hydrological assessments	Confirm current yield available from surface water supplies.	The existing surface water storages will continue to be the main source of supply for the bulk water supply system. It is expected that a hydrological review of the systems will be required as part of the dam safety upgrade projects. As part of these reviews, it is recommended that hydrological assessments are undertaken to confirm the yield available from the existing surface water supplies (Cooby, Cressbrook and Perseverance Dams).	Asset Capability	High If the yield from the surface water storages decreases because of updated information, there is a risk that a new source of supply could be required sooner than planned. Also, increased certainty in the existing yield volumes will increase confidence in timing for the new source of supply.
Hydrogeological assessments	Confirm current yield available from existing groundwater supplies.	There is uncertainty regarding the safe yield that can be extracted from many of the existing water supply sources.	Asset Capability	High If the safe yield can be increased, there is potential to

Action Type	Item	Details	Relates to	Priority and Reason
		A conservative approach to use the historical or anecdotal extraction volumes has been adopted for this report. There is potential for TRC to access additional water from their existing sources if reliability of supply can be confirmed, particularly for the GAB bores and City Basalt bores.		defer the timing of the next new supply source.
Stakeholder Engagement	Engage with Department of Natural Resources, Mines and Energy (DNRME) regarding regulatory changes required for the Wivenhoe to Cressbrook Raw Water Pipeline.	The Wivenhoe to Cressbrook Raw Water Pipeline supply option relies on an amendment to the existing *Cressbrook Creek Water Supply Scheme Operations Manual*, with modification to the resource entitlement volumes (up to 20,000ML/a from 14,000ML/a) as well as changes to the operating rules for the pipeline to allow operation above current limits. Further consideration to Environmental Flow Objectives would also be required.	Supply Option	High Agreement by DNRME to the modifications to the Cressbrook Creek Water Supply Scheme Operations Manual are essential to the feasibility of this supply option.
	Seqwater Engage with Seqwater regarding contractual changes required for the Wivenhoe to Cressbrook Raw Water Pipeline.	The Wivenhoe to Cressbrook Raw Water Pipeline supply option relies on a contractual agreement with Seqwater.	Supply Option	High Negotiation with Seqwater to increase extraction volumes from Wivenhoe (up to 13,100ML/a from 10,000ML/a) is essential to the feasibility of this supply option.

Action Type	Item	Details	Relates to	Priority and Reason
Treatment Options	Condition and capacity assessment of Mount Kynoch WTP.	Key assumptions based on existing planning reports have been made regarding the ability to stage further upgrades to Mount Kynoch WTP. These need to be confirmed through further investigation.	Treatment options	High Changes to the assumed ability to upgrade Mount Kynoch WTP could change the feasibility of this treatment option
		Further investigation is required into the base case upgrade for Mount Kynoch WTP, including confirming the optimal sizing for base case capacity.	Treatment options	High If the assumed base case capacity cannot be achieved, an alternative option will need to be implemented in a short time frame.
Feasibility assessment	Regional water security assessment	Undertake assessment of the feasibility of an inter-regional transfer option, including: • Available yield for TRC urban supply. • Ability to transfer raw water outside of the catchment and interstate. • Funding arrangements, and how prospective users would pay for access.	Supply Options	Medium It is unlikely that any inter-regional transfer option will proceed without funding from State or Federal governments. Also, the expected implementation timeframes mean that an alternative supply option will need to implemented earlier than an inter-regional option allows.

Action Type	Item	Details	Relates to	Priority and Reason
Technical assessments	Undertake investigations where further information may affect the shortlisting of options.	Some potentially suitable supply options have not progressed through the assessment framework due to insufficient information being available. The number of options ruled out due to insufficient information is: Gate 1: 11 supply options Gate 2: 9 Gate 3: 7	Supply Option	Medium Some supply options may be suitable for further consideration.
Rural Towns	Progress planning and design for Southern Regional Pipeline	It is planned to connect a number of rural towns to the bulk water supply system: Cambooya Clifton Greenmount Nobby Vale View	Supply options	Medium Some of these rural towns have current water supply issues that will be resolved by connection to the bulk water supply system.
Community Engagement	LOS objectives	Undertake community engagement to confirm and accept LOS objectives for TRC.	Service standards	Medium Community engagement may lead to adjustments to the LOS objectives.

Action Type	Item	Details	Relates to	Priority and Reason
	Options Assessment Framework	Undertake targeted community engagement to appropriately represent community attitudes in the criteria used in the options assessment framework.	Options Assessment	Low For consideration as part of the next revision of Water Vision.
		Undertake targeted community engagement to appropriately represent community attitudes in the relevant scores of options.	Supply options	Low For consideration as part of the next revision of Water Vision.
Data assessment	Demand management	A detailed review of the demand forecast and existing water restriction schedules could identify potential demand management measures that could be implemented to defer the timing of supply constraints.	Demand options	Low For consideration as part of the next revision of Water Vision.
Technical assessment	Infrastructure capacity	Further investigation to confirm the infrastructure capacity of Kulpi and Haden	Rural towns	Low No information was available to assess supply constraints for these towns. The populations of these towns is small and volumes required are low.
Inflow assessment		It is recommended that further analysis be undertaken to better understand the inflows and increase confidence in future inflow projections for the Wetalla WRF.	Sewerage system	Low There is spare treatment capacity at the Wetalla WRF.

15. GLOSSARY

Term	Definition
Advanced Water Reclamation Facility	A treatment plant providing tertiary treatment to WRF (see WRF) effluent.
Aquifer	An underground body of permeable rock that is able to contain or supply water.
Average Day demand	The recorded daily water supply demand, calculated as total demand for the year divided by 365 days
Average Dry Weather Flow	Average daily (24 hour) inflows to a sewerage network and sewage treatment plant.
Bore Field	A collection of bores extracting groundwater from an aquifer.
Bulk Water Supply System	The Toowoomba bulk water supply infrastructure includes all raw water and bulk water distribution infrastructure connected to the Mt Kynoch Water Treatment Plant (WTP) and the bulk water storages.
Capability	A measure of a specific component of water supply or sewerage infrastructure's ability to perform under prescribed operating conditions.
Capacity	The performance output of water supply and sewerage infrastructure under prescribed conditions (e.g. design capacity).
Dam Replenishment	The use of Purified Recycled Water (see Purified Recycled Water) to supplement dam supply.
Demand Management	Actions undertaken to either maintain or reduce current water demand including promoting water efficiency or substitution of sources.
Direct Potable Reuse (DPR)	The mixing of purified recycled water directly into the potable water distribution system.
Drought	A period of time for when the combined bulk water storages within the 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.

Term	Definition
Historical No Failure Yield (HNFY)	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.
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 hydrologic cycle.
Indirect Potable Reuse (IPR)	The addition of purified recycled water (i.e. potable water recovered from treated sewage effluent) into the bulk water storages. This is subject to further treatment at the water treatment plant before entering the potable water supply distribution system.
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.
Long-term yield (supply sources)	Long-term yield is the ability of a system to supply water on an average day, under average climatic conditions and is generally prescribed by water extraction entitlement limits defined from hydrological assessments for the respective water Resource Operating Plans.
Mean Day Maximum Month (MDMM)	A peak demand design parameter used in Queensland to reflect demand persistence in response to climatic conditions. Calculated as the highest 30-day moving average of daily water demand during a year.
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	Water use that is not used for residential or domestic purposes (e.g. commercial and industrial).
Options Assessment Framework	The framework that is applied to assessing options against each other to select a preferred strategy.

Term	Definition
Peak Demand	A factor applied to average day demands to reflect three design conditions, MDMM (refer MDMM), Peak Day, and Peak Hour.
Base Case	A range of actions that are required be undertaken regardless of other future water supply planning (refer to Section 7-8 for the specific actions)
Planning Criteria	Assessment parameters that encompass the following areas: raw water supply, water and sewerage infrastructure capacity and demand.
Purified Recycled Water	Sewage that has been treated to a very high standard 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.
Residential Water Use	Water use at a residence or for other domestic purposes.
Reticulated	An interconnected piped network. Can refer to both water and sewerage networks.
Sewage	Raw untreated effluent.
Sewerage	The network of infrastructure that conveys sewage to a treatment plant
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 Reclamation Facility	A sewage treatment plant.
Yield	The average annual volume of a supply source or a supply option to meet a specified demand at a specified probability of occurrence.

16. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c. Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

   (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d. Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e. This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this report.

f. If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g. This report does not provide legal advice.

17. REFERENCES

1. DNRME, 2020. *Cressbrook Creek Water Supply Scheme Operations Manual*
2. Engeny, 2019. *Toowoomba Region Water Security. Stage 2 Model Build and Water Security Assessment*
3. Engeny, 2020. *Water Futures Planning Basis*
4. Engeny, 2020. *Catchment Management Strategy*.
5. TRC, 2003. *Mt Kynoch WTP Upgrade Concept Design Report (DOCS #3318929)*
6. TRC, 2004. *EMS Groundwater Bore Register (DOCS #5449967*
7. TRC, 2012. *Bulk Water Supply Agreement (DOCS #5340469)*
8. TRC, 2016. *Mt Kynoch Water Treatment Plant Review Update. Internal Memorandum (DOCS #6942163)*
9. TRC, 2016. *Raw Water Trunk Mains Planning Report (DOCS #7092390)*
10. TRC, 2016. *Toowoomba Bulk Distribution Mains Report (DOCS #6891308)*
11. TRC, 2016. *Toowoomba Raw Water Trunk Mains Analysis Planning Report (DOCS #7092390)*
12. TRC, 2018. *Millmerran Water Source Investigation (DOCS #7669119)*
13. TRC, 2018. *Pittsworth Water Source Investigation (DOCS #8123164)*
14. TRC, 2018. *Southern Regional Pipeline Route Investigation. (DOCS #8565630)*
15. TRC, 2020. *Projections for Water Security Report*
16. WaterNSW, 2019. *Upper Mole River Dam Factsheet*.
17. TRC, 2019. *Toowoomba Bulk Water Supply Water Security Investigations Report – Preliminary Draft*.

APPENDIX A

Overview Figures

Legend

Dams
- Toowoomba Water Supply
- External Water Supply

Reticulation Mains
- Bulk Raw Water Supply
- Rural Water Supply System
- Wivenhoe Raw Water Pipeline
- Bulk Water Supply System

Water Treatment
- Mt Kynoch WTP
- Pechey WTP

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3221 7174
F: 03 3236 2399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

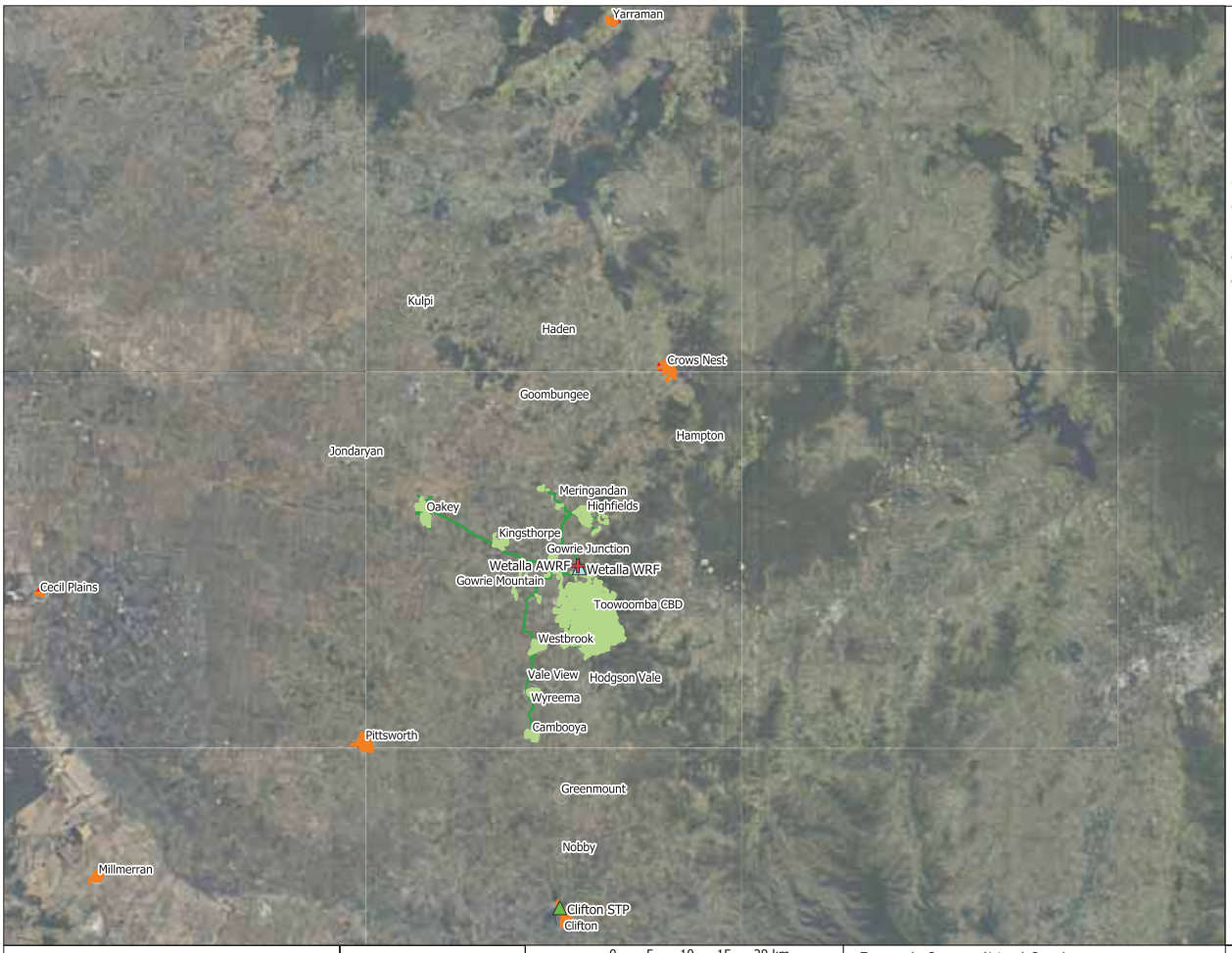
0 5 10 15 20 km

Scale in metres (1:500000 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Toowoomba Water Network Overview
Map 1 of 6

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 2 /7 /2020



Legend

Sewage Treatment
- Clifton STP
- Wetalla WRF
- Wetalla AWRF

Gravity Mains
- Greater Toowoomba Sewerage System
- Rural Sewerage Systems

Sewerage Rising Mains
- Greater Toowoomba Sewerage System
- Rural Sewerage Systems

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3221 7174
F: 03 3236 2399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 5 10 15 20 km

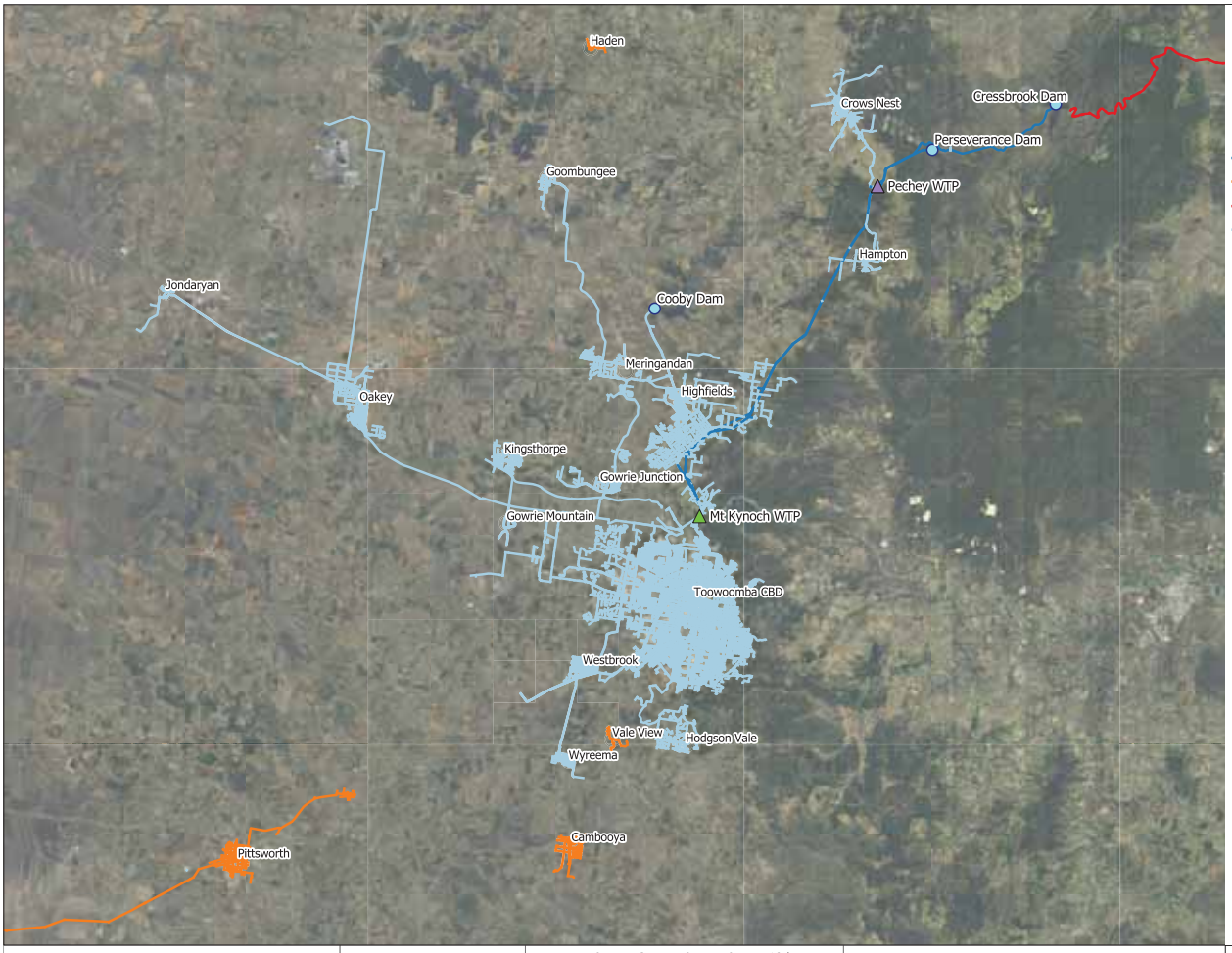
Scale in metres (1:500000 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Toowoomba Sewerage Network Overview

Map 2 of 6

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 2 /7 /2020



Legend

Dams
- Toowoomba Water Supply
- External Water Supply

Reticulation Mains
- Bulk Raw Water Supply
- Rural Water Supply System
- Wivenhoe Raw Water Pipeline
- Bulk Water Supply System

Water Treatment
- Mt Kynoch WTP
- Pechey WTP

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3221 7174
F: 03 3236 2399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 3 6 9 12 km

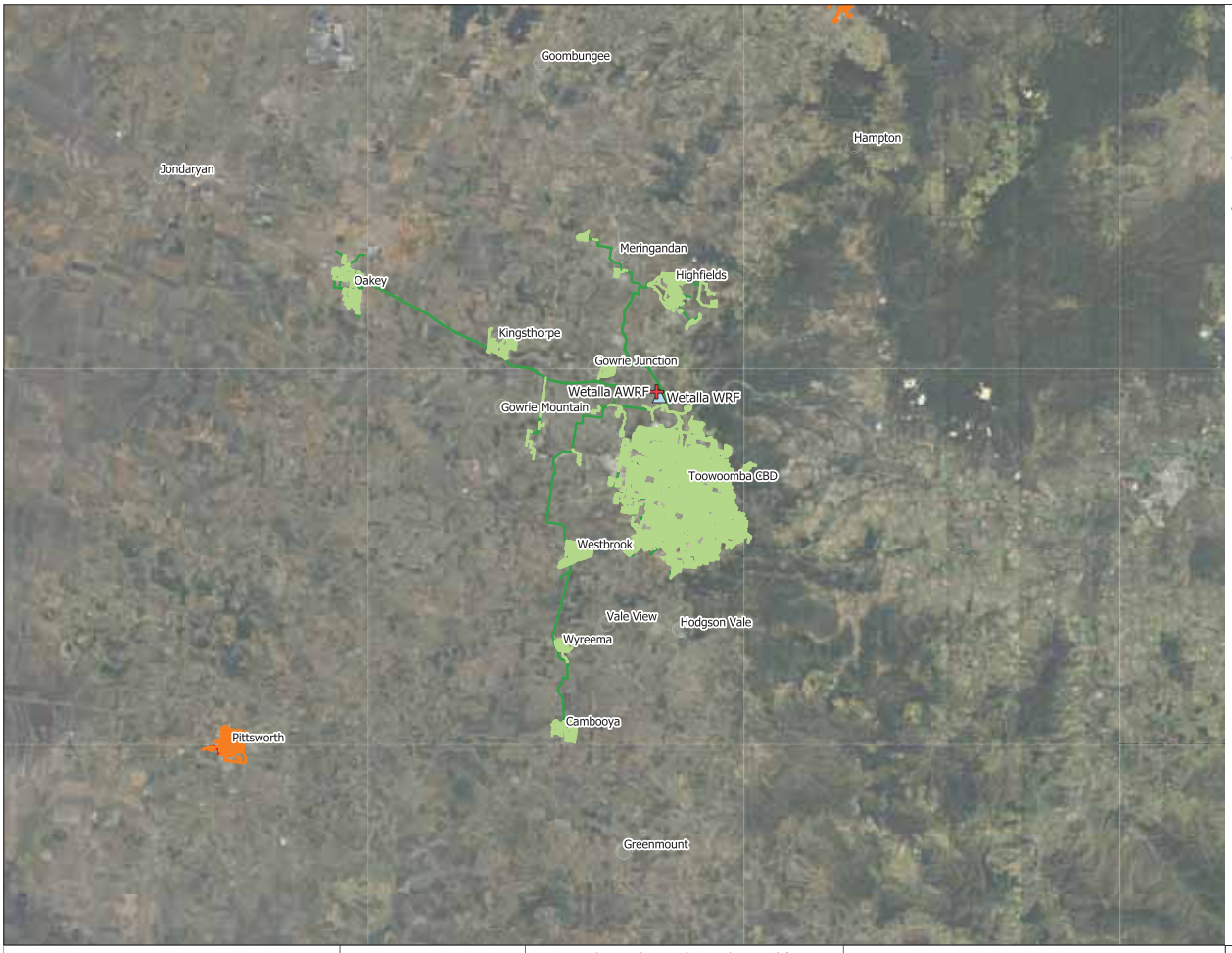
Scale in metres (1:250000@ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Toowoomba Bulk Water Supply System

Map 3 of 6

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 2 /7 /2020



Legend

Sewage Treatment
- Wetalla WRF
- Wetalla AWRF

Gravity Mains
- Greater Toowoomba Sewerage System

Rising Mains
- Greater Toowoomba Sewerage System

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3221 7174
F: 03 3236 2399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 3 6 9 12 km

Scale in metres (1:250000@ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Greater Toowoomba Sewerage System

Map 4 of 6

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 2 /7 /2020

Legend

Reticulation Mains

Rural Water Supply System

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3221 7174
F: 03 3236 2399

ENGENY

TOOWOOMBA REGION

0 0.25 0.5 0.75 1 km

Scale in metres (1:25000 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Toowoomba Rural Water Network

Map 5 of 6

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 2 /7 /2020

Legend

Gravity Mains — Rural Sewerage Systems

Rising Mains — Rural Sewerage Systems

Sewage Treatment — Clifton STP

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3221 7174
F: 03 3236 2399

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 0.25 0.5 0.75 1 km

Scale in metres (1:25000 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Toowoomba Rural Sewerage Network

Map 6 of 6

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 2 /7 /2020

APPENDIX B

Criteria and Options Assessment Framework

Towoomba Water Futures

Investment Strategy Options Assessment Framework

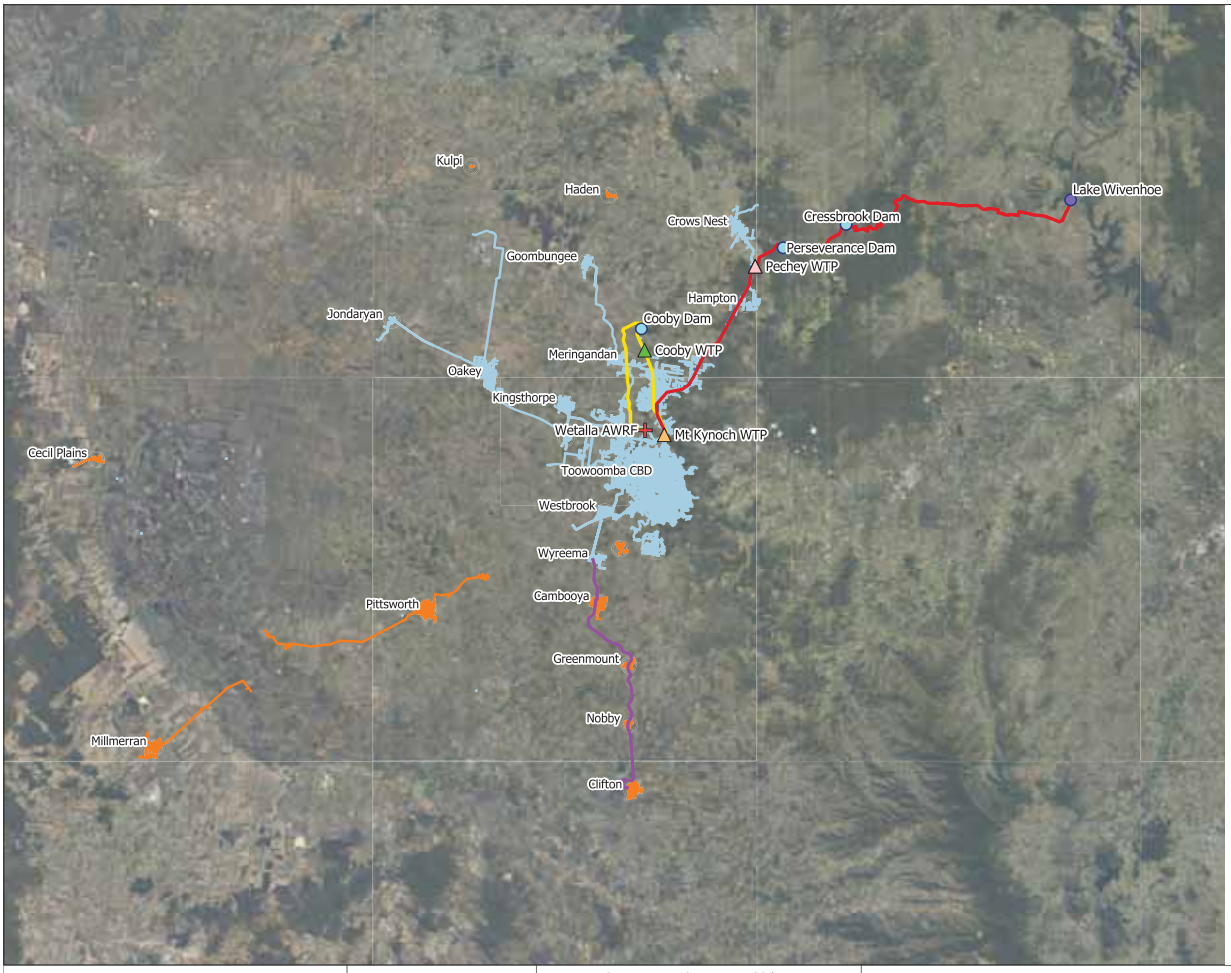
TRC Corporate Goal		Specific comments for Criteria			
		Neutral	**Green** (*italics indicates extracts of Goals from TRC Corporate Plan*)	**Amber**	**Red**
		No influence on criteria	**Positive influence on criteria**	**Minor negative influence on criteria**	**Major negative influence on criteria**
People	**General**	No expected community preference. No impact on cultural heritage values.	Aligns with local culture and traditions. Positive community input, option is acceptable to the community. Positive impact on cultural heritage. • Aligns with local culture and traditions (including Traditional Owners). *• Build social capital through the provision of accessible community infrastructure and programs (provide a fair water supply for all users (residential, rural).* *• Implement effective and genuine community consultation processes that enable participation, engagement and collaboration (Provides a solution that is acceptable to the TRC community).* *• Plan and provide facilities and programs that enable participation in sport and recreation (Creates opportunities for people to connect and belong).*	Minor community opposition and lack of acceptance. Minor impact on cultural heritage.	Major community opposition, option is not accepted by the community. Major impact on cultural heritage.
Place	**General**	No influence on criteria	• Protects catchment health. • Allows multiple, compatible uses (environment, agriculture, societal). *• Build community awareness and participation in natural and agricultural land conservation.* *• Advocate for, develop and implement environmental strategies that protect and enhance living assets in urban, natural and agricultural landscapes.* *• Ensure planning supports economic development while protecting and enhancing high quality agricultural lands, scenic amenity and community, environmental and heritage values.* *• Plan and provide an integrated and accessible network of open space, parkland, trails, corridors and natural areas including recreational waterways* *• Undertake integrated strategic land use, infrastructure planning and urban design to manage growth in a financially sustainable manner that enhances liveability (Enhances liveability).* *• Allows for open space, parkland, trails, corridors and natural areas including recreational waterways.* *• Sustainable for future generations.* *• Innovative.*	Minor negative influence on criteria	Major negative influence on criteria
	Catchments and Water Quality	No change to catchment condition.	Improves catchment condition.	Minor impact on catchment condition.	Major impact on catchment condition.
	Source Water	No change to raw water quality.	Good raw water quality. Minimal treatment required.	Average to poor raw water quality. Typical treatment required.	Very poor raw water quality. Complex treatment required.
Sustainability	**General**	No influence on criteria	*• Investigate and implement more effective and efficient processes and systems that focus on energy and operational improvements (produces minimal greenhouse gases).* *• Implement water sensitive urban design and stormwater management approaches that enhance natural systems and ensure a flood resilient region.* *• Advance water efficiency and security ensuring total water cycle management and innovation.* *• Plan, deliver and manage efficient, integrated and sustainable waste and resource recovery services and reduction of emissions from landfill (waste is minimised, or able to be recovered or reused).*	Minor negative influence on criteria	Major negative influence on criteria
	Environment	No impact on environment.	Reduces environmental risk associated with the option, including vegetation, flora and fauna, sensitive environmental areas.	Minor environmental risk associated with the option.	Major environmental risk associated with the option.
Prosperity	**General**	Neutral	*• Plan to ensure Toowoomba City is connected to a network of rural towns to make a vibrant region.* *• Leverage the opportunities inherent in major regional, state and national projects.* *• Ensure planning and infrastructure supports future economic growth of strong, viable and diverse economic clusters, regional centres and townships.*	Minor	Major
	Financial performance	Neutral	Low NPV. Low upfront capital. High residual asset life. Complements or reduces existing capital program. Does not require investment that will become sunk costs.	Minor	Major
	Funding arrangements	>$2M/ML, <$5M/ML State funding will be required.	Funding options are available and have been secured.	<$2M/ML. TRC funding is required.	>$5M/ML. Federal funding will be required
Performance	**Drought resilience**	Neutral	Provides a highly reliable drought supply (i.e. climate independent). e.g. manufactured water. Diversity of source water.	Can be used as a drought supply, but not entirely reliable (i.e. climate resilient). e.g. groundwater. Some diversity of source water.	Not reliable as a drought supply. e.g. surface water. Minimal diversity of source water.
	Regulatory	BAU approvals	No approvals required	12-24 months approval timeframe	24 months + approval timeframe
	Reliability	Neutral	Positive influence on criteria. Diversity of supplies/infrastructure. Reduces single sources of failure. Ability to adapt to climate change, degrading catchment.	Minor negative influence on criteria	Major negative influence on criteria
	System performance	Neutral	LOS objectives met or exceeded. All service standards met or exceeded. Low risk of detrimental response to sensitivities (demand, energy price, etc). Resilient to system peaks. Resilient to unplanned events (e.g. floods, bushfires, etc). Adaptable operating strategy. Capable of dealing with higher demands (e.g. additional source water, capacity available). Suitable for longer planning horizons.	Minor negative influence on criteria	Major negative influence on criteria
	Implementation/Deliverability	Neutral	Ability to deliver within timeframes. May improve over time with technology improvements.	Minor negative influence on criteria	Major negative influence on criteria

SUPPLY OPTIONS PLANNING ASSUMPTIONS

#	Key Assumptions
1	Depreciation of assets is linear.
2	Pipes have an 80-year asset life.
3	Dams have a 100-year asset life.
4	Treatment Plants have a 50-year asset life.
5	All other assets (pumps, electrical, etc) have a 30-year asset life.
6	Replacement of existing assets has not been considered.
7	Required supply volume available based on projected deficit in 2050 for either the AD or MDMM criteria, where a volume is unknown or unavailable.
8	Where a volume is known, this volume has been assumed to be available from the date required.
9	A Discount rate of 7.5% has been adopted.
10	Costs have been based on TRC's assets where applicable, costs for treatment plants, dams have been sourced from Engeny's record.
11	Assets have been assumed to be constructed at least 1 year in advance of need. (i.e. pipes required in 2026 are costed in 2025).
12	Where appropriate assets have been staged, equally.
13	Opex costs have been pro-rated to match the demand at each year.
14	Preliminary pipeline routes have assumed to follow road easements, unless provided.
15	Costs are $2020 AUD
16	Locations of new treatment plants are indicative only.
17	No condition assessment or detailed upgrade requirements for existing assets has been undertaken.

APPENDIX C

Options Figures



Legend

Dams
- Toowoomba Water Supply
- External Water Supply

Existing Reticulation Mains
- Bulk Raw Water Supply
- Rural Water Supply System
- Bulk Water Supply System

Investment Strategy Infrastructure
- Dam Replenishment Pipeline DR-1 (New)
- Wivenhoe Supply Pipeline WP-1 (Existing)
- Southern Regional Pipeline (New)

Treatment Options
- Cooby WTP (New)
- Mt Kynoch WTP (Base Case)
- Pechey WTP (Upgraded)
- Wetalla AWRF (Upgraded)

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3771 2124
F: 03 3736 7399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 10 20 km

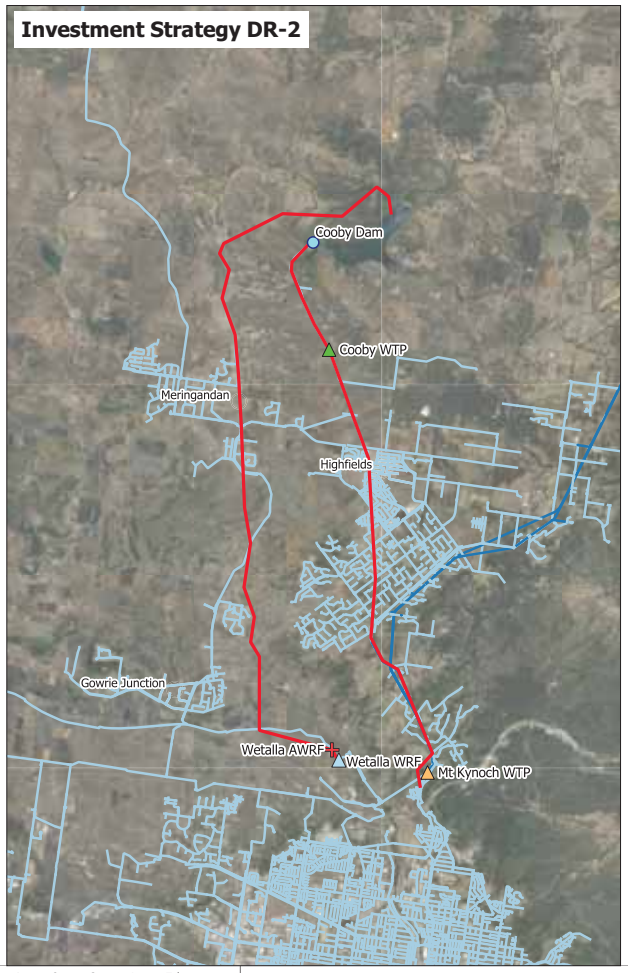
Scale in metres (1:500000@ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Investment Strategy Infrastructure

Map 1 of 4

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 15 /10 /2020



Legend

Dams
- 2Wisting Dams

2Wisting I eticulation Mains
- xulC I aR B ater SupplE
- xulC B ater SupplE SEstem

SupplE - ptions
- Dam I eplenishment Pipeline DI O (NeR)
- Dam I eplenishment Pipeline DI O1 (NeR)

Treatment - ptions
- Mt KEnoch B TP (Upgraded)
- Mt KEnoch B TP (xase wase)
- woobE B TP (NeR)
- B etalla AB I F (Upgraded)

SeRage Treatment
- B etalla B I F (Upgraded)

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3771 2124
F: 03 3736 7399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 1 2 3 4 5 km

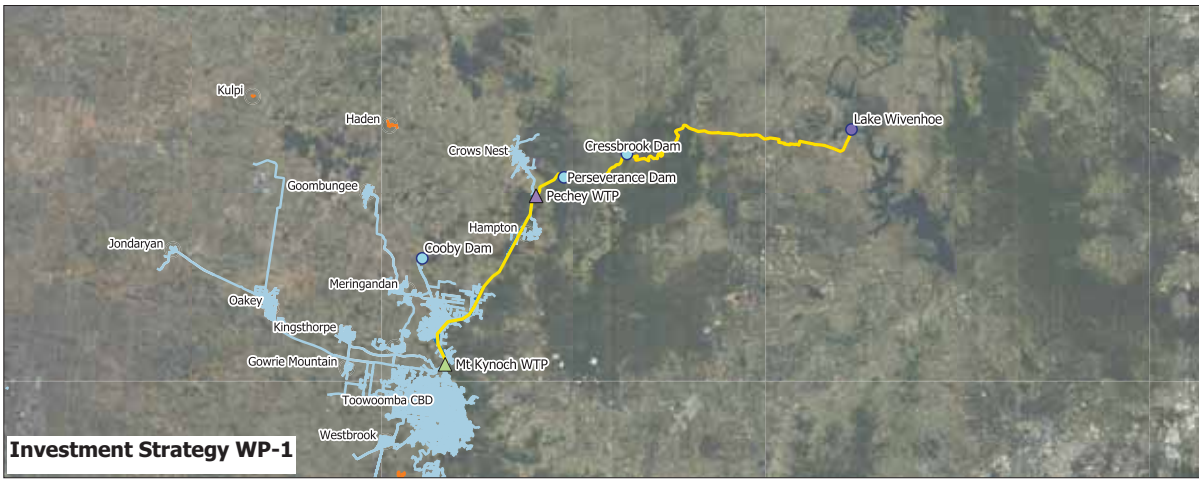
Scale in metres (1:100000@ A3)

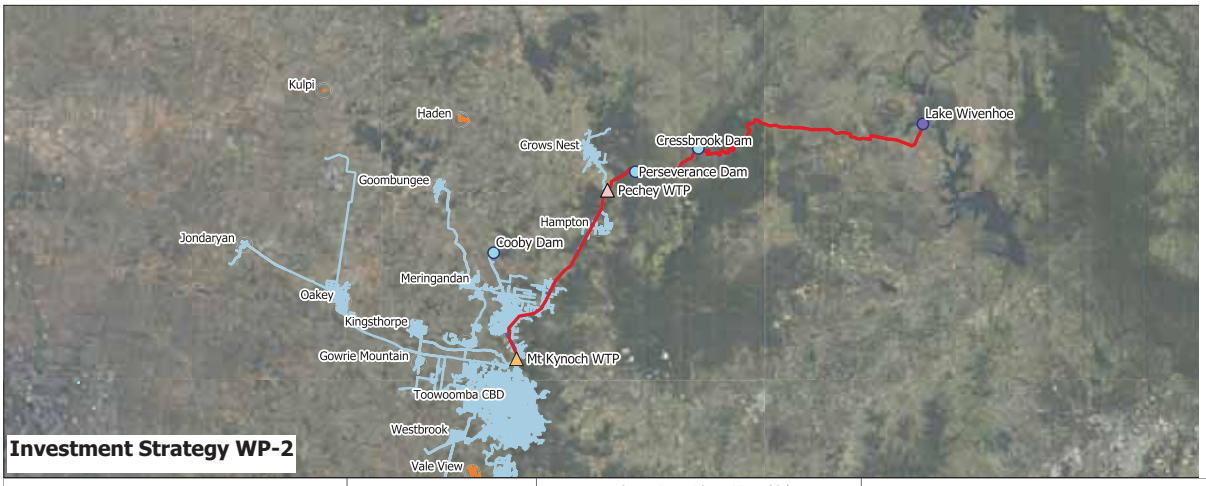
Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Dam I eplenishment ynvestment Strategies

Map 1 of 4

Job Number: M34000_090
I evision: 0
DraRn: AP
whecCed: Jk
Date: 9 L/0 L1010





Legend

Dams
- Toowoomba Water Supply
- External Water Supply

Exsiting Reticulation Mains
- Bulk Raw Water Supply
- Bulk Water Supply System
- Rural Water Supply System

Supply Options
- Wivenhoe Supply Pipeline WP-1 (Existing)
- Wivenhoe Supply Pipeline WP-2 (Augmented)

Treatment Options
- Mt Kynoch WTP (Upgraded)
- Mt Kynoch WTP (Base Case)
- Pechey WTP (Exisiting)
- Pechey WTP (Upgraded)

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3771 2124
F: 03 3736 7399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 5 10 15 20 km

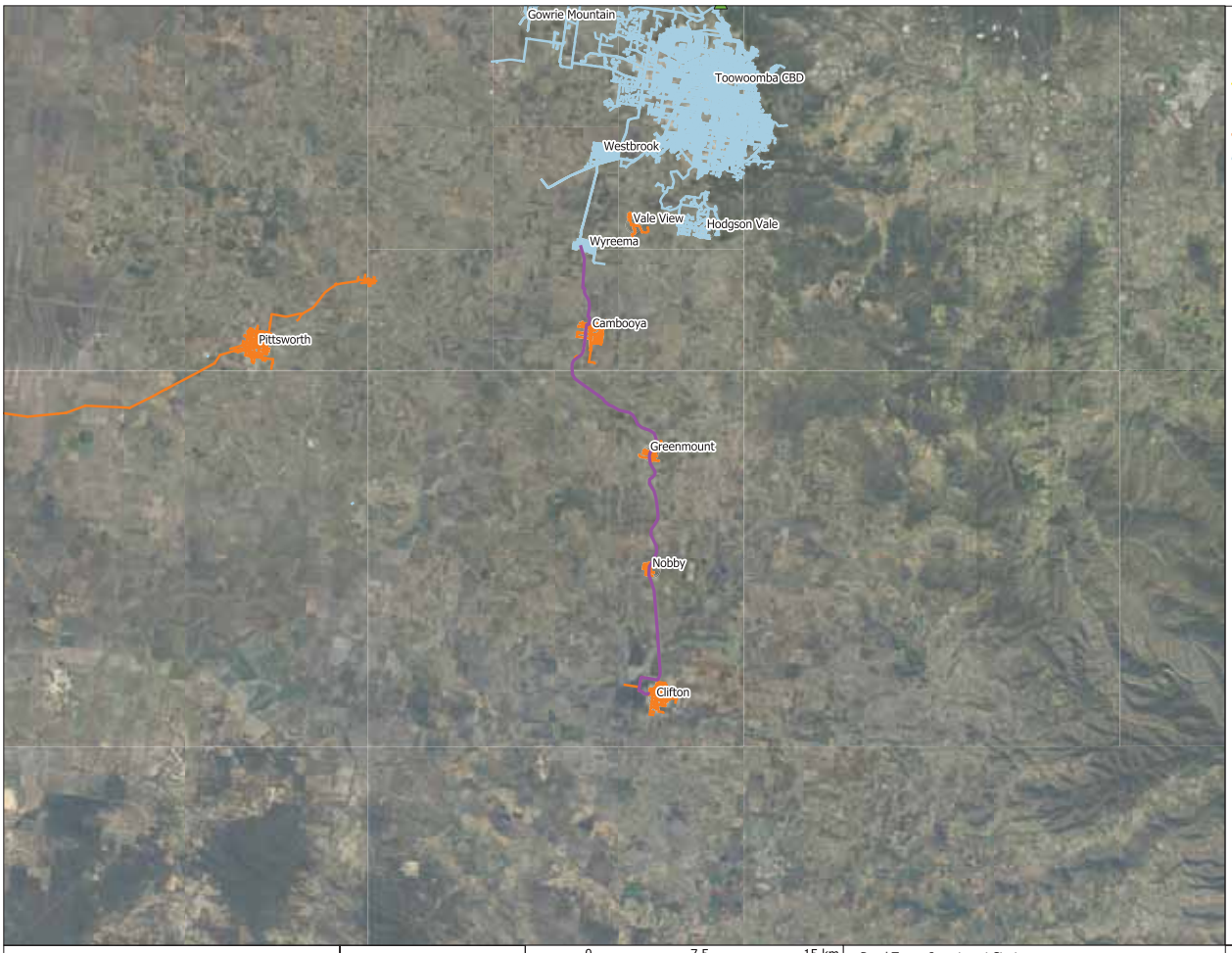
Scale in metres (1:500000@ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Wivenhoe Supply Pipeline Investment Strategies

Map 3 of 4

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 9 /10 /2020



Legend

Supply Option

- Dam Replenishment Pipeline DR-1 (New)

Existing Reticulation Mains

- Rural Water Supply System
- Bulk Water Supply System

Level 7, 500 Queen St Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 03 3771 2124
F: 03 3736 7399
E: admin@engeny.com.au

ENGENY WATER MANAGEMENT

TOOWOOMBA REGION

0 7.5 15 km

Scale in metres (1:250000 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Rural Towns Investment Strategy

Map 4 of 4

Job Number: M34000_090
Revision: 0
Drawn: AP
Checked: JL
Date: 9 /10 /2020

APPENDIX D

Supply Options Summary

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
1	Emu Creek Dam	Supply	Surface Water	Supply Deficiency	2026	This option considers the construction of the proposed Emu Creek Dam and associated transfer infrastructure to Cooby Dam. The Emu Creek Dam site is situated to the north of the Cressbrook Dam catchment between Blackbutt and Crows Nest.	*Yes*	*No*	*No*	-
2	Linville Dam - Configuration 1	Supply	Surface Water	Supply Deficiency	-	This option considers the construction of the proposed Linville Dam and associated transfer infrastructure to Cooby Dam. The proposed dam is located on Emu Creek near Harlin, on lower Warrill Creek near Willowbank and on the Bremer River near Mt Walker.	*No*	*No*	*No*	-
3	Linville Dam - Configuration 2	Supply	Surface Water	Supply Deficiency	-	This options considers the construction of the proposed Linville Dam and associated transfer infrastructure to Cooby Dam. The proposed dam is located on Emu Creek near Harlin, on lower Warrill Creek near Willowbank and on the Bremer River near Mt Walker.	*No*	*No*	*No*	-
4	Linville Dam - Configuration 3	Supply	Surface Water	Supply Deficiency	-	This options considers the construction of the proposed Linville Dam and associated transfer infrastructure to Cooby Dam. The proposed dam is located on Emu Creek near Harlin, on lower Warrill Creek near Willowbank and on the Bremer River near Mt Walker.	*No*	*No*	*No*	-
5	Mole River Dam	Supply	Interstate Pipeline	Supply Deficiency	2026	The Mole River is located approximately 40 km west of Tenterfield in northern New South Wales. In October 2019, the Federal and New South Wales Governments announced $24M to undertake a Final Business Case for building a new dam on the Mole River (WaterNSW 2019). https://www.waternsw.com.au/projects/new-dams-for-nsw/mole-river-dam	*Yes*	*No*	*No*	-
6	Nathan Dam	Supply	Surface Water	Supply Deficiency	2026	The proposed Nathan Dam site is situated on the Dawson River, approximately 36 km north east of Taroom.	*Yes*	*No*	*No*	-
7	Oakey Creek Dam	Supply	Surface Water	Supply Deficiency	2026	A potential site for a dam on Oakey Creek is located west of Cooby Dam between Meringandan West and Goombungee. It is located downstream of Cooby Dam and therefore the benefits of this dam site are reduced due to the existing yield available from Cooby.	*Yes*	*No*	*No*	-
8	Lockyer Creek Dam	Supply	Surface Water	Supply Deficiency	2026	The Department of Natural Resources (1996) identified a potential dam site on Lockyer Creek near the confluence with Alice Creek. The site is approximately 5 km south east of the Murphy's Creek township	*Yes*	*No*	*No*	-

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
9	Hodgson's Creek Dam	Supply	Surface Water	Supply Deficiency	2026	The site identified by the Department of Natural Resources (1996) is located south west of Pittsworth and south east of Cambooya, approximately 2 km to the south of Pittsworth Felton Road.	*Yes*	*No*	*No*	-
10	Supply Pipeline from Paradise Dam (Bundaberg Water Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Bundaberg Water Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from Paradise Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*No*	*No*	-
11	Supply Pipeline from Mary River Barrage (Lower Mary River Water Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Lower Mary River Water Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from the Mary River Barrage to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*No*	*No*	-
12	Supply Pipeline from Awoonga Dam (Awoonga Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Awoonga Water Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from the Awoonga Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*No*	*No*	-

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
13	Supply Pipeline from Borumba Dam (Mary Valley Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Mary Valley Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from the Borumba Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*No*	*No*	-
14	Supply Pipeline from Wuruma Dam (Upper Burnett Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Upper Burnett Supply Scheme. This option involves the construction of a supply pipeline (gravity driven) from the Wuruma Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*No*	*No*	-
15	Supply Pipeline from Leslie Dam (Upper Condamine Water Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	-	This option assumes a new raw water supply pipeline from the Leslie Dam to Toowoomba (Mt Kynoch WTP).	*No*	*No*	*No*	-
16	Interstate Supply Pipeline from Clarence River	Supply	Interstate Pipeline	Supply Deficiency	2026	This option involves the construction of a supply pipeline (gravity driven) from the Clarence River to Cooby Dam. The cost of purchasing an allocation has not been included. It has been assumed that an allocation is available given limited information available	*Yes*	*No*	*No*	-
17	Interstate Supply Pipeline from Tweed River	Supply	Interstate Pipeline	Supply Deficiency	2026	This option involves the construction of a supply pipeline (gravity driven) from the Tweed River to Cooby Dam. The cost of purchasing an allocation has not been included. It has been assumed that an allocation is available given limited information available	*Yes*	*No*	*No*	-
18	Supply Pipeline from Wyaralong Dam	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option involves the construction of a pumped supply pipeline from Wyaralong Dam. The cost of purchasing an allocation has not been included. It has been assumed that an allocation is available given limited information available	*Yes*	*No*	*No*	-
19	Supply Pipeline from Coolmunda Dam	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows limited supply availability in Coolmunda Dam, allowing for only a Low Yield Scenario to be considered. This option involves the construction of a supply pipeline (gravity driven) from the Coolmunda Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*No*	*No*	-
20	Modified Bradfield scheme	Supply	Intrastate Pipeline	Supply Deficiency	-	This option considers a modified Bradfield scheme. This scheme includes all options that would convey flows from northen Queensland to South East Queensland.	*No*	*No*	*No*	-

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
21	Oakey groundwater	Supply	Groundwater	Supply Deficiency	-	This option considers increasing the supply from the Oakey Creek alluvium, as part of the Upper Condamine Alluvial groundwater source.	*No*	*No*	*No*	-
22	Access Upper Condamine basalts	Supply	Groundwater	Supply Deficiency	-	This option considers increasing the supply from Upper Condamine Alluvium.	*No*	*No*	*No*	-
23	Toowoomba City Basalt Bores - AD current	Supply	Groundwater	Supply Deficiency	2026	This option involves the use of the total allocation from the Toowoomba City Basalts aquifer for the provision of supply. This would include additional bores and the purchase of allocation.	*Yes*	*Yes*	*No*	This option was requires further investigation in regard to reliability. Given the small yield and the unknowns in regard to safe reliable yield and quality. This source should be utilised as a drought contingency.
24	Great Artesian Basin Bores (reactivate existing)	Supply	Groundwater	Supply Deficiency	2026	This option involves the use of the total allocation from the Toowoomba City Basalts aquifer for the provision of supply. This would include additional bores and the purchase of allocation.	*Yes*	*Yes*	*No*	This option was requires further investigation in regard to reliability. Given the small yield and the unknowns in regard to safe reliable yield and quality. This source should be utilised as a drought contingency.

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
25	Great Artesian Basin Bores (new bores, increased allocation over existing entitlements)	Supply	Groundwater	Supply Deficiency	-	This option considers utilisation of the complete entitlemts avaiablie for the Great Artiesian Basin bores in the Eastern Downs Marburg sub-area.	*No*	*No*	*No*	-
26	Toowoomba City Basalt Bores to 6,040ML/a	Supply	Groundwater	Supply Deficiency	2026	This option involves the use of the total allocation from the Toowoomba City Basalts aquifer for the provision of supply. This would include additional bores and the purchase of allocation from existing licese holders.	*Yes*	*Yes*	*No*	This option was requires further investigation in regard to reliability. Given the small yield and the unknowns in regard to safe reliable yield and quality. This source should be utilised as a drought contingency.
27	Direct Potable Reuse	Supply	Recycled	Supply Deficiency	2026	This option includes upgrading the Wetalla AWRF to fill the deficit in supply. A pipeline is to be constructed between Wetalla and Mt Kynoch, where the water will be mixed with the Mt Kynoch Clear Water.	*Yes*	*Yes*	*No*	Direct Potable reuse is currently limited by current legislation. Community attitudes would also be negative for this option.
28	Dam Replenishment to Cooby	Supply	Recycled	Supply Deficiency	2026	This option includes upgrading the Wetalla AWRF to fill the deficit in supply. A pipeline is to be constructed between Wetalla and Cooby Dam, where the water will mix before treatment at Mt Kynoch.	*Yes*	*Yes*	*Yes*	-
29	Stormwater harvesting	Supply	Recycled	Supply Deficiency	-	This option considers the capture of stormwater to be treated to a sufficient level to substitute potable water for non-potable uses. E.g. irrigation to open space, laundry, outdoor etc.	*No*	*No*	*No*	-
30	Cloud Seeding	Supply	Other	Supply Deficiency	-	This option considers the use of cloud seeding to increase/enhance rainfall in the region.	*No*	*No*	*No*	-
31	Fog/Dew collection	Supply	Other	Supply Deficiency	-	This option considers the collection of fog and dew to supplement local water users.	*No*	*No*	*No*	-
32	A coastal desalination plant	Supply	Other	Supply Deficiency	-	This option considers the use of a coastal desalination plant to supplement Toowoomba's supply.	*No*	*No*	*No*	-

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
33	Aquifer Recharge (recycled water)	Supply	Groundwater	Supply Deficiency	-	This option considers the storage of raw water in aquifers to reduce losses due to evaporation and the capture flows that might otherwise be released during overflow events.	*No*	*No*	*No*	-
34	Aquifer Recharge (raw water)	Supply	Groundwater	Supply Deficiency	-	This option considers the storage of raw water in aquifers to reduce losses due to evaporation and the capture flows that might otherwise be released during overflow events.	*No*	*No*	*No*	-
35	Aquifer Recharge (stormwater)	Supply	Groundwater	Supply Deficiency	-	This option considers the storage of raw water in aquifers to reduce losses due to evaporation and the capture flows that might otherwise be released during overflow events.	*No*	*No*	*No*	-
36	Sewer Mining	Supply	Other	Supply Deficiency	-	This option considers the use of sewer mining to off-set supply within the grid connected network.	*No*	*No*	*No*	-

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
37	Coal seam gas water	Supply	Other	Supply Deficiency	-	This option considers the transfer of water from nearby CSG operations to the Toowoomba water network.	*No*	*No*	*No*	-
38	Wivenhoe Pipeline - AD supply	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option involves using the existing Wivenhoe Pipeline as a permanent source of water; in addition to current drought uses.	*Yes*	*Yes*	*Yes*	-
39	New Wivenhoe Pipeline sized only to transfer the supply deficit to 2050.	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option includes installing a new main duplicating the existing Wivenhoe pipeline, sized only the required supply deficit in 2050.	*Yes*	*Yes*	*Yes*	-
40	Wivenhoe Pipeline - AD full	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option involves using the existing Wivenhoe Pipeline as a permanent source of water; in addition to current drought uses. These costs increase in accordance with CPI increases every year; and do not account for usage as a drought measure.	*Yes*	*Yes*	*Yes*	-
41	Seqwater Bulk Supply Connection	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option includes the installation of a pipeline between Mt Crosby WTP and the clearwater storage at Mt Kynoch. Costs inlcude a provisional treatment cost for Mt Crosby Water, but does not inlcude any access costs.	*Yes*	*No*	*No*	-
42	Raise the Perseverance dam walls	Supply	Surface Water	Supply Deficiency	-	This option considers the raising of the dam wall to increase storage volume.	*No*	*No*	*No*	-
43	Raise the Cressbrook dam walls	Supply	Surface Water	Supply Deficiency	-	This option considers the raising of the dam wall to increase the available supply volume.	*No*	*No*	*No*	-
44	Raise the Cooby dam walls	Supply	Surface Water	Supply Deficiency	-	This option considers the raising of the dam wall to increase the available supply volume.	*No*	*No*	*No*	-

Supply Options Assessment Summary

Blue Sky List

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1	GATE 2	Gate 3: Multi Criteria Assessment	
							GATE 1 PASS	GATE 2 PASS	Pass to Gate 4	Gate 3 Comment
45	Desilt dams (increase available storage volume)	Supply	Surface Water	Supply Deficiency	-	This option considers desilting the dams to increase available storage volumes.	*No*	*No*	*No*	-
46	Advanced evaporation reduction technologies (15% coverage)	Supply	Other	Supply Deficiency	2020	This option involves the use of floating covers covering 15% of the surface of each dam to reduce evaporation	*Yes*	*Yes*	*No*	This option has been considered in the past and not implemented. Logistical and environmental issues are foreseen wit the use of any physical or chemical barrier over existing surface water storages.
47	Advanced evaporation reduction technologies (35% coverage)	Supply	Other	Supply Deficiency	2020	This option involves the use of floating covers covering 35% of the surface of each dam to reduce evaporation	*Yes*	*Yes*	*No*	This option has been considered in the past and not implemented. Logistical and environmental issues are foreseen wit the use of any physical or chemical barrier over existing surface water storages.
48	Advanced evaporation reduction technologies (50% coverage)	Supply	Other	Supply Deficiency	2020	This option involves the use of floating covers covering 50% of the surface of each dam to reduce evaporation	*Yes*	*Yes*	*No*	This option has been considered in the past and not implemented. Logistical and environmental issues are foreseen wit the use of any physical or chemical barrier over existing surface water storages.

Supply Options Assessment Summary

Gate 1 - Options Removed or Deferred

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1					
							Can the option be costed to ±100%	Can a yield be estimated for the option	Yield/Capacity	GATE 1 PASS	Gate 1 Comment	Gate 1 Defer
2	Linville Dam - Configuration 1	Supply	Surface Water	Supply Deficiency	-	This option considers the construction of the proposed Linville Dam and associated transfer infrastructure to Cooby Dam. The proposed dam is located on Emu Creek near Harlin, on lower Warrill Creek near Willowbank and on the Bremer River near Mt	Yes	No	-	No	Linville Dam configurations are intended for use for flood mitigation rather than as an urban water supply and would operate as part of the Wivenhoe-Somerset system.	No
3	Linville Dam - Configuration 2	Supply	Surface Water	Supply Deficiency	-	This options considers the construction of the proposed Linville Dam and associated transfer infrastructure to Cooby Dam. The prposed dam is located on Emu Creek near Harlin, on lower Warrill Creek near Willowbank and on the Bremer River near Mt	Yes	No	-	No	Linville Dam configurations are intended for use for flood mitigation rather than as an urban water supply and would operate as part of the Wivenhoe-Somerset system.	No
4	Linville Dam - Configuration 3	Supply	Surface Water	Supply Deficiency	-	This options considers the construction of the proposed Linville Dam and associated transfer infrastructure to Cooby Dam. The proposed dam is located on Emu Creek near Harlin, on lower Warrill Creek near Willowbank	Yes	No	-	No	Linville Dam configurations are intended for use for flood mitigation rather than as an urban water supply and would operate as part of the Wivenhoe-Somerset system.	No
15	Supply Pipeline from Leslie Dam (Upper Condamine Water Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	-	This option assumes a new raw water supply pipeline from the Leslie Dam to Toowoomba (Mt Kynoch WTP).	No	No	-	No	QBWOS shows supply available within the Upper Condamine Water Supply Scheme, however the allocation remaining is insufficient to service the demand needs of Toowoomba City. (210 ML/a, or 0.6 ML/d). Further consideration of this option would require legislative and funding mechanisms investigated.	Yes
20	Modified Bradfield scheme	Supply	Intrastate Pipeline	Supply Deficiency	-	This option considers a modified Bradfield scheme. This scheme includes all options that would convey flows from northen Queensland to South East Queensland.	No	No	-	No	Insufficient information available. Consideration of the Bradfield Scheme would be deferred to the State or Federal Governments	Yes
21	Oakey groundwater	Supply	Groundwater	Supply Deficiency	-	This option considers increasing the supply from the Oakey Creek alluvium, as part of the Upper Condamine Alluvial groundwater source.	No	No	-	No	This option was included in the Future Water Supply Options for Toowoomba City and Customer Shires Pre-feasibility Study (PB, 2006) and recommended not to proceed due to existing environmental issues and allocation. Advancements in treatment technology may provide an opportunity to utilise this source. Further investigation is required.	Yes
22	Access Upper Condamine basalts	Supply	Groundwater	Supply Deficiency	-	This option considers increasing the supply from Upper Condamine Alluvium.	No	No	-	No	This option was included in the Future Water Supply Options for Toowoomba City and Customer Shires Pre-feasibility Study (PB, 2006) and recommended not to proceed due to existing environmental issues and allocation.	No
25	Great Artesian Basin Bores (new bores, increased allocation over existing entitlements)	Supply	Groundwater	Supply Deficiency	-	This option considers utilisation of the complete entitlemts avaiable for the Great Artiesian Basin bores in the Eastern Downs Marburg sub-area.	Yes	No	-	No	This option has been deferred in this analysis. Analysis of the water allocations in the Eastern Downs Marburg sub-area has shown that currently no additional allocation is available for use by TRC. Consideration of purchasing allocations may be investigated if required.	Yes
29	Stormwater harvesting	Supply	Recycled	Supply Deficiency	-	This option considers the capture of stormwater to be treated to a sufficient level to substitute potable water for non-potable uses. E.g. irrigation to open space, laundry, outdoor etc.	No	No	-	No	Insufficient information available. Further investigation to identify flows from each catchment and the infrastructure to deliver where required should be undertaken in the future.	Yes
30	Cloud Seeding	Supply	Other	Supply Deficiency	-	This option considers the use of cloud seeding to increase/enhance rainfall in the region.	No	No	-	No	The technology is variable and results are dependent on environmental factors as such a reliable yield and cost cannot be determined at this stage.	No

Supply Options Assessment Summary

Gate 1 - Options Removed or Deferred

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 1					
							Can the option be costed to ±100%	Can a yield be estimated for the option	Yield/Capacity	GATE 1 PASS	Gate 1 Comment	Gate 1 Defer
31	Fog/Dew collection	Supply	Other	Supply Deficiency	-	This option considers the collection of fog and dew to supplement local water users.	No	No	-	No	The technology is variable and results are dependent on environmental factors as such a reliable yield and cost cannot be determined at this stage.	No
32	A coastal desalination plant	Supply	Other	Supply Deficiency	-	This option considers the use of a coastal desalination plant to supplement Toowoomba's supply.	No	No	-	No	Proximity to a high yield saline resource is limited.	No
33	Aquifer Recharge (recycled water)	Supply	Groundwater	Supply Deficiency	-	This option considers the storage of raw water in aquifers to reduce losses due to evaporation and the capture flows that might otherwise be released during overflow events.	No	No	-	No	Insufficient information available. Further investigation into the logistical, environmental, and operational considerations unique to the Toowoomba Region and its aquifer systems is required before further assessment can be undertaken. Further investigation regarding the water quality implication of mixing sources is required.	Yes
34	Aquifer Recharge (raw water)	Supply	Groundwater	Supply Deficiency	-	This option considers the storage of raw water in aquifers to reduce losses due to evaporation and the capture flows that might otherwise be released during overflow events.	No	No	-	No	Insufficient information available. Further investigation into the logistical, environmental, and operational considerations unique to the Toowoomba Region and its aquifer systems is required before further assessment can be undertaken. Further investigation regarding the water quality implication of mixing sources is required.	Yes
35	Aquifer Recharge (stormwater)	Supply	Groundwater	Supply Deficiency	-	This option considers the storage of raw water in aquifers to reduce losses due to evaporation and the capture flows that might otherwise be released during overflow events.	No	No	-	No	Insufficient information available. Further investigation into the logistical, environmental, and operational considerations unique to the Toowoomba Region and its aquifer systems is required before further assessment can be undertaken. Further investigation regarding the water quality implication of mixing sources is required.	Yes
36	Sewer Mining	Supply	Other	Supply Deficiency	-	This option considers the use of sewer mining to off-set supply within the grid connected network.	No	No	-	No	Insufficient information available. Further investigation of the available yield and integration into the network is required.	Yes
37	Coal seam gas water	Supply	Other	Supply Deficiency	-	This option considers the transfer of water from nearby CSG operations to the Toowoomba water network.	No	No	-	No	This option was included in the Future Water Supply Options for Toowoomba City and Customer Shires Pre-feasibility Study (PB, 2006) and recorded not to proceed on the basis of cost, regulatory and environmental issues.	No
42	Raise the Perseverance dam walls	Supply	Surface Water	Supply Deficiency	-	This option considers the raising of the dam wall to increase storage volume.	Yes	No	-	No	This option has been deferred in this analysis. Further investigation to determine the increase in available yield and costs to raise the wall. Should additional yield be available modification to the existing allocation and licence limits would be required.	Yes
43	Raise the Cressbrook dam walls	Supply	Surface Water	Supply Deficiency	-	This option considers the raising of the dam wall to increase the available supply volume.	Yes	No	-	No	This option has been deferred in this analysis. Further investigation to determine the increase in available yield and costs to raise the wall. Should additional yield be available modification to the existing allocation and licence limits would be required.	Yes
44	Raise the Cooby dam walls	Supply	Surface Water	Supply Deficiency	-	This option considers the raising of the dam wall to increase the available supply volume.	Yes	No	-	No	This option has been deferred in this analysis. Further investigation to determine the increase in available yield and costs to raise the wall. Should additional yield be available modification to the existing allocation and licence limits would be required.	Yes
45	Desilt dams (increase available storage volume)	Supply	Surface Water	Supply Deficiency	-	This option considers desilting the dams to increase available storage volumes.	Yes	No	-	No	This option has been deferred in this analysis. Further investigation of the available yield and costs to desilt are required.	Yes

Supply Options Assessment Summary

Gate 2 - Options Removed or Deferred

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 2				
							Is the option cost effective compared to other options (capital cost)?	Does the option fall outside "logical cost threshold" [stacked graph with levelised cost ($/ML)]	GATE 2 PASS	Gate 2 Comment	Gate 2 Defer
1	Emu Creek Dam	Supply	Surface Water	Supply Deficiency	2026	This option considers the construction of the proposed Emu Creek Dam and associated transfer infrastructure to Cooby Dam. The Emu Creek Dam site is situated to the north of the Cressbrook Dam catchment between Blackbutt and Crows Nest.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or	*Yes*
5	Mole River Dam	Supply	Interstate Pipeline	Supply Deficiency	2026	The Mole River is located approximately 40 km west of Tenterfield in northern New South Wales. In October 2019, the Federal and New South Wales Governments announced $24M to undertake a Final Business Case for building a new dam on the Mole River (WaterNSW 2019).	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective.	*Yes*
6	Nathan Dam	Supply	Surface Water	Supply Deficiency	2026	The proposed Nathan Dam site is situated on the Dawson River, approximately 36 km north east of Taroom.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
7	Oakey Creek Dam	Supply	Surface Water	Supply Deficiency	2026	A potential site for a dam on Oakey Creek is located west of Cooby Dam between Meringandan West and Goombungee. It is located downstream of Cooby Dam and therefore the benefits of this dam site are reduced due to the existing yield available from Cooby.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further	*Yes*
8	Lockyer Creek Dam	Supply	Surface Water	Supply Deficiency	2026	The Department of Natural Resources (1996) identified a potential dam site on Lockyer Creek near the confluence with Alice Creek. The site is approximately 5 km south east of the Murphy's Creek township	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*

Supply Options Assessment Summary

Gate 2 - Options Removed or Deferred

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 2				
							Is the option cost effective compared to other options (capital cost)?	Does the option fall outside "logical cost threshold" [stacked graph with levelised cost ($/ML)]	GATE 2 PASS	Gate 2 Comment	Gate 2 Defer
9	Hodgson's Creek Dam	Supply	Surface Water	Supply Deficiency	2026	The site identified by the Department of Natural Resources (1996) is located south west of Pittsworth and south east of Cambooya, approximately 2 km to the south of Pittsworth Felton Road.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
10	Supply Pipeline from Paradise Dam (Bundaberg Water Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Bundaberg Water Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from Paradise Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
11	Supply Pipeline from Mary River Barrage (Lower Mary River Water Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Lower Mary River Water Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from the Mary River Barrage to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
12	Supply Pipeline from Awoonga Dam (Awoonga Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Awoonga Water Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from the Awoonga Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
13	Supply Pipeline from Borumba Dam (Mary Valley Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Mary Valley Supply Scheme. This option involves the construction of a supply pipeline (incl. pumps) from the Borumba Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
14	Supply Pipeline from Wuruma Dam (Upper Burnett Supply Scheme)	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows significant supply availability in the Upper Burnett Supply Scheme. This option involves the construction of a supply pipeline (gravity driven) from the Wuruma Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*

Supply Options Assessment Summary

Gate 2 - Options Removed or Deferred

Option ID	Option Name	Category	Type	Failure Mode	Year Proposed	Description	GATE 2				
							Is the option cost effective compared to other options (capital cost)?	Does the option fall outside "logical cost threshold" [stacked graph with levelised cost ($/ML)]	GATE 2 PASS	Gate 2 Comment	Gate 2 Defer
16	Interstate Supply Pipeline from Clarence River	Supply	Interstate Pipeline	Supply Deficiency	2026	This option involves the construction of a supply pipeline (gravity driven) from the Clarence River to Cooby Dam. The cost of purchasing an allocation has not been included. It has been assumed that an allocation is available given limited information available	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
17	Interstate Supply Pipeline from Tweed River	Supply	Interstate Pipeline	Supply Deficiency	2026	This option involves the construction of a supply pipeline (gravity driven) from the Tweed River to Cooby Dam. The cost of purchasing an allocation has not been included. It has been assumed that an allocation is available given limited information available	*No*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
18	Supply Pipeline from Wyaralong Dam	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option involves the construction of a pumped supply pipeline from Wyaralong Dam. The cost of purchasing an allocation has not been included. It has been assumed that an allocation is available given limited information available	*No*	*Yes*	*No*	This option has not been considered further as there are other more cost-effective options available for integration with the Seqwater water grid.	*No*
19	Supply Pipeline from Coolmunda Dam	Supply	Intrastate Pipeline	Supply Deficiency	2026	QBWOS shows limited supply availability in Coolmunda Dam, allowing for only a Low Yield Scenario to be considered. This option involves the construction of a supply pipeline (gravity driven) from the Coolmunda Dam to Cooby Dam. The cost of purchasing the allocation from SunWater has not been included.	*Yes*	*Yes*	*No*	The levelized cost is significantly higher in magnitude than the remaining options. Inter-regional transfer options could be demonstrated to have a wider regional benefit. However as currently identified, as a dedicated supply to TRC, they are not cost effective. Cost is prohibitive for TRC to wholly fund. Any further consideration would require funding from State and/or Federal sources.	*Yes*
41	Seqwater Bulk Supply Connection	Supply	Intrastate Pipeline	Supply Deficiency	2026	This option includes the installation of a pipeline between Mt Crosby WTP and the clearwater storage at Mt Kynoch. Costs inlcude a provisional treatment cost for Mt Crosby Water, but does not inlcude any access costs.	*No*	*Yes*	*No*	This option has not been considered further as there are other more cost-effective options available for integration with the Seqwater water grid.	*No*

Toowoomba Water Futures

Investment Strategy Summary - Representative Options

Investment Strategy	Description	TRC Corporate Goal		Score	Comment	Overall Score
DR-1	Dam Replenishment (Cooby WTP + Mt Kynoch WTP)	**People**	**General**	Major community opposition, option is not accepted by the community. Major impact on cultural heritage.	There is a historical negative connotation to this option in Toowoomba, with vocal opposition to recycled water in the region. Further community engagement and education would be required to ensure this option's success.	
		Place	**General**	No influence on criteria	This option requires the construction of a new plant. Consideration of Traditional Owner's and environmental aspects would be required.	
			Catchments and Water Quality	Minor impact on catchment condition.	May have minor negative effects on the receiving source (Cooby Dam), such as increased nutrient levels that could lead to increase risk of algal blooms. Opportunity to improve catchment condition by redirecting wastewater load from the local outfall, however, this could be minimal depending on licence conditions, i.e., load However, overall there will be a minor impact on the Cooby Dam Catchment.	
			Source Water	No change to raw water quality.	Sewage as initial water source, requiring initial treatment through WRF, then further treatment through advanced recycled water plant, with multiple barriers, with robust controls , validation on ongoing monitoring and verification.	
		Sustainability	**General**	• Investigate and implement more effective and efficient processes and systems that focus on energy and operational improvements (produces minimal greenhouse gases). • Implement water sensitive urban design and stormwater management approaches that enhance natural systems and ensure a flood resilient region. • Advance water efficiency and security ensuring total water cycle management and innovation. • Plan, deliver and manage efficient, integrated and sustainable waste and resource recovery services and reduction of emissions from landfill (waste is minimised, or able to be recovered or reused).		
			Environment	Minor environmental risk associated with the option.	This option requires additional treatment processes, including RO, which is currently a energy intensive operation.	
		Prosperity	**General**	• Plan to ensure Toowoomba City is connected to a network of rural towns to make a vibrant region. • Leverage the opportunities inherent in major regional, state and national projects. • Ensure planning and infrastructure supports future economic growth of strong, viable and diverse economic clusters, regional centres and townships.	This option provides a drought resilient source. This would enhance water security to region. Would place Toowoomba as a progressive region.	
			Financial performance	Minor	This option is the median NPV. There is significant capital investment required to 2026, approximately $530-565M.	
			Funding arrangements	<$2M/ML. TRC funding is required.	Funding would expected to be solely from TRC.	
		Performance	**Drought resilience**	Provides a highly reliable drought supply (i.e. climate independent). e.g. manufactured water. Diversity of source water.	RW is a stable supply, however production is dependant on wastewater flows which can reduce during periods of drought.	
			Regulatory	12-24 months approval timeframe	IPR is currently an approved mechanism. A Recycled Water Management Plan, Validation Plan and detailed monitoring will be required. Extensive approvals will be required for a dam replenishment scheme.	
			Reliability	Positive influence on criteria. Diversity of supplies/infrastructure. Reduces single sources of failure. Ability to adapt to climate change, degrading catchment.	RW is a stable source. Production is based on the connected network and by itself would not meet demands.	
			System performance	LOS objectives met or exceeded. All service standards met or exceeded. Low risk of detrimental response to sensitivities (demand, energy price, etc). Resilient to system peaks. Resilient to unplanned events (e.g. floods, bushfires, etc). Adaptable operating strategy. Capable of dealing with higher demands (e.g. additional source water, capacity available). Suitable for longer planning horizons.	Some sensitivity to energy price, however this can be offset if necessary through upgrades to use renewable energy sources (i.e., Solar). However, this is adaptable with growth as feedwater will increase with growth. This option passes all LOS objectives.	
			Implementation/Deliverability	Minor negative influence on criteria	This option would require additional infrastructure to be build with upgrades to existing assets and new assets. A six year program is expected to be reasonable and achievable. There is the ability to improve technology and integrate renewable energy throughout the project.	
		Other	**Compatibility with Warwick Supply**	Possible with further augmentation	The additional volume from the dam replenishment provides sufficient volume to meet the AD supply for Toowoomba and Warwick as the replenishment removes some load from Mt Kynoch WTP and therefore suited to Warwick supply. Additional infrastructure to convey flows south would be needed.	

Toowoomba Water Futures

Investment Strategy Summary - Representative Options

Investment Strategy	Description	TRC Corporate Goal		Score	Comment	Overall Score
WP-1	Wivenhoe - Existing (Mt Kynoch)	**People**	**General**	Aligns with local culture and traditions. Positive community input, option is acceptable to the community. Positive impact on cultural heritage. • Aligns with local culture and traditions (including Traditional Owners). • Build social capital through the provision of accessible community infrastructure and programs (provide a fair water supply for all users (residential, rural). • Implement effective and genuine community consultation processes that enable participation, engagement and collaboration (Provides a solution that is acceptable to the TRC community). • Plan and provide facilities and programs that enable participation in sport and recreation (Creates opportunities for people to connect and belong).	This option represents BAU operation of assets.	
		Place	**General**	No influence on criteria		
			Catchments and Water Quality	No change to catchment condition.	Water quality in Wivenhoe is of similar quality to the receiving dam . Both supplies are Category 4 as defined on the Health based targets methodology	
			Source Water	No change to raw water quality.	No additional treatment would be required based on the additional supply from Wivenhoe	
		Sustainability	**General**	No influence on criteria	The option would require energy intensive pumping from Wivenhoe on a more regular basis.	
			Environment	Minor environmental risk associated with the option.	The current operating plan limits environmental flows when the Wivenhoe pipeline is active (ie Combined Storage is less than 40%). With increased reliance on the pipeline environmental flows would be heavily impacted under the current operating plan. This risk can be mitigated through changes to the existing operational plan.	
		Prosperity	**General**	• Plan to ensure Toowoomba City is connected to a network of rural towns to make a vibrant region. • Leverage the opportunities inherent in major regional, state and national projects. • Ensure planning and infrastructure supports future economic growth of strong, viable and diverse economic clusters, regional centres and townships.	This option represents a BAU for TRC.	
			Financial performance	Low NPV. Low upfront capital. High residual asset life. Complements or reduces existing capital program. Does not require investment that will become sunk costs. Potential reduction in cost due to price/cost sensitivities.	This option is lowest Capital and NPV option. There is minimal capital investment in excess of the Base case.	
			Funding arrangements	<$2M/ML. TRC funding is required.	Funding would expected to be solely from TRC.	
		Performance	**Drought resilience**	Can be used as a drought supply, but not entirely reliable (i.e. climate resilient). e.g. groundwater. Some diversity of source water.	Uses surface waters, which are heavily impacted by drought.	
			Regulatory	12-24 months approval timeframe	Modification to the Cressbrook ROP would be required to facilitate the use of the Wivenhoe pipeline, outside of currently agreed drought conditions. Updates to Quality Management Plans would be required for staged upgrades of WTP . Would require agreements with third parties (Seqwater) as well as DNRME approvals.	
			Reliability	Minor negative influence on criteria	This option does not provide TRC with an alternative supply, with all volume sourced from existing sources.	
			System performance	LOS objectives met or exceeded. All service standards met or exceeded. Low risk of detrimental response to sensitivities (demand, energy price, etc). Resilient to system peaks. Resilient to unplanned events (e.g. floods, bushfires, etc). Adaptable operating strategy. Capable of dealing with higher demands (e.g. additional source water, capacity available). Suitable for longer planning horizons.	This option meets all LOS objectives	
			Implementation/Deliverability	Ability to deliver within timeframes. May improve over time with technology improvements.	This option uses existing assets.	
		Other	**Compatibility with Warwick Supply**	Possible with further augmentation	This option does not have sufficient volume to meet supply to Warwick without further allocation from Seqwater.	