Attachment A

Rous Regional Supply:

Future Water Project 2060

Integrated Water Cycle Management Strategy

Final Draft for public exhibition

March 2021

The Traditional Custodians of current and future water supply catchments are the Widjabal Wi-abal people of the Bundjalung nation. Hydrosphere Consulting and Rous County Council acknowledge the Widjabal Wi-abal people's deep relationship with the land and water and strongly values their traditional laws, knowledge and lessons about places and sustainability.

Rous County Council is committed to the reconciliation process. For Rous County Council, reconciliation means recognising the importance of working with the Traditional Custodians of current and future catchment and natural resource areas managed by Rous County Council.

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20-017: ROUS FUTURE WATER PROJECT 2060

REV	DESCRIPTION	AUTHORS	REVIEW	APPROVAL	DATE
0	Draft for RCC review	R. Campbell, K. Menzies	M. Howland	M. Howland	1 June 2020
1	Minor edits	R. Campbell		R. Campbell	5 June 2020
2	Public exhibition	R. Campbell		R. Campbell	9 June 2020
3	Draft following public exhibition – preferred scenario and implementation plan	R. Campbell, K. Menzies	M. Howland	M. Howland	4 Feb 2021
4	Final draft	R. Campbell, K. Menzies	M. Howland	M. Howland	25 Feb 2021
5	Minor edits	R. Campbell	M. Howland	M. Howland	1 Mar 2021
6	Revised cost estimates	R. Campbell	M. Howland	M. Howland	10 Mar 2021

EXECUTIVE SUMMARY

Introduction

The Rous Future Water Project 2060 identifies new water supply sources to ensure long-term water supply security for the region. This project builds on extensive investigations undertaken by Rous County Council (RCC) over the last few decades to identify potential source augmentation options and enable selection of a preferred long-term strategy. This report documents the outcomes of detailed investigations undertaken regarding potential source augmentation options and implementation scenarios. The scenarios have been compared using a multi-criteria analysis (MCA) considering environmental, social and financial outcomes. Following consultation on the potential options and scenarios in 2020, and a resolution of Rous County Council [61/20], the Future Water Project 2060 has been developed to include a diversified portfolio of actions to meet the region's water security needs.

The dry year demand for water at 2060 is predicted to be between 16,000 ML/a and 16,700 ML/a, an increase of approximately 5,000 ML/a over current (2020) dry year demand. The water supply demand has been compared to the secure yield of the system (13,350 ML/a) which has shown that a new water source will be required from 2024. Without action, the yield deficit is predicted to be 5,619 ML/a at 2060.

A secure water supply is critical to ensure the regional community's health and quality of life as well as a sustainable environment and continued economic prosperity. RCC has a duty to ensure that there is enough water available to meet the long-term needs of the Ballina Shire, Byron Shire, Lismore City and Richmond Valley Councils and their communities.

Water Supply Options and Scenarios

A coarse screening assessment considered a range of new as well as previously identified supply options. The following options passed the coarse assessment and are discussed in detail in this report:

1. Dunoon dam (20 GL – 50 GL).
2. Connection to Marom Creek WTP (upgraded) with or without local groundwater supplies.
3. Groundwater harvesting – Woodburn, Tyagarah, Newrybar and Alstonville.
4. Desalination.
5. Indirect potable reuse (treated wastewater from constituent council wastewater treatment plants transferred to RCC surface water supplies).

Despite the risks and data gaps identified in this report, Option 1 (Dunoon dam) and Option 3 (groundwater) are considered to be feasible and are included as the primary water source in the source augmentation scenarios considered in this report. There is currently detailed information available on these options to enable a robust comparison of source augmentation scenarios. Option 2 - Connection to the Marom Creek water supply has a low initial cost with minimal planning and development required. The WTP is an existing asset and this option is considered to be worth pursuing to meet the short-term demand deficit.

Option 4 (desalination) and Option 5 (IPR) are not as attractive due to operational constraints and expected stakeholder opposition. Hence, desalination and IPR are not considered to be viable primary components of the source augmentation scenarios. However, RCC will continue to investigate these options as more data becomes available.

This report compares two potential source augmentation scenarios to provide water security to 2060:

- Scenario 1 – Groundwater (with Marom Creek). Scenario 1 includes the connection of Marom Creek WTP to the regional supply in the short term with staged implementation of groundwater schemes and treatment plants until the required supply yield is achieved.
- Scenario 2 – Dunoon dam. Scenario 2 includes the connection of Marom Creek WTP to the regional supply in the short term with construction of a new dam at Dunoon. Scenario 2A considers a 20 GL dam designed to allow for future augmentation to 50 GL (expected to be required at approximately 2080). Scenario 2B considers a 50 GL dam. Both scenarios include initial implementation of the Marom Creek and Alstonville groundwater options. The Dunoon dam scenarios include the upgrade of Nightcap WTP in 2034 from 70 ML/d to 100 ML/d.

The scenarios have been compared considering environmental, social and financial outcomes. Based on the MCA, the most favourable scenario is groundwater.

Consultation

RCC undertook public exhibition and sought comment through an online survey and written submissions to gauge feedback on the water supply scenarios. The key themes in the feedback received are:

- The majority of respondents agree that it is important to act now to secure the long-term water supply for the region.
- There was a high level of objection to Dunoon dam based on concerns about environmental and cultural heritage impacts.
- The majority of respondents prefer water security achieved through:
    - Rainwater tanks and greater self-sufficiency, along with capture and re-use of stormwater.
    - Enhanced demand management.
    - Permanent water restrictions.
    - Water recycling, including IPR.
    - Addressing leaks and losses within the reticulation system.
- There was majority support expressed for the extraction, treatment and use of groundwater, provided this is sustainable and creates no unacceptable environmental impacts.
- The majority of respondents expressed support for the conservation of potable water (e.g. not watering gardens or washing cars with potable water), with alternatives made available for non-potable purposes.
- A smaller number of respondents recommended desalination as an option, particularly for coastal areas.

Strategy Components

In response to the community feedback and key considerations for the regional water supply, the Future Water Project 2060 will include a diversified portfolio of actions to meet the region's water security needs:

- Immediate actions: to increase the system secure yield from 2024.
- Ongoing actions: business as usual actions including reducing potable water demand, improving knowledge of future demand and secure yield and drought management planning.
- Innovative actions: to investigate the increased use of recycled water.

- Long-term actions to confirm and develop the most appropriate long-term water supply scheme components to be implemented.

The implementation of the preferred scenario for augmentation of water supply sources will be undertaken in stages which have been selected based on the benefits, costs, lead time, impact on drought contingency sources and expected success of each option in contributing to a secure water supply for the region. Stage 1 of the preferred scenario includes Marom Creek WTP treating groundwater from Alstonville in addition to existing surface water supplies from Marom Creek weir. Stage 2 of the preferred scenario will include the implementation of the Tyagarah groundwater source as a primary supply and maintaining Woodburn groundwater as a dry period supply.

Stages 1 and 2 of the Future Water Project 2060 are shown on Figure 1. The yield increase for each stage of the preferred augmentation scenario to 2040 is shown on Figure 2. The development of water sources and treatment facilities is shown schematically on Figure 3. Source augmentation options beyond Stage 2 will require further investigation but may include additional groundwater schemes, desalination or water recycling.

The Future Water Project 2060 will also include:

- Ongoing implementation of the *Regional Demand Management Plan 2019-2022* and regular review and update of the plan.
- Water loss management focused on RCC assets.
- Smart metering focused on RCC retail customers and a regional approach where feasible.
- Ongoing review and update of drought management requirements.
- Development and implementation of a direct potable reuse pilot scheme.
- Additional investigations into the feasibility of indirect potable reuse as part of the regional water supply.
- Ongoing investigations into the preferred long-term source augmentation strategy.
- Stakeholder engagement through a number of methods.

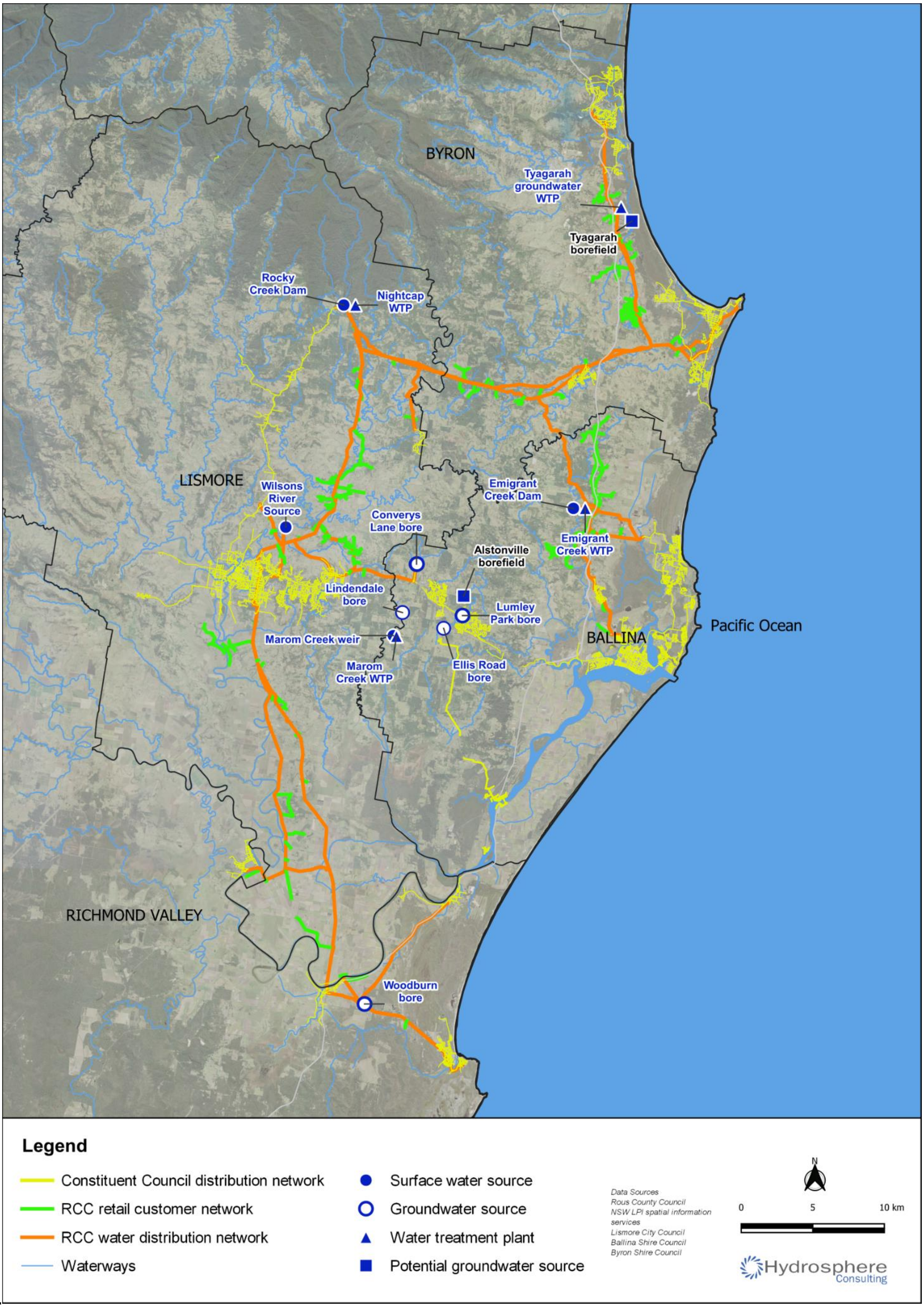

Figure 1: Preferred scenario: Marom Creek, Stage 1 and 2 groundwater

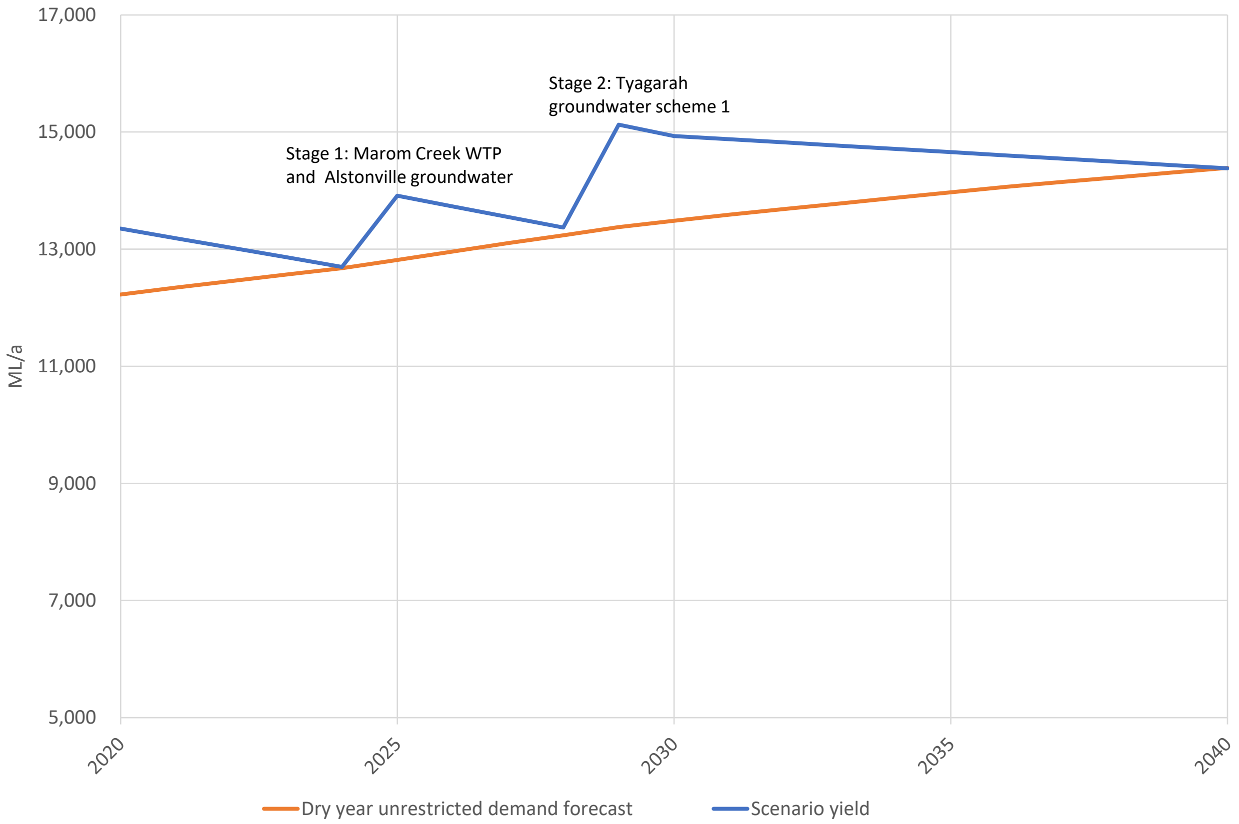

Figure 2: Preferred scenario: staging and secure yield

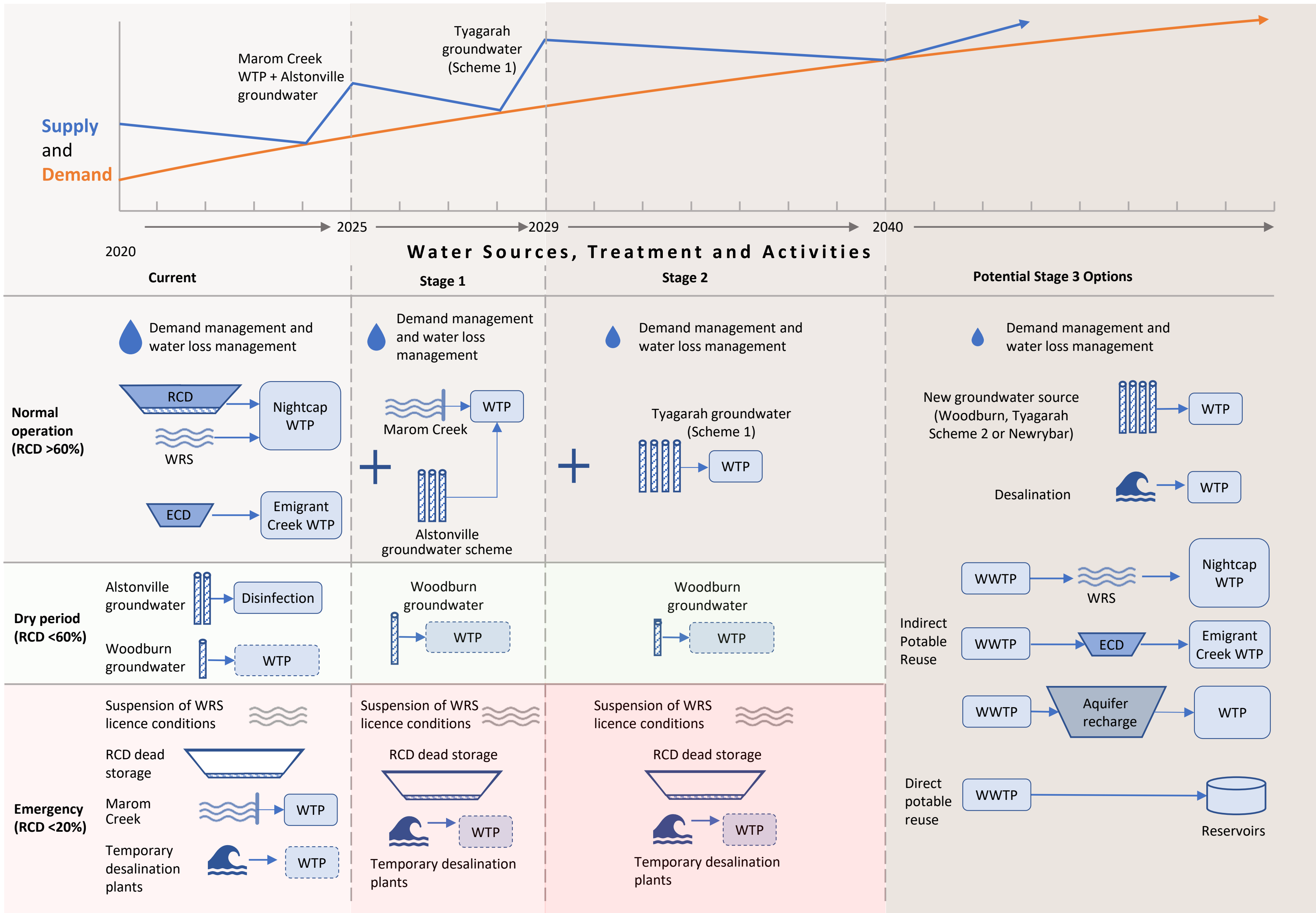

Figure 3: Staging of water source augmentation

Strategy Implementation

The delivery of the preferred scenario is shown in Table 1 and illustrated schematically on Figure 4. The delivery of the Future Water Project 2060 over the next ten years is expected to cost $154 million. The Future Water Project 2060 will be reviewed annually and updated every four years.

Implementation risks have been identified in this report for the adopted Stage 1 and 2 water source options. RCC will continue to conduct detailed investigations for the preferred scenario and address these risks. Although definitive action is required in the short-term, adaptive management approaches have also been identified in this report. RCC will consider alternative approaches if any components of the preferred scenario become infeasible.

Table 1: Future Water Project 2060 implementation (2022 – 2031)

			Stage 1				**Stage 2**				**Stage 3**	
Delivery Program year			**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 1**	**Year 2**
Stage	**Task/ year**		**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Stage 1	Marom Creek											
	Alstonville groundwater											
	Woodburn groundwater	New bores										
		Existing bore 3 + WTP										
Stage 2	Tyagarah groundwater											
Stage 2 & 3	Groundwater source land acquisition											
Stage 3	IPR investigations											
	Stage 3 source planning											
	DPR pilot scheme											
-	Dunoon dam land disposal											
Ongoing	RCC Demand management planning											
Ongoing	Water loss management											
Ongoing	Smart metering											
Ongoing	Stakeholder engagement											
Ongoing	Drought management planning											
Ongoing	Demand forecasting (incl. data acquisition)											
Ongoing	Secure yield assessment											
Ongoing	IWCM Strategy review											

Source planning, design and approvals	Construction	Demand management	Strategic planning	Verification	Operation

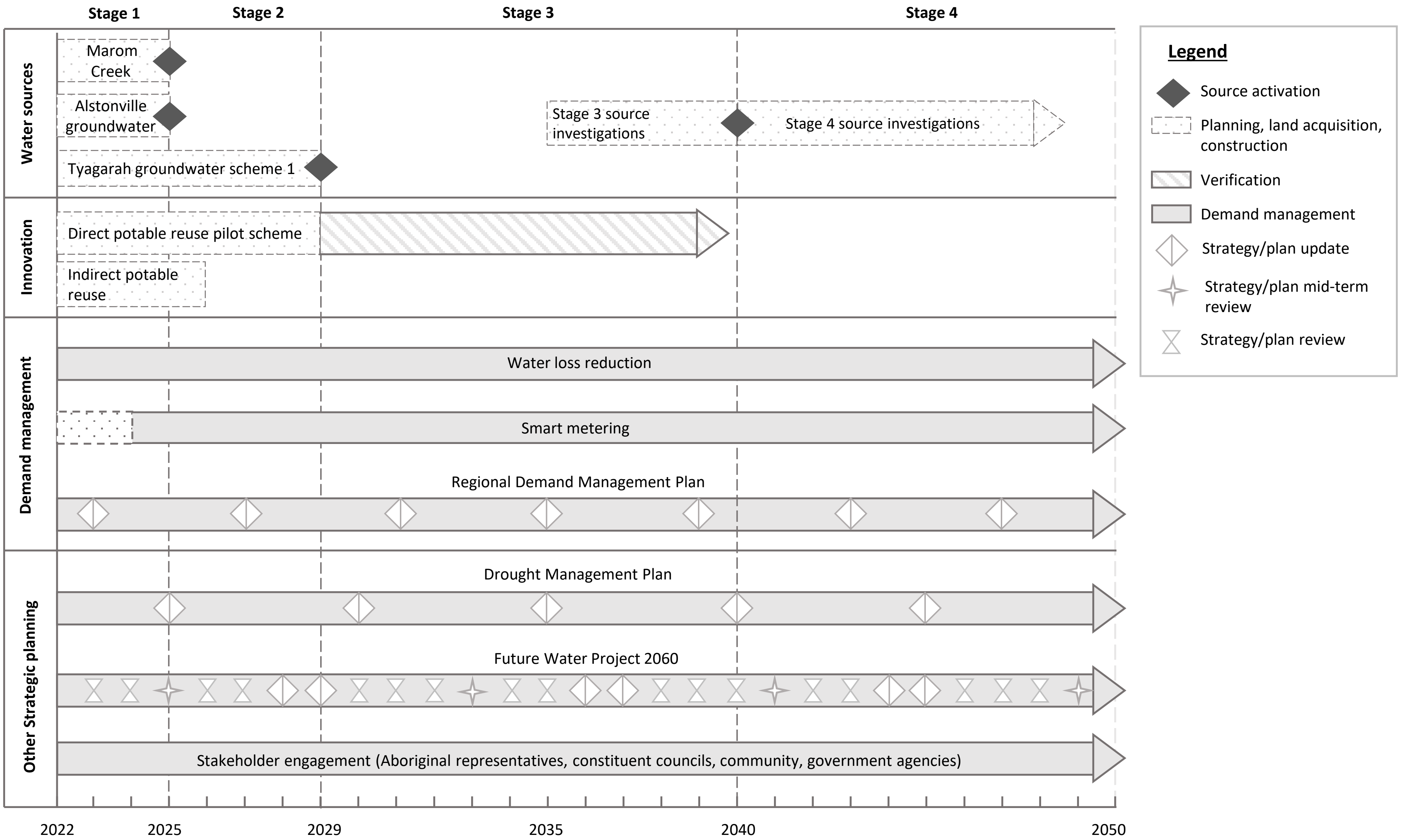

Figure 4: Future Water Project implementation planning

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FIGURES

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1. INTRODUCTION

Rous County Council (RCC) provides bulk water to four local water utilities (LWUs) on the far north coast of NSW, servicing the urban areas of the following constituent council local government areas (LGA):

- Ballina Shire Council (BaSC), excluding Wardell and surrounds.
- Byron Shire Council (BySC), excluding Mullumbimby.
- Lismore City Council (LCC), excluding Nimbin.
- Richmond Valley Council (RVC), excluding Casino and all land west of Coraki.

RCC also provides water supply services to rural and urban connections direct from the bulk supply trunk main system (retail customers).

The Rous Future Water Project 2060 identifies new water supply sources to ensure long-term water supply security for the region. This project builds on extensive investigations undertaken by RCC over the last few decades to identify potential source augmentation options and enable selection of a preferred long-term strategy. This report documents the outcomes of detailed investigations undertaken regarding potential source augmentation options and implementation scenarios. The scenarios have been compared using a multi-criteria analysis considering environmental, social and financial outcomes. Following consultation on the potential options and scenarios, the Future Water Project 2060 has been developed to include a diversified portfolio of actions to meet the region's water security needs.

The NSW Government encourages best-practice management by water utilities throughout regional NSW, which includes Integrated Water Cycle Management (IWCM) planning. The NSW Government has supported this planning work with co-funding provided through the Safe and Secure Water Program. The development of the Future Water Project 2060 has followed the IWCM process of options and scenario development and assessment, consultation and strategy development. The Future Water Project 2060 is RCC's IWCM Strategy.

2. BACKGROUND

2.1 History of Strategy Development

In 1995 RCC adopted the following long-term water supply strategy after investigation of a range of options and consultation with stakeholders:

1. Implementation of demand management strategies to promote efficient water use among consumers (implemented through the Regional Demand Management Plan).
2. Promotion of alternative water supply initiatives, such as dual reticulation of recycled water in new urban developments (implemented through the Regional Demand Management Plan).
3. Development of the Wilsons River Source (WRS), drawing freshwater from the upper limits of the Wilsons River tidal pool, upstream of Lismore.
4. Nomination of the proposed Dunoon dam, to be developed if and when required to maintain water supply security following the implementation of the other options.

Detailed investigations into options for Dunoon dam, a concept design, environmental and cultural heritage assessments commenced in 2008 and were completed in 2013 (refer Section 8). Public consultation undertaken at the time indicated that the community’s preference was for RCC to consider the future water supply issues more broadly before proceeding with Dunoon dam. As a result, RCC commenced work on the Future Water Strategy (FWS). The available information at that time indicated that existing water supplies would be sufficient to meet annual demand until 2024 and by 2060 there would be a likely secure yield shortfall of approximately 6,500 ML/a (considering climate change). The background information and the decision-making process for the development of the FWS were captured in the integrated water planning (IWP) process (MWH, 2014). The integrated planning approach involved (MWH, 2014):

- Identification of future water management issues over a long-term planning horizon.
- Development of strategy assessment triple-bottom-line objectives and criteria in response to the water management issues.
- Assessment of options and scenario development in order to address the water management issues.
- A participatory approach with stakeholder feedback.
- Recognition of future uncertainties and implementation risks, requiring ongoing monitoring and review.

The FWS was adopted in 2014 with three key actions – demand management, increased use of groundwater and potentially water re-use. Since the adoption of the FWS, RCC has undertaken extensive investigations into groundwater as an additional source. These studies included extensive reviews and consultation with stakeholders to identify appropriate groundwater investigation areas as well as conducting groundwater drilling programs (refer Section 10). These studies found that groundwater sources investigated in Newrybar (coastal sands), Woodburn (coastal sands) and Dunoon (fractured rock aquifers) will require higher cost than previously estimated, additional treatment and may not be as reliable as assumed in the FWS IWP process. In addition, the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources* excludes additional aquifer access licences in the Alstonville Basalt Plateau groundwater source as the long-term average annual extraction limit is less than existing water requirements.

2.2 Specialist Studies

As part of the Rous Future Water Project 2060, specialist studies have been undertaken to further investigate the following source augmentation options:

- Groundwater supplies.
- Indirect potable reuse.
- Desalination.
- Dunoon dam.

The findings of these studies are documented in this report. A revised demand forecast (Section 5) and assessment of secure yield of the above options (Section 6) were also undertaken.

2.3 Regional Investigations

2.3.1 Northern Rivers Regional Bulk Water Supply Study (2013)

In 2013, the Northern Rivers Regional Organisation of Councils (NOROC, now the Northern Region Joint Organisation) developed a long-term (50-year) regional water supply strategy in order to evaluate the potential benefits to future water supply security resulting from a regionally integrated system. The study (Hydrosphere Consulting, 2013b) investigated numerous interconnection and supply scenarios to identify options that warrant further investigation in future stages of the strategy development. To progress the development of a regional water supply strategy, the study recommended various investigations including:

- Regional investigations that are specific to the regional approach and would require cooperation between the Local Water Utilities (LWUs, RCC; Tweed Shire Council, TSC; Kyogle Council, KC; BaSC, BySC, LCC and RVC).
- Strategic planning including yield studies, monitoring, water loss management and demand management.

The 2013 study found that major additional water supplies will be required to meet the growth in demand within the RCC bulk supply area and the TSC Bray Park system and actions to address the yield deficit in these systems have not yet been finalised. TSC is pursuing investigations relating to the raising of Clarrie Hall Dam and the drought security connection to South-east Queensland (SEQ) water link. RCC's priority from the FWS was the investigation of groundwater supplies and more recently, the potential for indirect potable reuse or the Marom Creek (Wardell) water supply to partially meet water supply needs within the bulk supply area (refer Section 9).

The 2013 study concluded that a regional approach may provide improved financial outcomes through economies of scale as well as access to a wider range of options to improve efficiency, system resilience and operational flexibility. The interconnection of RCC and TSC systems is considered to be a major component of a true regional approach. The potential non-regional supply options (raising Clarrie Hall Dam, SEQ link and groundwater supplies) have not yet been developed to a point where the future TSC and RCC supplies can be considered secure. TSC has confirmed that its current priority is the investigations for the raising of Clarrie Hall Dam and an emergency connection to SEQ water grid, with the resulting augmented supply expected to be sufficient to 2046. A review of the action plan (Hydrosphere Consulting, 2018a) found that the recommendations of the 2013 study in relation to interconnection of the RCC and TSC systems were still considered to be appropriate, even if they are not implemented in the short-medium term.

2.3.2 Toonumbar Dam

Local councils have been in discussions with Water NSW during 2019 about the potential to access additional releases from Toonumbar Dam. Utilisation of water from Toonumbar Dam is generally low as existing licence holders do not fully exhaust their entitlements as unregulated surface water and groundwater sources are also available and these are preferred by the major water users due to lower water usage charges. Licence holders use from 55 to 950 ML/a from Toonumbar Dam (Hydrosphere Consulting, 2020b). Anecdotal evidence suggests that surface water licences are currently used as a drought security measure. During summer 2019/20, the level in Toonumbar Dam was very low which is attributed to increased use of Toonumbar Dam licences and low inflows.

Toonumbar Dam has 3,000 ML/a of available general security supply which is predicted to be equivalent to 1,250 ML/a of high security town supply (Hydrosphere Consulting, 2020b). However, it is not possible to convert existing water entitlements to town water supply licences under the existing Water Sharing Plan for the Richmond River. The Water Sharing Plan is due for review and update by June 2022.

WaterNSW is currently undertaking modelling to confirm the available capacity for allocation of additional extraction licences as part of the 20-year infrastructure options study and the NSW Government may consider options involving increased use of Toonumbar Dam for town water supply as part of that study. Options involving raising of Toonumbar Dam and increased access to water for town water supply needs are potentially viable source augmentation options for the RCC regional supply although there is insufficient information available at present to pursue these options (refer Section 7).

2.3.3 Far North Coast Regional Water Strategy

A long-term Regional Water Strategy is being developed to guide how the NSW Government can best manage the challenges that are facing the Far North Coast region. The Department of Planning, Industry and Environment (DPIE) is identifying actions that can address these challenges to support a liveable and prosperous Far North Coast region. The draft strategy (NSW Government, 2020) presents a long list of potential options to maintain and diversify water supplies, protect and enhance natural systems, support water use and deliver efficiency and conservation, strengthen community preparedness for climate extremes and improve the recognition of Aboriginal people’s water rights, interests and access to water. The list of options draws on previous studies (including the *Northern Rivers Regional Bulk Water Supply Study* and investigations undertaken by RCC) and consultation activities and includes the options considered by RCC to augment the regional town water supply as part of the FWS and Future Water Project 2060. Following public exhibition of the draft strategy in late 2020, the Department of Planning, Industry and Environment (DPIE) will screen and assess the feasibility of each option and develop a final strategy.

3. EXISTING REGIONAL WATER SUPPLY

The RCC bulk and retail water supply transfer network is shown on Figure 5. The supply network extends from Ocean Shores in the north and Byron Bay in the east, west to Lismore and south to Evans Head. Surface waters are the primary water resource utilised by RCC although there are also some groundwater sources available for use during dry periods (Table 2). The principal component of the RCC bulk supply is Rocky Creek Dam (RCD) situated 25 km north of Lismore near the village of Dunoon. Water from RCD is treated at the Nightcap Water Treatment Plant (WTP) and is distributed through three trunk mains owned and operated by RCC. One trunk main supplies treated water to Lismore and to the Richmond Valley area. The other two mains supply Byron Bay and Ballina Shires. Water from the WRS upstream of Lismore is pumped directly from the Wilsons River to the Nightcap WTP for filtration and distribution to consumers. Water from Emigrant Creek Dam (ECD) is treated at the Emigrant Creek WTP and is distributed to supplement supplies to Ballina and Lennox Head.

Table 2: RCC water sources

Details	**Rocky Creek Dam**	**Emigrant Creek Dam**	**Wilsons River Source**	**Converys Lane bore**	**Lumley Park bore**	**Woodburn bores[1]**
Water Source[2]	Terania Creek	Alstonville Area	Wyrallah Area (Wilsons River)	Bangalow Groundwater	Alstonville Groundwater	Richmond Coastal Sands
Source Type	Large in-stream storage	Large in-stream storage	Run-of-river abstraction	Groundwater extraction	Groundwater extraction	Groundwater extraction
Storage capacity	14,000 ML	820 ML	-	-	-	-
Area served	Lismore City, Richmond Valley, Ballina and Byron Shires	Ballina and Lennox Head	Lismore City, Richmond Valley, Ballina and Byron Shires	Alstonville, Wollongbar (dry periods)	Alstonville, Wollongbar (dry periods)	Woodburn, Evans Head, Broadwater (dry periods)
Water Treatment	Nightcap WTP (68 ML/d)	Emigrant Creek WTP (7.5 ML/d)	Nightcap WTP	Chlorination	Chlorination	-
Licence entitlement	12,358 ML/a[3]	2,620 ML/a[3]	5,400 ML/a[3]	150 ML/a[4]	530 ML/a[4]	242 ML/a[5]

1. Some Woodburn bores were compromised by the construction of the Pacific Highway. Bore 3 is available as a drought source but would require a package WTP and pump to make it operational.
2. As specified in the relevant Water Sharing Plan.
3. Water Sharing Plan for the Richmond River Area Unregulated, Regulated and Alluvial Water Sources (2010).
4. Water Sharing Plan for the Alstonville Plateau Groundwater Sources (2003).
5. Not subject to a Water Sharing Plan.

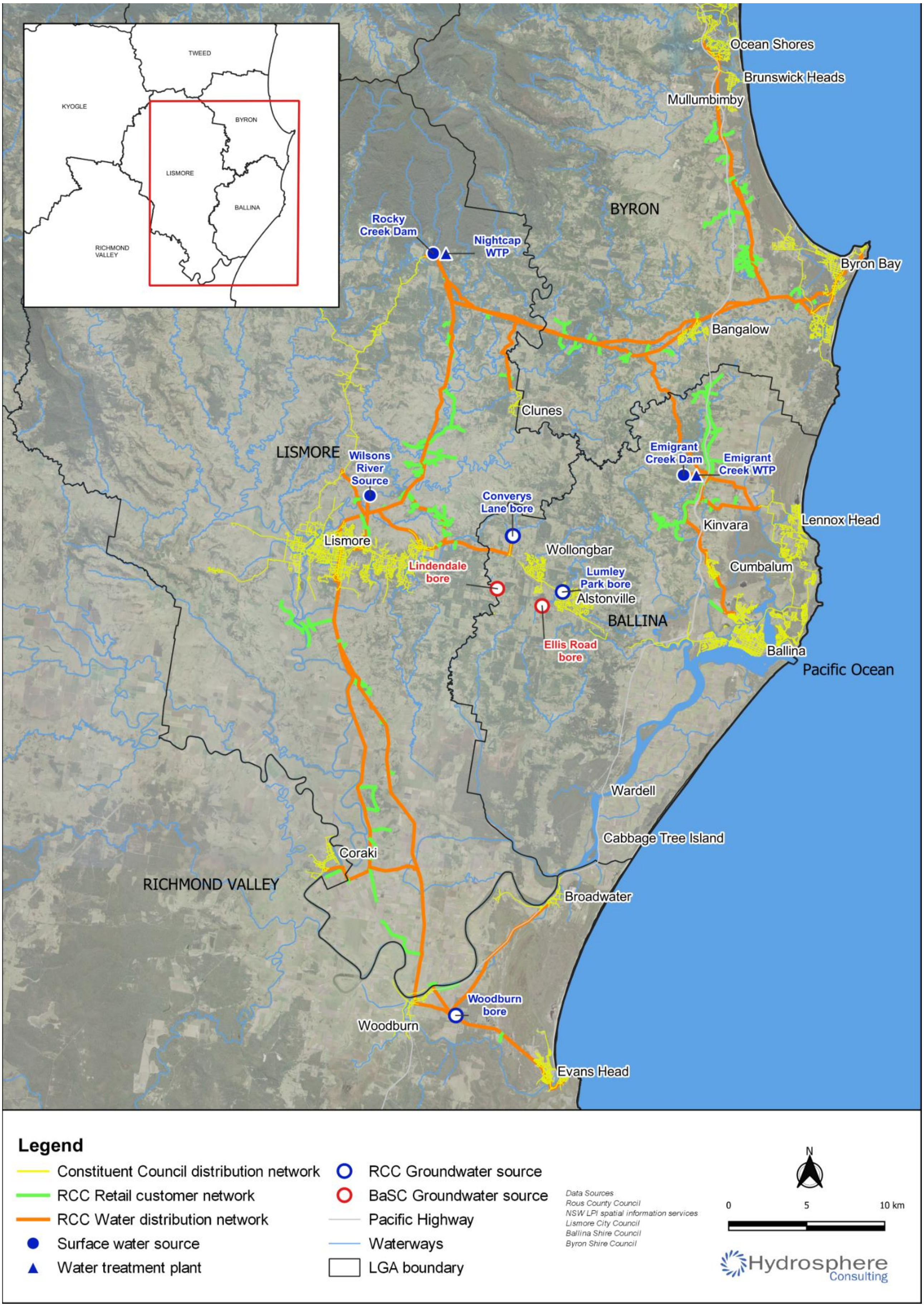

Figure 5: Regional bulk supply network

Table 3 summarises the current operating rules for the regional supply which are based on RCD storage levels. Woodburn bore 3 is not currently operational and would require a pump and package WTP installed as a temporary measure if required during dry periods. The groundwater from Lumley Park and Converys Lane bores can be disinfected and pumped into Wollongbar reservoir however additional treatment will be required to mitigate identified water quality risks. The Convery's Lane bore is at the end of its useful asset life and is planned to be replaced in the vicinity with a new and deeper bore. The Alstonville Plateau bores at Lindendale (200 ML/a allocation) and Ellis Road (350 ML/a) are owned by BaSC and have been decommissioned but may provide additional supply for 30 days with existing entitlements. The works required to recommission these bores are documented in a report to BaSC (CWT, 2018).

Table 3: Bulk water supply operating rules

RCD supply level (% of full supply volume)	Status	Source usage
100%	Normal operation	RCD only
95%	Normal operation	Start WRS and ECD
60%	Dry period operation	Start Woodburn bore 3, Lumley Park and Converys Lane bores
30%	Dry period operation	Start BaSC's plateau bores (Lindendale and Ellis Road)
20%	Emergency operation	Start emergency supply source
15%	Emergency operation	Start emergency supply source
10%	Emergency operation	Start emergency supply source

Extreme drought conditions are rare, but history has shown that circumstances can change quickly and rainfall can vary substantially. The most severe drought occurred from mid-2002 to May 2003, where storage levels dropped to 25% in RCD and restrictions were ramped up to Level 5 over a number of months. Restrictions were in place for a total of 206 days (approximately 10 months). A drought also occurred in 2007 when storage level dropped below 60% and Level 1 restrictions were introduced for 156 days. During the 2019/20 drought, the RCD level fell to a minimum of 61% of full supply volume in mid-January 2020 and RCC introduced Level 1 restrictions due to the low inflows into RCD and to reflect the restrictions imposed in other parts of the region.

In the past, restrictions have been effective in slowing the rate at which water storage levels drop, allowing more time to implement alternative supply options as required. The *Regional Water Supply Drought Management Plan* (Hydrosphere Consulting, 2016) was adopted in 2016 to provide a regional restriction regime that applies to all customers served by the RCC regional water supply. Water restrictions are applied if storage levels in RCD fall to reduce demand and prolong the supply.

The drought restriction regime consists of four colour-coded restriction commencing when RCD reaches 60% (dry period operation) as shown in Table 4. Each restriction level has an associated target demand and water saving measures for residential and non-residential potable water use.

Table 4: Regional water restriction levels and target reduction in demand

Restrictions	Everyday water saving measures	Level 1: Moderate	Level 2: High	Level 3: Very High	Level 4: Severe	Emergency
Trigger to introduce restrictions	-	RCD = 60%	RCD = 45%	RCD = 30%	RCD = 20%	RCD = 10%
Target reduction in demand	0%	5%	15%	25%	35%	45%

Leading up to the introduction of restrictions and during their implementation, restrictions will be actively supported by an Operational Readiness Plan which includes:

- Routine actions – undertaken on a regular basis depending on the restriction level including:
    - Assessing the risk of future water restrictions.
    - Ensuring preparation and approval of communication tools.
    - Considering any required changes to water supply management.
- Drought actions – undertaken when water restrictions are introduced.

During drought conditions, the existing water sources will diminish according to the net demand at a particular restriction level. As a drought progresses, it may be necessary to consider potential alternative supplies to supplement existing sources. If level 4 restrictions are implemented, RCC will prepare for activation of an emergency source which would be activated at level 5 (emergency). RCC has a number of water source options that can be implemented with relatively short lead times to slow the rate at which RCD levels drop and allow more time to implement alternative supply options if required. Once RCD levels reach 20%, emergency supply options may be required if drought conditions continue. Potential emergency supply options include:

- Increased extraction from the WRS outside of the current licence. It is expected that there is about 17,000 ML of water contained in the tidal pool, which could be pumped to Nightcap WTP using the existing infrastructure if the licence conditions were temporarily suspended (Hydrosphere Consulting, 2016). This could meet demand for an additional 920 days (2.5 years) at emergency level restricted (target) demand. One key risk factor of this option is that during drought conditions the salt water/fresh water interface moves upstream in the Wilsons River, which could compromise fresh water supply. Experience in the 2002/03 drought showed that this movement occurred slowly and did not compromise this emergency source. Prolonged drought and use of the source may result in the interface moving to the intake point.
- Increased extraction from Marom Creek weir with treated water from Marom Creek WTP delivered to Wollongbar reservoir for supply to a defined area of Wollongbar/Alstonville. This is also considered as a primary source augmentation option (refer Section 9).
- Temporary desalination plants. Use of portable desalination units is one way of diversifying supply sources and reducing the risk of running out of water in an extreme drought. The units would be removed when no longer required. Desalination options are discussed further in Section 11.

Each option also requires individual lead-in times and activation tasks (Table 5). There is the potential to install additional groundwater bores as emergency sources (refer Section 10) but there is expected to be a significant lead time to construct and commission new bores.

Table 5: Activation requirements for potential emergency sources

Potential emergency source	Activation requirements	Timing
WRS increased extraction	• Seek approval from Natural Resources Access Regulator (NRAR) to operate outside normal licensing rules.	Unknown
Marom Creek weir	• Seek approval from NRAR to operate outside normal licensing rules. Preliminary investigations have been undertaken (refer Section 9).	2 weeks
Temporary desalination plants	• Confirm location and availability of plant. Preliminary investigations have been undertaken (refer Section 10.10).	3 months

Source: Hydrosphere Consulting (2016)

While these options provide a necessary safeguard in the event of a drought emergency, they do not provide a viable solution for securing Council's bulk water supply over the long term.

4. DEMAND MANAGEMENT

Demand management led by RCC has been an integral part of planning and management of water supply assets and ongoing supply management in the region since 1995 and these initiatives have been successful in reducing water demand. The demand per connection has decreased with these water conservation measures as well as pay-for-use pricing and water restrictions. In recent times, the rate of reduction in per connection consumption has reduced as the level of water conservation in the community already achieved means that there is less opportunity for further reduction in consumption. Although further reduction in per connection demand is likely to be more difficult to achieve in the future, RCC and its constituent councils are committed to responsible water use and ongoing reduction in demand.

The *Regional Demand Management Plan 2019 – 2022* (RDMP, Hydrosphere Consulting, 2018b) describes the water supply demand management initiatives to be implemented by RCC and its constituent councils over the four-year period. Enhanced demand management initiatives presented in the FWS were reviewed during the development of the RDMP to build on the successes of previous demand management initiatives and continue to deliver comprehensive and effective water conservation programs throughout the region (Table 6).

Table 6: Demand management strategies considered in the RDMP 2019 - 2022

Demand management strategy	**Comments**	**Adopted strategies for RDMP 2019 – 2022**
Residential initiatives		
Rebates – rainwater tanks	Not considered cost effective in the FWS but the program has broad community support.	The rainwater tank rebate program will continue in current form with active promotion.
Rebates – recycled water	Program has been reviewed with consideration of recycled water scheme development.	Enhanced promotion of rebates where recycled water is available.
Rebates – showerheads	Rebates have been offered since 1996. Water efficient showerheads are now readily available and the opportunity to replace inefficient showerheads is reduced.	No additional action required in this RDMP.
Water Efficiency Labelling Scheme (WELS), Building Sustainability Index (BASIX)	Programs are mandated by the NSW Government.	No additional action required in this RDMP.
Permanent low-level restrictions	Not considered feasible with current legislation.	Increased promotion of voluntary measures (Voluntary Permanent Water Savings) is included in this RDMP.
Non-residential initiatives		
Enhanced Blue and Green Business Program	The effectiveness of program has been reviewed and modifications have been developed.	Sustainable Water Partner Program targeting high water users with water efficiency plans, rebates, recognition program and increased engagement.

Demand management strategy	Comments	Adopted strategies for RDMP 2019 – 2022
Open space water efficiency	June 2016 study found low level of usage and low number of customers in the region.	Not included in this RDMP.
Constituent council initiatives		
Water loss reduction	Strategic and regional approach to water loss management is critical to the success of the RDMP.	The RDMP actions will improve accuracy and understanding of water loss components and target leakage reduction.
LWU (constituent council) demand management plans	Not required as each council will implement actions from this RDMP.	Not included in this RDMP.
Community engagement and education		
Community engagement and education - schools	Programs have been successful but need to be matched to available resources.	This RDMP includes an overarching program of education to be delivered through schools.
Community engagement and education - households	Actions are required to increase understanding of household water consumption.	Actions aim to provide increased awareness of consumption patterns and potential for water savings for all households and will also target residential customers with high consumption.
Other initiatives		
Smart metering	The status of current initiatives across the region and available technologies have been reviewed. Ongoing review of available technologies is required.	Smart metering program to be developed and optimised in this RDMP as this is a potentially highly effective technology to identify leaks and high consumption.

Source: Hydrosphere Consulting (2018b)

The actions adopted as part of the RDMP align with current demand management trends, community desires for water conservation and best practice management to achieve a range of demand management objectives. The RDMP actions and key performance indicators (KPIs) are summarised in Table 7.

The ongoing monitoring and evaluation of RDMP actions will continue to inform the direction for demand management in the region. The RDMP actions are designed to be flexible to adapt to changing circumstances such as demand patterns, community behaviour, technological advances and the availability of alternative water supplies as well as increased knowledge of demand management indicators and trends.

While the implementation of demand management measures has delivered significant reduction in water use, further reductions are becoming more difficult to achieve (due to demand hardening). The RDMP includes the following components to address this:

- Increased communication, promotion and customer engagement to increase uptake of the programs.
- Improved implementation and reporting processes to support the available resources for delivery of the actions.
- A stronger regional focus to achieve improved implementation and commitment to the actions.

Table 7: RDMP actions

Action	Target Groups	Objectives	Key Indicators of Success	Key Performance Indicators (KPIs)
Action 1: Monitoring, evaluation and reporting	RCC and constituent councils	• Ensure timely, accurate and consistent reporting to assist with ongoing RDMP development and evaluation. • Ensure consistency with existing reporting requirements and avoid duplication or additional reporting. • Ongoing information on consumption reported to consumers.	Ongoing reporting of action implementation and success	-
Action 2: Water loss management	RCC and constituent councils	• Accurately quantify the amount of losses on a quarterly basis. • Detect and repair leaks. • Reduce losses to sustainable levels.	Non-revenue water (NRW) - region	12% of water supplied 1,620 ML/a
			NRW - local supplies	Local targets to be developed
			Leaks repaired	90% within 4 hours of identification
Action 3: Sustainable Water Partner Program	Businesses and community groups with high consumption (>5 ML/a)	• Assist businesses and community groups to improve water efficiency and reduce water/sewer bills.	Water savings realised through the Sustainable Water Partner Program (SWPP)	5 ML/a from year 2 (2019/20 onwards)
Action 4: Smart metering	All customers	• Investigate implementation of new technology for identifying leaks and monitoring customer consumption.	Water savings realised by participants with smart meters	KPIs to be developed as part of Business Case for investment in smart metering infrastructure
			Number of new smart meters installed	
			Feedback from participants	

Action	Target Groups	Objectives	Key Indicators of Success	Key Performance Indicators (KPIs)
Action 5: Recycled water	All customers within dual reticulation service areas	• Develop cost-effective opportunities for replacement of potable water use with treated sewage effluent. • Encourage the use of recycled water to supplement potable water supplies.	New customers connected (apart from BASIX connections)	BaSC – 30 p.a. BySC – 5 p.a.
			Reduction in metered potable water supply	BaSC – 25% BySC – 10%
Action 6: Rainwater tank rebates	All residential customers	• Encourage the use of rainwater to supplement potable water supplies. • Increase take up of rainwater tank rebates through training and cost-effective, tailored marketing activities.	Number of rebates provided	65 p.a.
			Reduction in metered potable water supply for participating customers	25%
			Tank suppliers and council staff trained/“accredited”	KPI to be developed as part of training program
Action 7A: Community engagement and education - households	All residential customers	• Provide information to assist households to use water more efficiently. • Improve understanding of household consumption compared to benchmarks and targets. • Provide practical tools that allow consumers to take specific action relevant to their water use activities. • Provide resources to deliver water efficiency messages. • Improved promotion of voluntary permanent water saving measures.	Residential demand per connection – region	165 kL/a
			Residential demand per connection – local supplies	Local targets to be developed
			Residential demand per capita – region	175 L/person/d
			Residential demand per capita – local supplies	Local targets to be developed
Action 7B: Community engagement and education - schools	Preschools, primary and secondary schools	• Promote water efficiency messages through school education. • Improved promotion of voluntary permanent water saving measures.	-	-
Action 7C: Community engagement and education – high residential water users	Residential customers with high (>2 kL/d) consumption.	• Implement actions to reduce consumption of high residential water users. • Improved promotion of voluntary permanent water saving measures.	Number of participants in program	50 p.a. from year 3 (2020/21)
			Water savings achieved by participants	25%

The collection of regionally consistent and meaningful data to gauge the success of the actions relies on consistent definition and monitoring of customer and demand data across the region. The RDMP also includes strategies to standardise the collection of data and the evaluation of demand across the region to increase confidence in the information that is used to inform demand management planning.

A key goal of Council's regional demand management planning has always been to defer investment in new water sources as much as possible, however demand management alone cannot address the forecast decline in the secure yield of Council's existing water supply system over the next 40 years due to changing climate conditions. Water efficiency measures must be coupled with source development. Investment in new water sources cannot be continuously deferred and eventually a new water source will be required to meet the region's long-term water needs.

RCC has adopted and has commenced implementing the actions in the RDMP. Water conservation and demand management is a long-term program and will be an integral part of the Future Water Project 2060, regardless of the source augmentation options chosen.

5. DEMAND FORECAST

RCC previously developed a long-term water supply demand forecast as part of the development of the 2014 FWS (Hydrosphere Consulting, 2013a). The demand forecast has been updated as part of the Rous Future Water Project 2060 (Hydrosphere Consulting, 2020a). The updated demand forecast incorporates information supplied by RCC and the constituent councils including:

- Customer and meter reading data since 2011.
- Bulk production and bulk supply data.
- BASIX data (number and consumption of water efficient properties e.g. with rainwater tanks).
- Recycled water (dual reticulation) programs and reduction in potable water supply demand.
- Development projections – lot yield, size, type and supply area.
- Water loss management actions and predicted efficacy.

The demand forecast includes the estimated water savings from ongoing demand management initiatives across the region and the reduction in water use from NSW Government BASIX sustainable building requirements and dual-reticulation (non-potable water) reuse schemes implemented by some of the constituent councils.

The Rous regional bulk supply currently services 41,870 connected residential properties and 5,110 connected non-residential properties (total 46,980 connections). By 2060, the Rous regional bulk supply is predicted to serve 57,560 connected residential properties (based on estimated lot yields) and 9,360 connected non-residential properties (total 66,920 connections). The Rous regional bulk supply currently produces 11,300 ML/a (five-year average). The predicted average demand per connection has been estimated for each connection type in each supply area. Dry year demand per connection has also been estimated based on climate correction of the bulk supply demand.

Future demand predictions have been developed from the growth predicted in the region (two growth scenarios for Ballina Shire and one growth scenario for other supply areas as provided by the constituent councils) and predicted water loss reduction (nil savings – using current water losses and savings predicted by the council water loss management plans) as follows:

- Demand Scenario 1A: Revised forecast dry year demand (estimated Ballina lot yield, current water losses).
- Demand Scenario 1B: Revised forecast dry year demand (upper estimated Ballina lot yield, current water losses).
- Demand Scenario 2A: Revised forecast dry year demand (estimated Ballina lot yield, reduced water losses).
- Demand Scenario 2B: Revised forecast dry year demand (upper estimated Ballina lot yield, reduced water losses).

The dry year demand for water at 2060 is predicted to be between 16,000 ML/a and 16,700 ML/a, an increase of approximately 5,000 ML/a over current dry year demand. The four demand scenarios are compared to the 2013 forecast demand in Figure 6.

The annual demand in each five-year period for each scenario (current supply area) and the local supply areas are provided in Table 8.

RCC has indicated that water loss reduction actions will be implemented, therefore Scenario 2A will be used for future water supply planning.

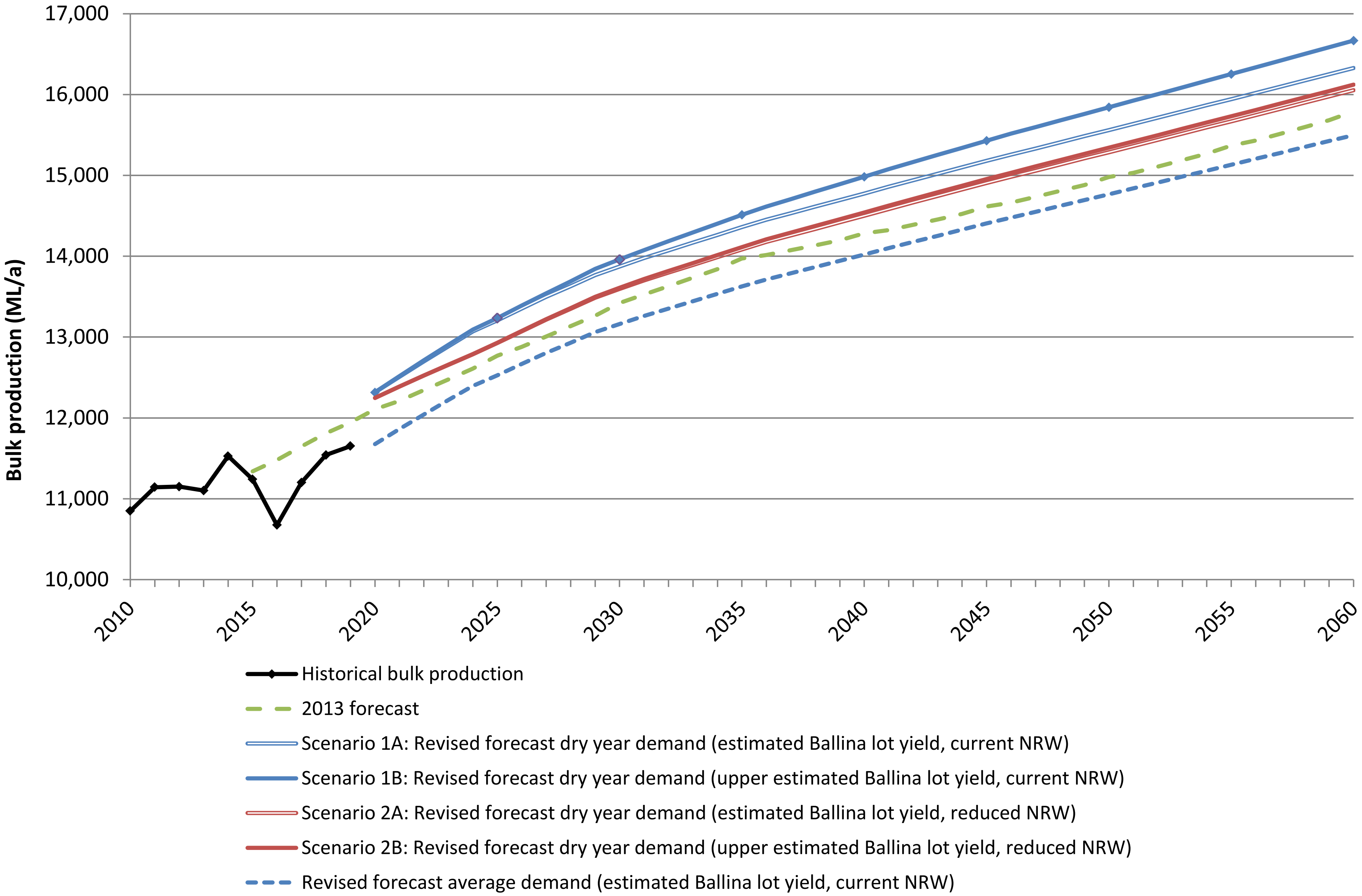

Figure 6: Forecast demand (bulk production) scenarios and comparison with the 2013 forecast – Rous bulk supply area

Table 8: Demand forecast scenarios – Rous bulk supply area (ML/a)

Scenario	2020	2025	2030	2035	2040	2045	2050	2055	2060
Existing bulk supply area									
Scenario 1A: Revised forecast dry year demand (estimated Ballina lot yield, current water losses)	12,315	13,208	13,872	14,359	14,775	15,179	15,560	15,943	16,328
Scenario 1B: Revised forecast dry year demand (upper estimated Ballina lot yield, current water losses)	12,319	13,233	13,956	14,510	14,979	15,426	15,840	16,250	16,664
Scenario 2A: Revised forecast dry year demand (estimated Ballina lot yield, reduced water losses)	**12,225**	**12,814**	**13,483**	**13,972**	**14,388**	**14,793**	**15,175**	**15,557**	**15,942**
Scenario 2B: Revised forecast dry year demand (upper estimated Ballina lot yield, reduced water losses)	12,226	12,817	13,498	14,002	14,430	14,845	15,235	15,624	16,015

6. SECURE YIELD

6.1 Secure Yield Methodology

The current NSW Security of Supply Methodology in NSW has been in use for over 25 years and modelling approaches have been developed to determine the secure yield based on this methodology. The security of supply basis has been designed to cost-effectively provide sufficient storage capacity to allow a water utility to effectively manage its water supply in future droughts of greater severity than experienced over the past 100 or more years. 'Secure yield' is defined as the highest annual water demand that can be supplied from a water supply headworks system while meeting the '5/10/10 design rule'. This rule dictates that water restrictions must not be too severe, not too frequent, nor of excessive duration, hence under the NSW Security of Supply requirement, water supply headworks systems are normally sized so that:

a) Duration of restrictions does not exceed 5% of the time; and

b) Frequency of restrictions does not exceed 10% of years (i.e. 1 year in 10 on average); and

c) Severity of restrictions does not exceed 10%. Systems must be able to meet 90% of the unrestricted dry year water demand (i.e. 10% average reduction in consumption due to water restrictions) through simulation of the worst recorded drought, commencing at the time restrictions are introduced.

This enables water utilities to operate their systems without restrictions until the volume of stored water approaches the restriction volume. If at this trigger volume, the utility imposes drought water restrictions which reduce demand by an average of 10%, the system would be able to cope with a repeat of the worst recorded drought, commencing at that time, without emptying the storage. Water security is achieved if the secure yield of a water supply is at least equal to the unrestricted dry year annual demand (NSW Office of Water, 2013).

Estimating the yield of a headworks system involves two stages:

- Stream flow estimation: Developing an appropriate sequence of stream flows for the water sources.
- System behaviour modelling: Modelling the behaviour of the headworks system subject to operating constraints using the stream flows to assess what demand subject to reliability or security criteria can be satisfied.

Consideration also needs to be given to possible impacts of climate change. Draft *Guidelines on Assuring Future Urban Water Security* (NSW Office of Water, 2013) provide guidance to NSW local water utilities on assessing and adapting to the impact of variable climatic patterns on the secure yield of urban water supplies. The methodology in these guidelines enables local water utilities to estimate their future secure yield taking into account the expected impact of future climatic patterns.

Determining the impact of climate change on the secure yield of a water supply system involves two modelling steps:

- Modification of daily rainfall and evapotranspiration data and calibrated rainfall-runoff models to produce climate changed daily stream flows; and
- The daily climate changed streamflow, rainfall and evapotranspiration are input into the water supply system simulation models to determine climate changed secure yields.

The methodology has been developed from a pilot study (Samra and Cloke, 2010) which involved undertaking hydrological and system modelling to determine the impact of climate change on secure yield. The pilot study incorporates the scientific logic of the CSIRO's Murray Darling Basin Sustainable Yields

Project which used daily historical data from 1895 to 2006 and applied the relevant global climate models (GCMs) to provide projected (~2030) climate changed data for each GCM for this period.

The rainfall-runoff model is used to estimate daily stream flows for each GCM and for the historical data provided with the GCM data. The current system simulation model is used to determine the secure yield for each of the 15 GCMs, as well as for the above historical data on the basis of the 5/10/10 design rule.

Whilst the 15 GCMs represent a range of plausible climate futures for around the year 2030, there is some uncertainty which needs to be acknowledged when considering the full range of possible outcomes. The secure yield is determined for all 15 GCMs under the 5/10/10 design rule as well as the secure yield for the GCM with the lowest yield for a more severe restriction regime (10/15/25). The critical results are for:

- GCM with the median secure yield under the 5/10/10 design rule.
- GCM with the lowest secure yield under the 5/10/10 design rule.
- GCM with the lowest secure yield under the 10/15/25 design rule.

6.2 Secure Yield of Existing System

The secure yield assessment has been undertaken using the RCC Bulk Water Supply Security Model which was developed by Engeny Water Management in 2019 using GoldSim 12.1 and updated for the Future Water Project in 2020 and 2021. Data for the existing water sources used in the assessment are shown in the following table (in addition to characteristics and operating rules provided in Table 2 and Table 3).

Table 9: Existing system data used in secure yield assessment

Details	Rocky Creek Dam	Emigrant Creek Dam	Wilsons River Source	Converys Lane bore	Lumley Park bore	Woodburn bores
Dead storage	150 ML	50 ML	-	-	-	-
Leakage	1.15 ML/d	0.23 ML/d	-	-	-	-
Seepage	6.5 L/s	1.9 L/s	-	-	-	-
Environmental flow release	None	10 L/s when there is inflow	-	-	-	-
Transfer capacity	68 ML/d (950 L/s over 20 hours)	108 L/s	Based on river flow and season	0.2 ML/d	1.0 ML/d	None (not currently operational)

Source: Engeny (2021)

The secure yield of the existing system for the climate experienced over the last 120 years and with 1°C climate warming is presented in Table 10.

Table 10: Secure yield – existing system

Historic climate (5/10/10)	Reduction factor	1°C climate warming
13,350	0.88	11,720

Source: Engeny (2021)

The guidelines do not specify the year to apply the yield with the climate experienced over the last 120 years, the decline in yield to the projected 1°C climate warming and the decline in yield beyond that time. The following assumptions have been made in this report:

- The secure yield with the current climate is assumed to represent the available supply in 2020.

- The secure yield with projected 1°C climate warming is assumed to represent the available supply in 2030.
- Between 2020 and 2030, there is assumed to be a linear reduction in secure yield.
- Beyond 2030, the secure yield is assumed to reduce at a slower rate until 2060.

The dry year unrestricted demand forecast (Demand Scenario 2A: estimated Ballina lot yield, reduced water losses) is shown in Figure 7 compared to the secure yield. Figure 7 shows that the existing system yield will be sufficient to supply the dry year unrestricted demand until approximately 2024. The yield deficit at 2060 is 5,619 ML/a.

The above secure yield estimates do not consider the impact of changed environmental flow regimes as discussed in Section 6.3.

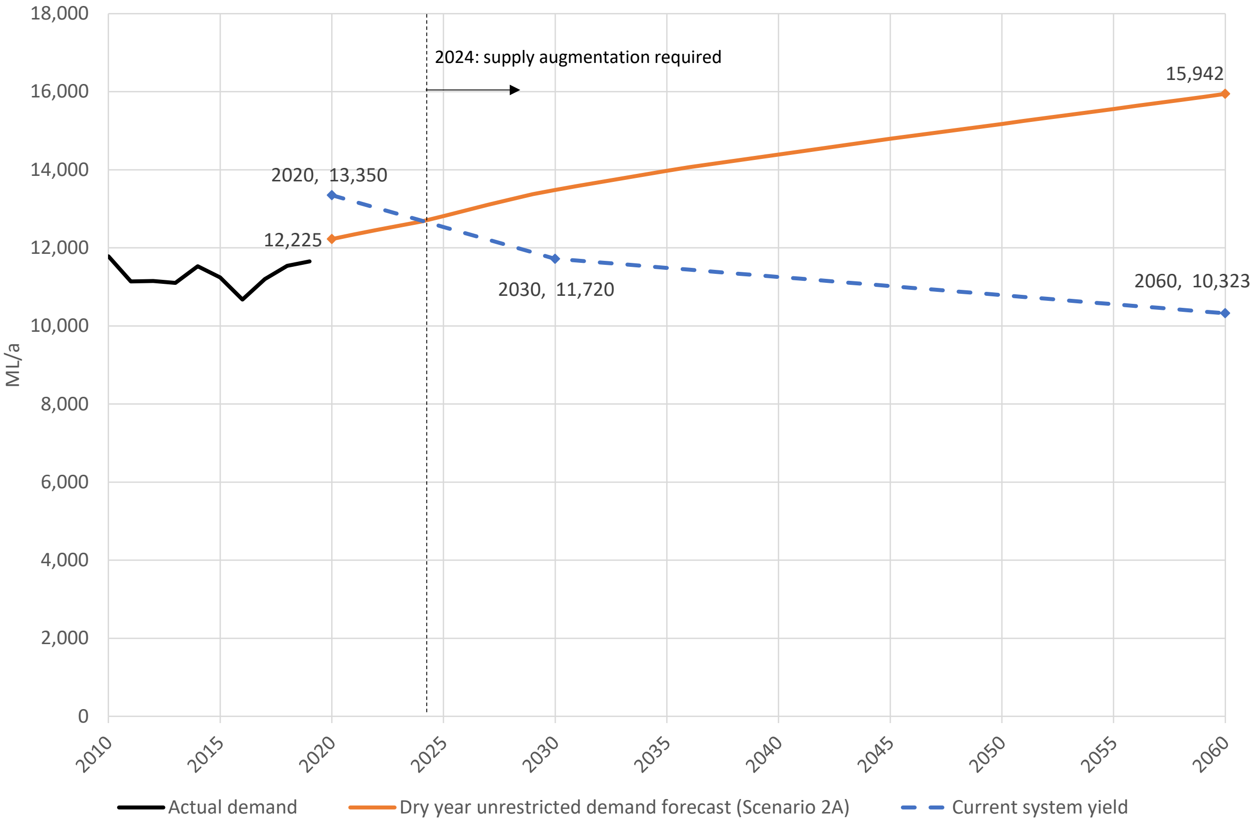

Figure 7: Comparison of existing system secure yield and demand forecast

6.3 Review of Environmental Flow Regimes

Hydrosphere Consulting (2020d) documents a review of the environmental flow regimes for each existing surface water source and the Dunoon dam option to identify any potential implications for the operation of the supply sources and hence determine the impact of changed regimes on the secure yield. The desktop review documents the likely extent of influence of current riverine extractions on downstream environments considering the influence of other catchment impacts on these reaches. Recommended environmental flow requirements were developed through critical review of available information, previous studies of downstream environments and the likely impacts of extraction assessed through analysis of modelled hydrological data and reference to other relevant literature.

Key outcomes of the review for the existing surface water sources are summarised as follows:

- Rocky Creek Dam (RCD):
    - There are no currently provisions for environmental flow releases from RCD and it is not a requirement of the current water access licence. Downstream flow in Rocky Creek below the dam occurs as a result of overflows (spilling) of the dam during high flow conditions and seepage through the dam wall (approx. 0.7 ML/d). These conditions have been in place for approximately 70 years since dam construction in the early 1950s.
    - RCD is having a large hydrological impact on all flow components in Rocky Creek, except for the highest flood flows (> 500 ML/d). Impacts are particularly pronounced during low flow periods occurring from late winter, through spring into early summer when the dam spills very infrequently. Previous assessments have identified that there are downstream ecological impacts due to RCD and associated water extraction and that these impacts are exacerbated by modified catchment conditions downstream of the dam (e.g. catchment clearing and altered land use leading to water quality decline and habitat degradation).
    - Previous assessment of pre-determined environmental flow scenarios for RCD determined that none of the scenarios were adequate to protect aquatic ecosystems, a conclusion that is supported by the 2020 review.
    - Any future environmental flow scenario for RCD would need to be formulated and justified through a robust assessment of existing environmental conditions and associated flow requirements. It is acknowledged that provision of environmental flows at RCD is likely to significantly affect secure yield of this water source and require infrastructure modifications to allow for regulation of releases and physical monitoring of dam inflows and outflows. Therefore, the environmental benefits for Rocky Creek will need to be considered holistically in comparison to the impacts of alternative source augmentation to determine an appropriate balance.
- Emigrant Creek Dam (ECD):
    - The current water access licence requires that when flow is entering ECD, the flow in the downstream watercourse should be equivalent to the flow entering the storage or sufficient to maintain visible flow at Tintenbar downstream of the dam, whichever is the lesser.
    - Environmental flow releases at ECD occur via a water outlet pipe in the base of the dam which remains open with an estimated discharge of approximately 0.8 ML/d. This is the only current provision for environmental flow during low flow (non-spilling) periods.
    - The modified hydrology as a result of ECD operations appears to be having the greatest impact on low to moderate flows in Emigrant Creek with a pronounced impact on moderate flow events which occur during late spring and early summer. During these times naturally occurring peaks in flow or ‘freshes’ are not passed downstream of ECD, due to dam filling after a prolonged dry period. This is expected to impact downstream water quality, overall water levels and habitat availability as well as fish passage and enhance drying of habitat and substrate. The modelling indicates that high flows and flood flows are not greatly impacted by current water supply operations and therefore impacts on channel geomorphological processes and high flow biological triggers for species are expected to be minimal in Emigrant Creek.
    - The current environmental flow regime, with a minimum estimated flow of 0.8 ML/d has been in place for many years. This flow is likely to exceed natural flows at some times of the year when there is no inflow to ECD, however given the modified nature of the catchment, it is considered that this elevated baseflow during these periods is beneficial, particularly in

relation to water quality, and it is likely that the aquatic environment now has some dependence on this minimum flow. Despite this, the current provision for base environmental flow at ECD of 0.8 ML/d is regarded as unlikely to be sufficient to fully protect downstream aquatic ecosystems and is likely to be leading to sub-optimal outcomes for the ecological functioning of the creek.

  - It is acknowledged that the provision of more onerous environmental flows for ECD is likely to reduce overall water supply security and increase or bring forward the need for additional water supply sources. In this case, the environmental benefits for Emigrant Creek will need to be considered holistically in comparison to the impacts of source augmentation to determine an appropriate balance.

- Wilson River Source (WRS):
  - Environmental flow requirements for the WRS are built into the water access licence pumping rules that are based on Wilsons River flows. Abstractions from the WRS tidal pool cause changes to flow rates in the Wilsons River below the abstraction point creating a slight decrease in the rate of low to moderate flows. This causes minor upstream movements of saline water under average and low flow conditions.

7. COARSE SCREENING ASSESSMENT

The coarse screening assessment undertaken for the 2014 FWS has been updated (Hydrosphere Consulting, 2020b) as part of the Future Water Project 2060. The source augmentation options considered included all options from the 2014 FWS as well as new options identified since then. The outcomes of the coarse screening assessment are given in Table 11.

Table 11: Coarse assessment outcomes – supply options

No.	Option	Description	Conclusion	Result
1 - Do nothing – status quo				
1	River/creek raw water extraction (current system)	Existing RCC supply – RCD, ECD and WRS.	Existing sources will not meet future demand.	Fail
2 - Existing source augmentation				
2a	Raise RCD	Raising the existing dam by up to 8 metres to a height of up to 36 metres and increasing the storage capacity from 14,000 ML to 35,000 ML. Because of the need to provide environmental flows, this would only increase the yield of the dam by about 1,200 ML/a.	High capital cost and environmental impact for low future yield.	Fail
2b	Raise ECD	Raise the existing dam.	Site geology significantly limits the height to which the dam could be raised, and the relatively small catchment area results in only a very small increase in yield.	Fail
3 - Toonumbar Dam				
3a	Purchasing or trading existing water entitlements from Toonumbar Dam	Accessing existing low security water entitlements within the Toonumbar regulated water source. Water would be transferred to the Casino WTP for treatment to potable standards and then pumped into the RCC supply.	RCC may be able to buy existing licences, but these would not provide the level of security required.	Fail
3b		New town water supply licence within the Toonumbar regulated water source under existing Water Sharing Plan. Water would be transferred to the Casino WTP for treatment to potable standards and then pumped into the RCC supply.	Town water supply licences are not permitted under the existing Water Sharing Plan. High security water available (estimated 300 ML/a) from Toonumbar Dam is not sufficient to meet supply deficit.	Fail

No.	Option	Description	Conclusion	Result
3c	Pipeline from Toonumbar Dam or Eden Creek to Casino or RCD	Water Sharing Plan modified to allow town water supply licences.	High security water available (estimated 300 ML/a) from Toonumbar Dam is not sufficient to meet supply deficit.	Fail
3d	Raising Toonumbar Dam	10 m or 20 m raising has previously been considered. Water would be transferred to the Casino water treatment plant and then pumped into the RCC supply.	Availability of high security water is unknown.	Pass
4 - Dunoon dam				
4a	Staged Dunoon dam (20 GL – 50 GL)	Initial 20 GL storage on Rocky Creek with provision for future raising to 50 GL. Water would be treated at Nightcap water treatment plant.	Provides long-term yield benefit. Environmental and cultural heritage impacts will need to be assessed and potentially offset.	Pass
4b	Toonumbar Dam environmental flows to offset Dunoon dam release requirements	Operational changes may be considered by the NSW Government.	No details available. Further consideration is recommended as a complementary action with Dunoon dam.	Pass
5 - Regional interconnection				
5a	Connection to Tweed Shire Bray Park system and Dunoon dam	Interconnection of the Rous and Bray Park systems with source augmentation (raising Clarrie Hall Dam with Dunoon dam).	Tweed Shire Council is planning to raise Clarrie Hall Dam as a short-term augmentation option for the Bray Park water supply and therefore does not support this option. This is a long-term (>30 years) option only.	Fail
5b	Connection to Tweed Shire Bray Park system and Toonumbar Dam	Interconnection of the Rous and Bray Park systems with source augmentation (raising Clarrie Hall Dam with Toonumbar Dam).	Tweed Shire Council is planning to raise Clarrie Hall Dam as a short-term augmentation option for the Bray Park water supply and therefore does not support this option.	Fail
5c	Connection to Casino (Jabour Weir)	Interconnection of the Rous supply with the Casino water supply sourced from Jabour Weir.	Has been considered by Richmond Valley Council to augment Casino water supply but provides insufficient yield for Rous bulk supply.	Fail
5d	Connection to Marom Creek water treatment plant	Raising of Marom Creek Weir and reinstatement of aquifer supplies and upgraded WTP to supply Alstonville/Wollongbar with excess to Lismore.	Offers diversification of surface water sources for RCC with expected secure yield of approximately 800 – 1,000 ML/a (NUWS, 2018).	Pass

No.	Option	Description	Conclusion	Result
6 - Groundwater				
6a	Groundwater extraction	Various groundwater supplies have been considered (reinstatement of bores at Woodburn and Alstonville, new borefields at Tyagarah, Newrybar and Alstonville)	Scheme costs are likely to be higher than first thought but localised groundwater supplies can provide a diversified supply to some areas of the bulk supply network. However, the Water Sharing Plan limits new licences in some groundwater sources.	Pass
7 - Stormwater				
7a	Urban stormwater irrigation	Collection and storage of urban stormwater runoff, followed by treatment and irrigation of the treated water onto open space areas.	Due to climate dependence, stormwater reuse does not provide a significant yield benefit.	Fail
7b	Non-potable urban stormwater reuse (dual reticulation)	Dedicated reticulation system to supply treated stormwater for outside use and toilet flushing within new urban development areas.		Fail
7c	Indirect potable urban stormwater reuse	Stormwater collected and transferred to an existing water treatment plant (e.g. Nightcap or Emigrant Creek) for subsequent supply to consumers.		Fail
8 - Desalination				
8a	Desalination	Conversion of saline water to fresh water suitable for potable use. Potentially staged desalination plant capacity.	Climate resilient water source but with significant power requirements and brine management constraints to be addressed.	Pass
9 – Wastewater recycling				
9a	Indirect potable reuse to surface waters	Highly treated reclaimed water supply into RCD, ECD or WRS for subsequent extraction, treatment and transfer using existing infrastructure.	Climate resilient water source. Quantity of water available has not been confirmed. NSW government policy has not been developed for planned indirect potable reuse.	Pass
9b	Dual reticulation (urban)	Dedicated reticulation system to deliver treated reclaimed water for outside use and toilet flushing within new urban development areas.	Included in Regional Demand Management Plan (Ballina Shire and Byron Bay).	Pass

No.	Option	Description	Conclusion	Result
9c	Managed aquifer recharge with treated wastewater effluent.	Intentional recharge of an aquifer under controlled conditions, either by injection or infiltration, in order to store a water source for later abstraction and use (indirect reuse), or for environmental benefits.	RCC does not currently utilise groundwater apart from emergency sources. Groundwater options including aquifer recharge may be considered feasible pending outcomes of the current studies. This will be treated as a groundwater supply option (similar to the 2014 FWS) as aquifer recharge is not an augmentation option by itself. Based on recent investigations, groundwater options are expected to be limited by location and water quality rather than quantity and therefore aquifer recharge may not be required.	Fail
9d	Potable reuse	Treating sewage effluent to produce reclaimed water of a quality that would be suitable for drinking purposes. This water would then be provided direct to consumers.	The community/regulators are unlikely to support/approve this option while other options are feasible, even though they may have a greater whole-of-life cost.	Fail

The following options were not considered in detail in the development of the 2014 FWS (due to low yield benefit and/or other risks). The findings of the original IWP process are still considered valid and these options will not be considered further in this report:

- Raise RCD.
- Raise ECD.
- Purchasing or trading existing water entitlements from Toonumbar Dam.
- Regional interconnection with Casino water supply (Jabour Weir).
- Managed aquifer recharge with treated wastewater effluent.
- Direct potable reuse - while direct potable reuse is not considered viable at present due to regulatory constraints, RCC will participate in detailed studies to develop the technology required to gain regulatory and community acceptance (refer Section 15.4).
- Stormwater reuse.

The following new options have been considered but did not pass the coarse assessment and will not be considered further in this report:

- Pipeline from existing Toonumbar Dam or Eden Creek to Casino or RCD.
- Regional interconnection with the Tweed Shire Bray Park system.

The “do nothing” option (reliance on existing surface water sources) will not form part of the long-term strategy but will be used to compare the benefits and costs of supply scenarios.

The following options passed the coarse assessment and are discussed in detail in this report:

1. Staged Dunoon dam (20 GL – 50 GL).
2. Connection to Marom Creek WTP (upgraded) with or without local groundwater supplies.
3. Groundwater harvesting – Woodburn, Tyagarah, Newrybar and Alstonville.
4. Desalination.
5. Indirect potable reuse (treated wastewater from constituent council wastewater treatment plants transferred to RCC surface water supplies).

Options involving use of water from Toonumbar Dam will not be considered in the Future Water Project as the NSW Government's infrastructure options study will not be completed within the required timeframe.

Demand management will not be considered as a source augmentation option but will be an integral part of the long-term strategy through the implementation of the RDMP (Section 4).

8. OPTION 1: DUNOON DAM

8.1 Concept Design

The Dunoon dam site is located on Rocky Creek downstream of the existing RCD. The site is approximately 2.5 km west of the village of Dunoon. The dam would store inflows from its catchment up to the existing RCD and from spills over the RCD spillway. Water from Dunoon dam would be pumped to the Nightcap WTP and subsequently used for town water supply throughout the RCC service area.

Three possible dam types were considered in an Options Study (Public Works Dams and Civil, 2013a). The two options considered viable were:

- Earthfill type embankment across the creek with an excavated spillway in the left abutment.
- Roller compacted concrete gravity structure where spill flows are accommodated over the central part of the wall into the creek below.

Although the roller compacted concrete dam would involve a much larger haulage of materials from off-site locations, it requires a significantly smaller footprint on the site, reducing both the physical and visual impact on the local environment and was therefore preferred in the Options Study. A concept design for a 50 GL roller compacted concrete has been prepared (Public Works Dams and Civil, 2013b) including:

- A roller compacted concrete gravity structure with a 30 m wide central overflow spillway.
- A concrete dissipator at the toe of the spillway to collect spill flows and prevent erosion of the foundation and potential undermining of the dam wall.
- An intake structure attached to the upstream face of the wall with facilities for selective withdrawal of water from the storage.
- A conduit located in the creek bed under the dam wall, used initially for creek diversion during construction and then converted to a permanent outlet pipe connecting the base of the intake structure to the valve house immediately downstream of the dam.
- A valve house structure housing the main guard valves and downstream discharge valves as well as the main branch line to the adjacent raw water pumping station.
- A concrete dissipator at the downstream end of the valve house to accommodate outlet flows and avoid erosion of the foundation.
- A pumping station and associated equipment to enable the transfer of raw water from the toe of the dam to existing water mains at Dorroughby.
- 8 km long rising main from the pumping station to Dorroughby.
- 3.3 km of new access road (including two bridges) plus 9 km of upgraded road.
- Power supply, electrical and telemetry facilities.

The additional flow of raw water from Dunoon dam will require the upgrade of Nightcap WTP to 100 ML/d in 2034.

A 50 GL storage provides a full supply level (FSL) at RL 82.25 mAHD. The maximum flood level (MFL) is at RL 90.02 mAHD with the dam crest level at RL 90.60 mAHD which allows for appropriate freeboard as required by the NSW Dams Safety Committee (Public Works Dams and Civil, 2013b).

A 20 GL storage has also been investigated as a possible staged approach to construction of the dam (Public Works Dams and Civil, 2013c). As for the 50 GL arrangement, the 20 GL dam would incorporate a concrete gravity structure with a 30 m wide spillway at the centre of the dam and plunge pool at the downstream toe. A diversion tunnel would be located at creek bed level, just left of the spillway through the dam wall. This would be converted to an outlet tunnel once construction of the dam has been completed. An intake structure would be attached to the back of the wall while an outlet/valve house would be located at the downstream end together with an associated pumping station. Design features would be incorporated in the 20 GL arrangement to facilitate future raising of the dam:

- The positions of the valve house and pumping station are located downstream of the dam to suit a larger dam.
- Sizing of the pumping station, valve house, pipework and associated equipment has been determined to suit a larger dam.
- The section dimensions for the intake tower allow for possible future raising of the storage to 50 GL.

The 20 GL storage provides a FSL at RL 67.20 mAHD, MFL at RL 74.36 mAHD and the dam crest level at RL 74.96 mAHD.

Figure 8 shows the dam inundation area for the two storage options. The surface area at FSL is 1,650,000 m² and 2,430,000 m² for the 20 GL and 50 GL storage volumes respectively (based on dam stage storage data provided in Public Works Dams and Civil (2013a). Figure 8 also shows the route of the rising main to Nightcap WTP and the new access road.

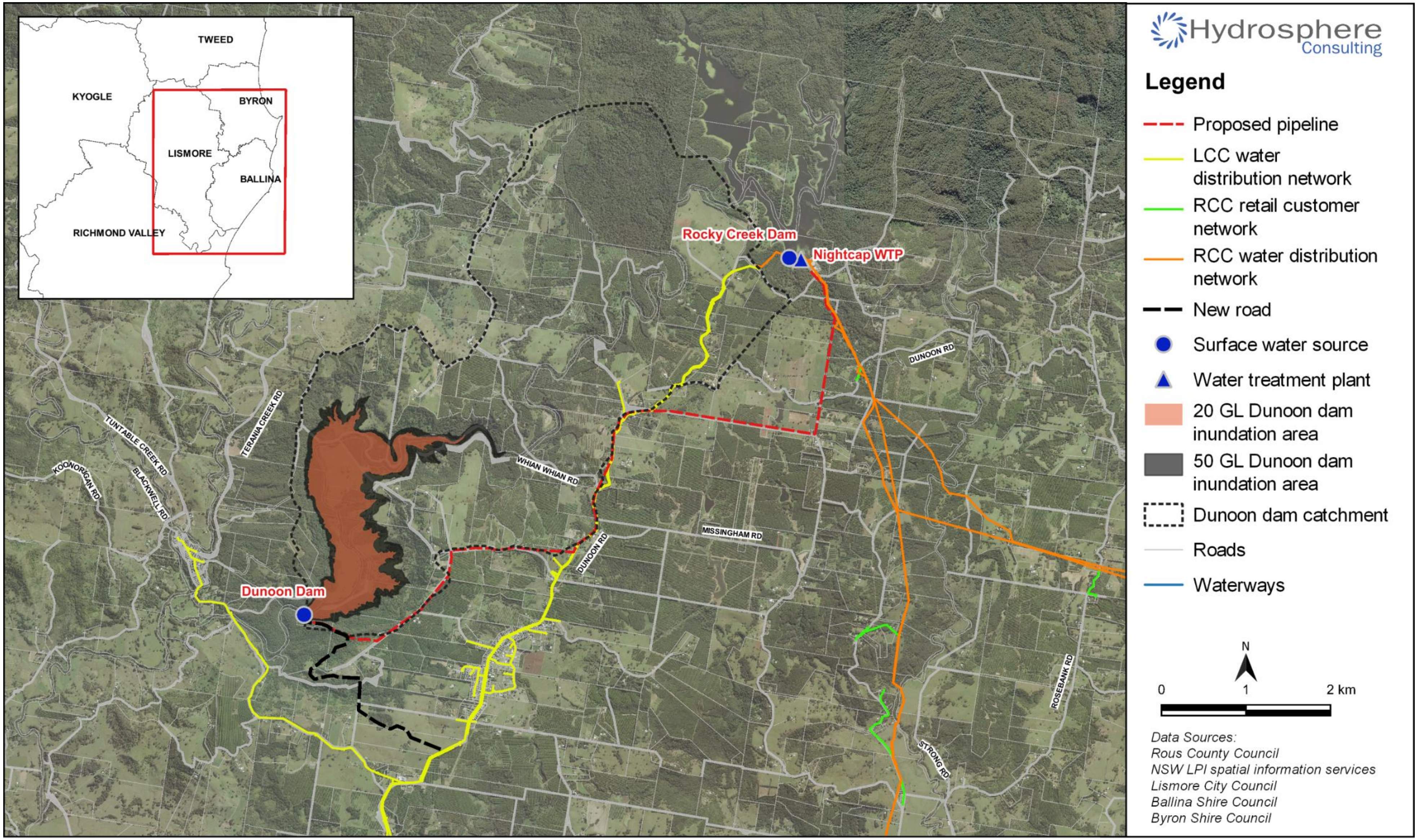

Figure 8: Dam location and inundation area for 20 GL and 50 GL storage options

8.2 Catchment Description

The Dunoon dam would have a catchment area of approximately 19 km^2. Dunoon dam would also receive overflows from RCD and therefore when RCD is spilling, the Dunoon dam catchment area also incorporates the RCD catchment, giving a total catchment area of 50 km^2 (Hydrosphere Consulting, 2020c). Figure 9 provides an overview of mixed land use in the catchment. RCC currently owns several parcels of land within the Dunoon dam catchment and would seek to purchase the remaining land within the buffer zone surrounding the dam, should this option be adopted for future water supply. The remaining catchment areas are either protected as parks and reserves or are under private ownership. Whian Whian Falls is a popular recreational location with easy access from the public road. If constructed, the upstream extent of the 50 GL Dunoon dam would be just downstream of the base of the falls. Currently, cleared grazing land makes up approximately 40% of the catchment, horticulture (primarily macadamia farms) occupy 30%, and approximately 18% of the catchment is classified as parks and reserves (the majority of which is within Nightcap National Park). The remaining land uses comprise rural residential lots (4.6%), cropping (2.2%), forestry (1.3%) and rivers and drainage channels (4.4%) (Hydrosphere Consulting, 2020c).

The RCC *Catchment Management Plan 2021-2025* (Hydrosphere Consulting, 2020c) set the strategy for the coordinated management of RCC’s drinking water catchments for the next 5 years (2021-2025). The implementation plan for the Dunoon Dam catchment has a strategic focus on land management for land owned by RCC in that catchment. RCC will continue to maintain and improve the condition of riparian buffer zones through regular maintenance, weed control and enhancement. For areas under agistment, RCC will ensure that agistment agreements include requirements for appropriate management to prevent erosion,land degradation and management of priority weeds.

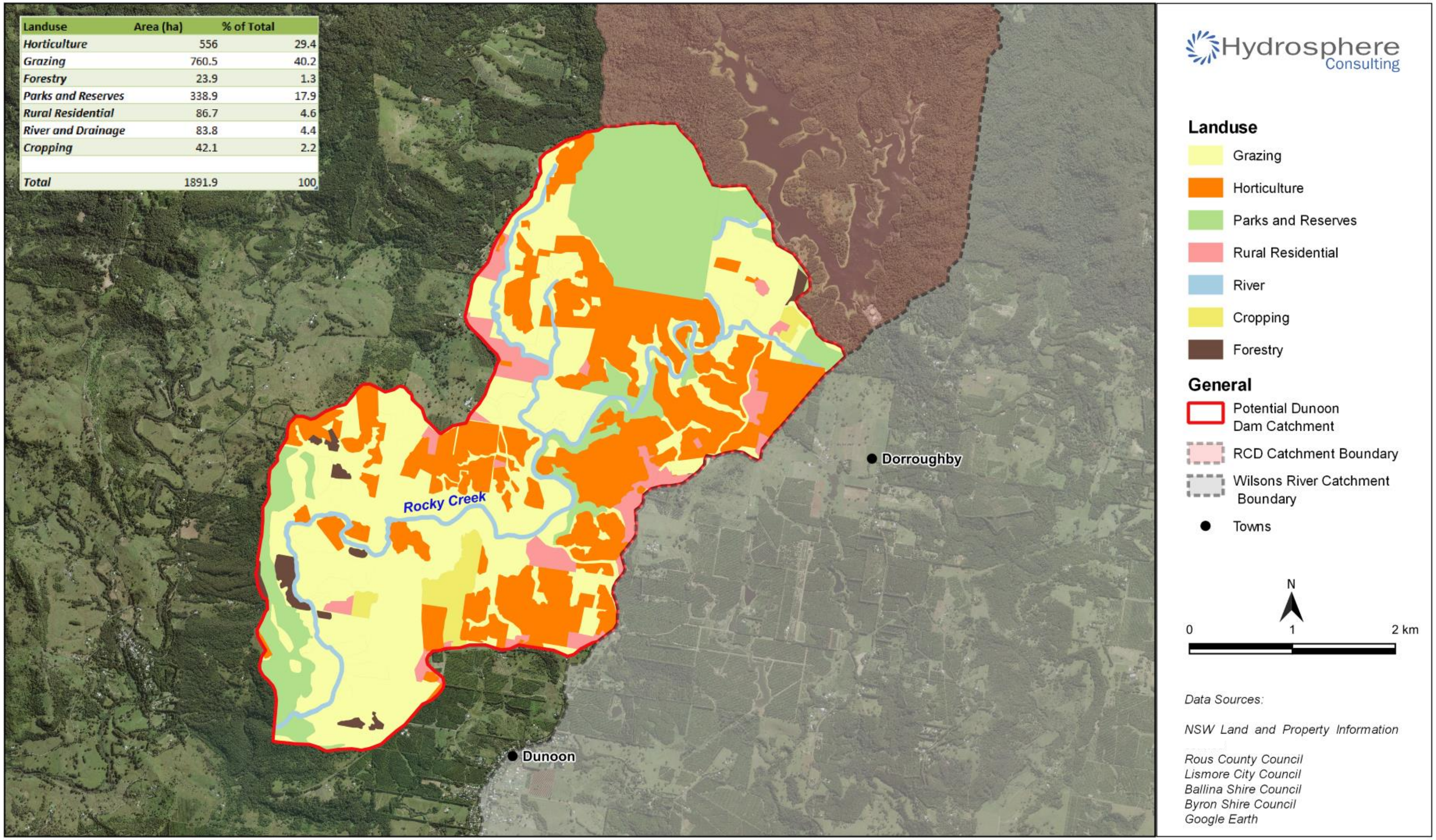

Figure 9: Dunoon dam catchment and existing land use

Source: Hydrosphere Consulting (2020c)

8.3 Planning and Approvals Pathway

RCC has obtained preliminary planning pathway advice for the Dunoon dam proposal (Public Works Advisory, 2020a). *State Environmental Planning Policy (State and Regional Development) SEPP 2011* designates development that is state significant development, state significant infrastructure, critical state significant infrastructure and regionally significant development. The Dunoon dam would be State Significant Development in accordance with the requirements of the State and Regional Development SEPP as the development has a capital investment value of more than $30 million and is permitted with development consent in land use zone W1 Natural Waterways under the Lismore Local Environmental Plan 2012 and permitted without consent in land use zone RU1 Primary Production under SEPP (Infrastructure) 2007 (as per current land zonings under the LEP). The Minister for Planning (or the Independent Planning Commission) would be the consent authority.

An Environmental Impact Statement (EIS) would need to be prepared in accordance with Schedule 2 of the *Environmental Planning & Assessment Regulation, 2000.* The approvals expected to be required are summarised in Table 12.

Table 12: Summary of likely approvals required

Agency	Requirements	Reference
Department of Planning, Industry and Environment (DPIE)	Development consent	Pt 4, Division 4.7, *Environmental Planning and Assessment Act, 1974*
Department of Primary Industries - Fisheries	Notification to the Minister for the construction of a new dam	Section 218, *Fisheries Management Act, 1994*
	Permit for dredging or reclamation work undertaken by a local government authority	Section 200, *Fisheries Management Act, 1994*
Environment Protection Authority (EPA)	Environment protection licence for extractive activities and concrete works (possible)	Chapter 3, *Protection of the Environment Operations Act, 1997*
DPIE - Water	Water Access Licence for water use	*Water Management Act, 2000*
Department of Agriculture, Water and the Environment (Commonwealth)	Referral for significant impact on Matters of National Environmental Significance (MNES)	*Environment Protection and Biodiversity Conservation Act, 1999* (Commonwealth)

Source: Public Works Advisory (2020a)

8.4 Terrestrial Ecology

A survey and assessment of the terrestrial ecology for the footprint of the dam, the buffer region surrounding this footprint and associated access to the dam wall area (SMEC, 2011) was undertaken to identify ecological constraints to inform feasibility assessments and concept planning for the dam. The study consisted of a desktop assessment and seasonal flora and fauna surveys undertaken between April and October 2010. A summary of the findings of the terrestrial ecological assessment from SMEC (2011) is provided below.

The study area is characterised by extensively cleared agricultural land containing remnant fragments of native vegetation occurring primarily along riparian corridors and a larger fragment within the sandstone escarpments of the west and south of the proposed dam wall. The condition of native vegetation and habitat varied from poor (areas infested with exotic species) to good (less accessible areas around the proposed dam wall), depending on the level of historic clearing and disturbance from agricultural activities (SMEC, 2011).

One endangered ecological community (EEC), Lowland Rainforest which is listed under the *Threatened Species Conservation Act* 1995 (TSC Act), was recorded during field investigations. In addition, nine flora and 17 fauna species (including one frog, one mammal, one fruit-bat, six microbats and eight birds) listed as threatened in NSW under the TSC Act were also recorded. Of these species, eight flora and one fauna species are also listed nationally under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act). An additional seven fauna species listed as migratory or marine under the EPBC Act as well as two Rare or Threatened Australian Plants (RoTAP) and three regionally significant plant species were also recorded (SMEC, 2011).

The proposed dam would clear a total of 272 ha of vegetation, of which 57 ha is predominantly native (Warm Temperate Rainforest, Subtropical Rainforest with 34 ha of Lowland Rainforest EEC, Tallowwood Open Forest and Flooded Gum-Tallowwood-Brush box Open Forest). The loss of rainforest communities is considered to be particularly significant, given the regional history of clearance for timber and plantations and thus fragmented nature of the remnants of these communities (SMEC, 2011).

The dam would remove important habitat features and local linkages for threatened fauna species. In particular, movement pathways for the threatened Koala will be impeded from the installation of the dam wall, spillway and the inundation area. Loss of feeding resources for the listed Grey-headed Flying Fox, Rose-crowned Fruit-dove and White-eared Monarch and nesting resources for migratory birds from the removal of rainforest and Camphor laurel communities is also likely to be significant within the study area. Further, the loss of foraging resources provided within the dry sclerophyll forests, which are rare in the region, will impact on the threatened Glossy-black Cockatoo and Scarlet Robin. Loveridges Frog (*Philoria loveridgei*) was also found just outside the footprint of the proposed dam at a lower elevation and more southerly point than has been previously recorded. Habitat for this species may also be impacted by the proposal (SMEC, 2011).

The works will also remove threatened flora species within the inundation and dam infrastructure areas and their habitat. There is also the potential for indirect impacts through key threatening processes such as the spread of *Lantana camera* and dieback caused by the root-rot fungus (*Phytophthora cinnamomi*) (SMEC, 2011).

Assessment of the impacts (without mitigation) has determined that the works would significantly impact all threatened flora species detected (nine species) and 15 of the recorded threatened fauna species and their habitat within the study area. Mitigations measures have been identified to minimise impacts on terrestrial ecology including design considerations, pre-construction and construction phase actions. Measures to minimise wildlife connectivity impacts, removal of threatened flora and endangered ecological communities and minimising impacts on fauna habitat have also been identified including fauna bridges.

However, residual impacts that cannot be minimised to acceptable levels through mitigation will still be present. Significant impacts are still likely to occur as a result of:

- Loss of Lowland Rainforest EEC.
- Loss of threatened flora species and RoTAP species.
- Loss of threatened fauna habitats.
- Severance of local wildlife corridors.

Habitat and conservation offsets are an option to compensate for these significant impacts to terrestrial biodiversity as a result of the proposed dam. The buffer area surrounding the dam could be used as an offset for the dam, however additional areas may also be required to be reserved for conservation, managed and improved as part of an offset package for the dam, should it proceed. SMEC (2011) recommended that an

Offset Strategy is prepared detailing the location of offsets, ecological restoration requirements, and ongoing management requirements and to investigate opportunities to improve the habitat linkage between Nightcap National Park (5 km to the north and a listed World Heritage Area) along Rocky Creek to the dam site. Although the proposal is likely to have a significant impact on important vegetation within the study area (both endangered ecological communities and habitat for threatened species), there are also large areas within the study area and around it that were once rainforest or wet sclerophyll forest but are now infested with weeds (SMEC, 2011). These areas could benefit from improved management as part of offsets for the project. This has the potential to reduce the significance of the impact of the dam, if managed appropriately. Further assessment of these options would be required prior to seeking project approval.

An assessment of terrestrial ecology impacts will be required in accordance with the provisions of the *Biodiversity Conservation Act, 2016* including requirements of the Biodiversity Offsets Scheme using the Biodiversity Assessment Method.

8.5 Buffer Zone Planning

The establishment of vegetated buffer zones around water supply reservoirs is a recognised catchment management strategy which helps to protect the water quality and reduce risks to water supply. Hydrosphere Consulting (2009) developed a Buffer Zone Strategic Plan through a desktop assessment which analysed the environmental requirements for the buffer zone of the proposed Dunoon dam (50 GL) through an evaluation of industry standards, catchment conditions and water quality risk.

Hydrosphere Consulting (2009) recommends a three-part approach to water quality management in the catchment involving the protection of high-risk areas with the storage buffer, targeted riparian management in the upstream catchment and community education to encourage improved farming practices and land management in the catchment.

The recommended buffer zone identified by the assessment has an average width of approximately 180 m from the maximum inundation area and covers approximately 224 ha of land surrounding the storage. The boundaries for the proposed buffer zone are shown in Figure 10. Despite a high degree of existing vegetation within the proposed buffer zone, there is also a large amount of weed infestation. Significant weed management and/or native planting effort will be required to maximise the biodiversity benefits and water quality protection characteristics of the buffer zone (Hydrosphere Consulting, 2009).

The extent of individual landholdings that form part of the buffer zone would need to be acquired by RCC to implement the buffer zone strategy.

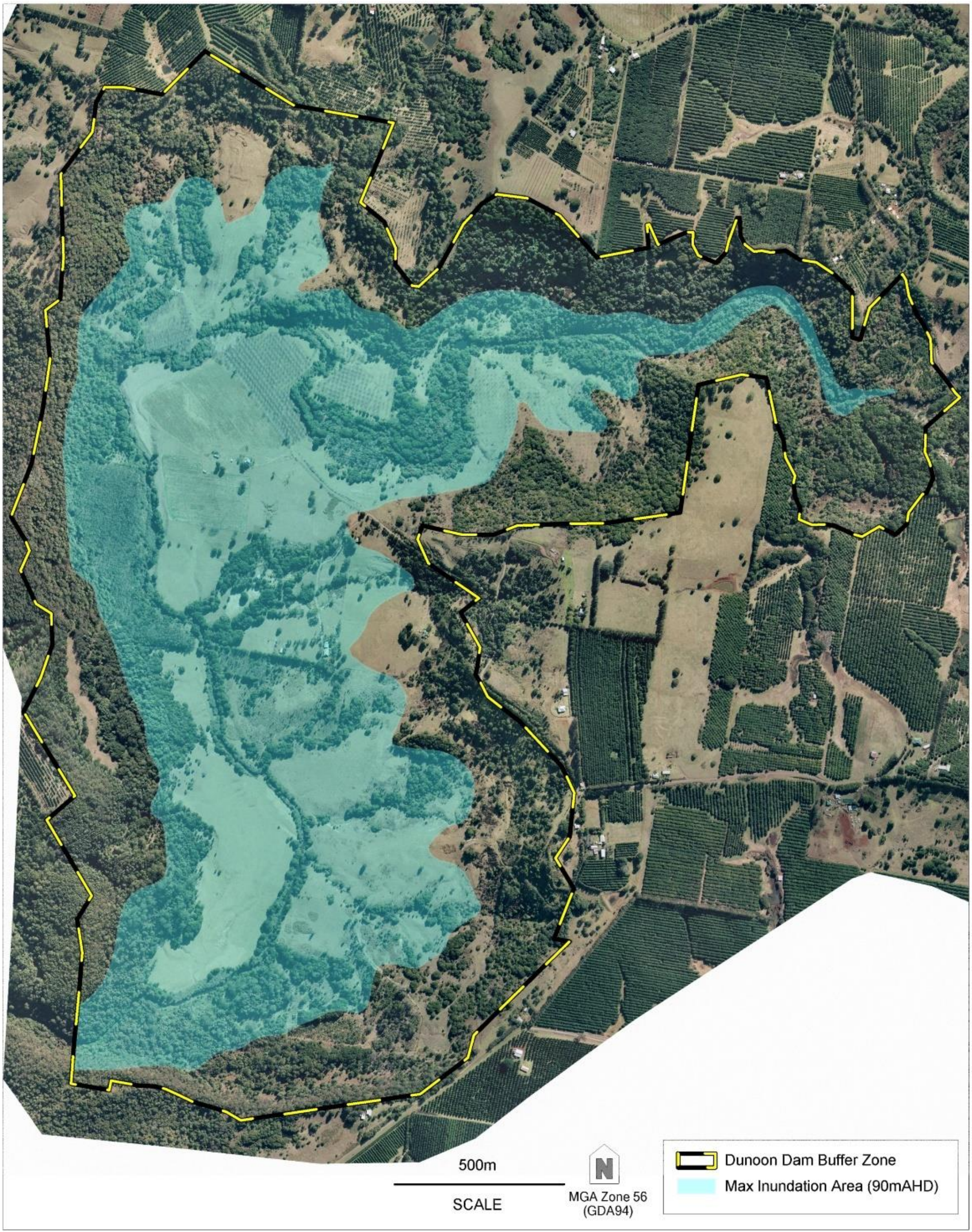

Figure 10: Proposed Dunoon dam (50 GL) buffer zone

Source: Hydrosphere Consulting (2009)

8.6 Aquatic Ecology

An aquatic ecology assessment was undertaken to examine the potential impacts of the proposed dam on aquatic habitats and communities upstream, within and downstream of the proposed dam inundation area (ELA, 2012a). The assessment was updated following a peer review (SMEC, 2012). A summary of the findings of the aquatic ecological assessment from ELA (2012a) is provided below.

A detailed program of desktop and field-based survey was undertaken to examine key aspects of the aquatic ecology. Desktop surveys included review of previous studies in and around the study area and searches of the relevant databases for potential threatened species presence. Field studies included assessment of aquatic and riparian flora, aquatic and riparian habitat, water quality and fauna surveys including fish, other vertebrates (primarily birds, platypus and amphibians) and macroinvertebrates (ELA, 2012a).

The desktop assessment, including database searches, found one EEC, 30 flora, six frog, 24 bird and three mammal species listed as threatened within or around the study area. Three fish species, Eastern Freshwater Cod, Purple Spotted Gudgeon and Oxleyan Pygmy Perch were identified as potentially occurring in the study area (ELA, 2012a).

Flora surveys showed variable habitat condition along the reach with poorer condition generally relating to the level of disturbance or clearing in the immediate catchment surrounding the site. Areas with more intact tree cover showed few exotic species and better overall condition. The number of exotic species showed a general increase downstream from RCD to the Terania Creek sites. Small-leaved Privet, Camphor Laurel and Lantana were significant weed species found in several riparian zones. Brazilian Watermilfoil was identified as a potentially significant exotic macrophyte (ELA, 2012a).

The water quality assessment identified that the current water quality is good with most key parameters falling within or below the ANZECC specified range. The large pool below the proposed dam wall remained weakly thermally stratified for the entire survey period and there were several short periods where the temperature difference between the surface and bottom temperatures was greater than 1°C, indicating that stratification is a normal part of the function of that pool. Flows of approximately 20 ML/d (at RCD) for several days were sufficient to reduce thermal stratification to less than 1°C. Water quality is maintained in this system by low and even base flow levels (ELA, 2012a).

Aquatic macroinvertebrates surveys recorded 5,055 individuals from 73 families and 23 orders. Vertebrate surveys identified 13 fish species, two frog species and 28 bird species, with no rare or threatened species recorded. No introduced fish species were found. Platypus surveys identified individuals at several sites during various surveys and burrow clusters were found at the three sites surveyed (ELA, 2012a).

Wildlife database searches identified that the Eastern Freshwater Cod, Purple Spotted Gudgeon, Oxleyan Pygmy Perch and Black Necked Stork may occur in the study area, however, these species were not recorded during the field surveys. An assessment of significance determined that the proposed dam is unlikely to have a significant impact on these species (ELA, 2012a). Given records and potential habitat for this species in the area, ELA (2012a) recommended that additional survey work undertaken for a more detailed impacts assessment should consider the occurrence of these species and whether assessment under the EPBC Act is required.

Mitigation measures and monitoring requirements were recommended to address the impacts on aquatic ecology resulting from the altered flow patterns in Rocky Creek as a result of the construction and operation of the proposed dam. As there are no current provisions for controlled release of water from RCD, there are few if any flow related management measures that can be implemented upstream of Dunoon dam. The channel form and ecological function of impacted reaches has stabilised following the adjustment to the impact of the current operation of RCD and has an armoured bed, as such this reach is resistant to impacts from change in flow regime including the reduction in spilling flows from RCD. ELA (2012a) recommended that practical management upstream of the Dunoon dam should focus on improving general catchment and riparian condition to minimise sedimentation processes through stock exclusion and the planting of riparian endemic native species. Minor flow-based management may be achieved through refinement of operating rules to achieve balance between sustainable yield of both dams and minimise hydrological impacts on this reach may be possible.

Potential mitigation measures within the inundation area were also identified including stratification, algae control, sediment and nutrient trapping, foreshore management and offsetting the loss of aquatic and riparian habitat within the inundation area. Offsetting and/or conservation options within the larger Terania Creek catchment are recommended in the assessment of environmental flows (ELA, 2012b).

The assessment of environmental flows (ELA, 2012b) discussed in Section 8.7 has proposed an environmental flow regime for the proposed dam to protect the key aspects of creek hydrology, ecology, process and function. Maintaining (or improving) the environment through the environmental flow regime will largely negate the requirements for further significant mitigation measures. The low flow contingency releases will act to improve the environment for key species with connecting releases and other habitat provision when the current flow regime would remain unconnected (ELA, 2012a).

The construction of a fish ladder or lift is not recommended by ELA (2012a) as it would likely only provide artificial lake habitat for migrating species as Whian Whian Falls at the upstream end of the proposed dam lake acts as a natural migration barrier to habitats further upstream. If species were able to migrate beyond Whian Whian Falls they could only access the additional reach to the RCD wall. In this case the potential habitat quantity and quality above the proposed dam wall does not justify the expense of a fish ladder (ELA, 2012). In preference to a fish ladder, options to improve the aquatic and riparian habitat in the larger Terania catchment through fencing from stock and establishment of an endemic native riparian buffer are preferred by ELA (2012a). This buffer will act to improve the riparian and aquatic habitat through the reduction of inflowing sediment and nutrients, improve water quality through shading and provision of endemic organic material and the creation of habitat for riparian and semi-aquatic species.

Hydrosphere Consulting (2020d) considered that the proposed dam will present a barrier to both upstream and downstream fish migration. It is important that environmental flow design is undertaken with due consideration of fish passage and options for integrated design to achieve optimum outcomes. For example, there is potential for any environmental flows to attract fish to the base of the dam and without a fishway to facilitate movement further upstream, the fish may aggregate at this location and be susceptible to increased predation and potentially poor water quality which could result in fish kills. Additionally, fishways require water to run, which provides opportunities for using this operational water to provide a base environmental flow.

The aquatic ecology and environmental flows assessment may also require more detailed assessment to focus on the proposed dam disturbance and inundation area. ELA (2012a) also recommended that the Offset Strategy (refer Section 8.4) should include mitigation of potential impacts on aquatic and riparian habitat.

8.7 Environmental Flows

An environmental flow assessment was undertaken to determine if an environmental flow regime within the Rocky Creek system could be developed that would maintain and/or improve the downstream environment, in consideration of ecological needs and the current legislative framework (ELA, 2012b). The assessment was updated following a peer review (SMEC, 2012). A summary of the findings of the environmental flow assessment from ELA (2012b) is provided below.

A holistic study was undertaken to examine the environmental flow requirements of the current system. This approach integrated information from a range of disciplines including ecology, hydrology, water quality and geomorphology. A combination of desktop review, hydrological and geomorphic modelling and field studies was undertaken by ELA (2012b) to determine the key flow requirements of the system.

Modelled flows at a daily time-step at several points along Rocky Creek, Terania Creek and Leycester Creek using the Integrated Quantity Quality Model (IQQM) were used in the review for a 114-year period. Flow data for the natural and current (with RCD online and current system operating rules) were compared to determine the nature of the hydrological regime in the creek system. Assessment and comparison of data was undertaken via examination of hydrographs for different periods, key flow statistics such as mean, maximum and minimum, flow duration analysis, flood frequency analysis and determination of the rates of rise and fall of flood events.

Field investigations undertaken by ELA (2012b) included detailed survey of the physical stream environment including channel morphology and the relationship between flow and physical processes. Ecological and environmental surveys were undertaken to detail key species (flora and fauna), water quality and habitat at three time periods from October 2010 to June 2011 to capture seasonal variations. Field surveys were conducted at a range of locations to facilitate comparison between different potential impact zones and an unimpacted control area.

Hydrological assessment showed that both the natural and current Rocky Creek flow regimes are highly variable with extended periods of low flows and floods occurring at any time of the year. RCD has reduced flows downstream of the dam from the base flow to moderate flow range, but larger flood events are largely unaffected as they tend to fill and spill the dam. Data for natural flows show key flow components of base flows (2-6 ML/d), low flows (6-30 ML/d) and moderate flows (30-200 ML/d) are responsible for maintaining key ecological, water quality and channel functions. High flows (>200 ML/d) including floods greater than 17,000 ML/d provide for channel disruption and formation processes through movement of large cobbles and high energy flows (ELA, 2012b).

Geomorphic assessments showed that Rocky Creek below RCD is largely confined, with limited potential for erosion. The main unarmoured zone of Rocky Creek will be inundated by the proposed dam. Below RCD, the character of the channel is dominated by boulder and bedrock structures. These channel types are predominantly controlled by large flood events (ELA, 2012b).

Water quality in the system was indicative of good condition throughout the survey period. Nutrients, turbidity and chemical characteristics were all either well within the recommended ANZECC guidelines or where these guidelines were not met were in a range that is not critical to biota, ecological processes or physical function or the creek system (ELA, 2012b).

The flora and fauna in Rocky Creek are adapted to a flow regime dominated by disruptive high flows that move large and small sediments and scour in-stream and riparian vegetation. Maintenance of a flow regime that provides for irregular high flows and maintains base to moderate flow variability, including natural rates of rise and fall, should maintain and/or improve channel habitats and ecological condition in the Rocky Creek system downstream of the proposed Dunoon dam. At the key flow level of 100 ML/d the main fish barriers downstream of the proposed Dunoon dam infrastructure are open for migration to all potential fish species including the threatened Eastern Freshwater Cod (ELA, 2012b).

Following detailed survey and assessment of the hydrology, geomorphology, water quality and aquatic ecology of the Rocky Creek system a set of environmental flow rules was established by ELA (2012b) with the specific objective to maintain or improve the environmental and habitat values downstream of the proposed dam. These flow rules provide for a largely unchanged flow regime for flows up to 100 ML/d with contingency flows provided for prolonged dry periods. The general flow rules are:

- Transparency of inflows up to 100 ML/d at Dunoon dam.
- If inflow to Dunoon dam exceeds 100 ML/d, maintain release of 100 ML/d.
- When inflow to Dunoon dam drops below 100 ML/d, allow natural rates of fall.
- If the unregulated spill exceeds 100 ML/d, no transparent release.

Further a set of contingency rules was developed by ELA (2012b) to permit longitudinal channel connection in key fish migration periods during prolonged dry periods. These rules are:

- If inflow to Dunoon dam is less than 0.7 ML/d, maintain release from Dunoon dam of 0.7 ML/d.
- If, by March 1, there has been < 3 days of inflows ≥ 100 ML/d (either as one or multiple events) over the preceding 60 days, release 100 ML/d for 3 consecutive days.
- If, by August 1, there has been < 3 days of inflows ≥ 100 ML/d (either as one or multiple events) over the preceding 60 days, release 100 ML/d for consecutive 3 days.
- If, by October 1, there has been < 3 days of inflows ≥ 100 ML/d (either as one or multiple events) over the preceding 50 days, release 100 ML/d for consecutive 3 days.

These general environmental and contingency flow rules provide for a largely unchanged flow regime for flows up to 100 ML/d. Field assessment undertaken by ELA (2012b) showed that at this level all key barriers downstream of the main proposed dam infrastructure are open to Eastern Freshwater Cod movement. In addition, flows in this range (base to moderate flows) provide for the other key environmental processes of fauna habitat provision, movement of smaller fish and other vertebrates, fine sediment flushing and water quality maintenance. Contingency flows potentially enhance the system by introducing flow pulses in periods where the current system had sustained low flows (ELA, 2012b).

Detailed assessment of the potential impacts of the proposed dam on the flow regime of the Rocky Creek system considering the proposed environmental flow regime and changes to the operation of other water supply resources was undertaken by ELA (2012b). The environmental flow regime provides a substantial mechanism to minimise the impacts of dam operation on the Rocky Creek system while maintaining the downstream environment. Whole-of-catchment solutions will also assist in mitigating impacts of the proposed dam. The conservation of native vegetation riparian zones, including the buffer zone surrounding the dam as well as the creeks that make up the Terania system (i.e. Rocky Creek, Tuntable Creek and Terania Creek) will help to maintain and improve water quality and habitat for aquatic species, including those identified threatened species (ELA, 2012b).

The environmental flows assessment also recommended that mitigation measures should be incorporated into environmental management plans relating to both construction and operation to manage impacts on the system as a result of the proposed environmental flow regime. Monitoring of hydrology, water quality and aquatic ecology during the pre-construction and operational phases of the project was also recommended.

The review of environmental flow regimes (Hydrosphere Consulting, 2020d) concluded the following in relation to Dunoon dam:

- Previous assessment of environmental flows by ELA (2012b) followed a holistic approach incorporating multi-faceted ecosystem components and supported by field survey data and modelled flow data under a range of flow scenarios. The study was completed over 8 years ago but the methods employed remain valid and reflect contemporary environmental flow assessment methods.
- One exception was the reliance on a small number of benchmark fish species to establish environmental flow requirements. Further investigation of fish species within the subject site and connected aquatic environments is recommended to update species information and allow for a comprehensive assessment as to the suitability of the environmental flow regime proposed by ELA (2012b). This would include providing more information to determine whether the presence of key species used in determining environmental flows (e.g. Eastern Freshwater Cod) occur naturally or only exist through artificial stocking.
- Should Dunoon dam be considered further as a future source, there may be opportunities for development of a balanced system of synergistic operating rules and environmental flow releases from RCD to Dunoon dam, providing benefits for Rocky Creek in the reach between the two dams (approximately 8 km).

8.8 Cultural Heritage

A preliminary Heritage Impact Assessment was undertaken for the proposed Dunoon dam (Ainsworth Heritage, 2013). The assessment was updated following a peer review (Australian Museum Business Services, 2012). A summary of the findings of the heritage assessment from Ainsworth Heritage (2013) is provided below.

Ainsworth Heritage (2013) reviewed the Aboriginal and non-Aboriginal history of the Dunoon area. Settlement of the area was undertaken first by the Widjabul people of the Bundjalung Nation, who were then displaced from the land by white settlers. The arriving white settlers first cleared and then cultivated the land for various crops, a process that has continued to the current day.

Based on the information gleaned from the research phase of the assessment, a field survey was undertaken which sought to identify and record both Aboriginal and Non-Aboriginal sites. Thirteen Non-aboriginal sites were located, which were assessed to have varying significance of a local nature. The most notable sites were the Depression era causeway and the Fraser Road and McPherson Homesteads. Numerous Aboriginal sites were located, consisting of scarred trees, grinding grooves, artefacts and a collection of burials. The collection of Aboriginal sites together is generally of State significance, allowing assumptions on how the Widjabul utilised and accessed the valley over time. Large sections of the dam area were inaccessible due to a combination of thick vegetation and steep terrain in conjunction with inclement weather patterns. The recommendations of the assessment have outlined where additional research will be required to ensure that any future impact is properly assessed and mitigated if the proposed dam is to go ahead.

Due to the nature of the proposed development, the vast majority of sites will undergo high impact which will result in the loss of most of the sites unless mitigation measures are put in place. As part of the review of the draft report, the views of both the Aboriginal Stakeholders and the wider community was sought in order to ensure that the management and mitigation measures, largely concerned with recording and recovery, are undertaken in consultation and conjunction with the relevant stakeholders. This is in accordance with OEH guidelines and will provide much greater certainty for the recommendations and conclusions of the report.

Non-Aboriginal heritage within the proposed dam site which would see high impact has been determined to be of little or no significance and presents no impediment to any future plans for the site. However, management recommendations have been developed by Ainsworth Heritage (2013b) for individual sites

Ainsworth Heritage (2013b) considers that there remains a risk that the approval of the proposed development may be refused on heritage grounds. The assessment recommends that further investigations of the burials with limited excavation is undertaken, subject to relevant approvals and not before all other water augmentation options have been considered. Areas for future assessment for Potential Archaeological Deposits (PADs) have also been identified. Continued consultation with Aboriginal stakeholder groups as to the best methods of protection for all identified sites is also required (Ainsworth Heritage, 2013).

Based on the inundation area (Figure 8), most cultural heritage sites are likely to be impacted through inundation for both the 20 GL and 50 GL storages (apart from the eastern-most site and the historic site to the south-east) although the elevation of the sites has not been documented. The two historic sites to the north may be outside the inundation area for the 20 GL dam. The Aboriginal marked trees in the dam infrastructure area could potentially be protected. Inundation of the sites with a smaller dam (FSL at lower elevation) has not been determined.

8.9 Secure Yield

NSW Urban Water Services (2013) assessed the yield benefit from the 20 GL and 50 GL Dunoon dam for the current climate and 1ºC warming as part of the IWP process (Table 13).

Table 13: Increase in system secure yield with Dunoon dam

Option	Historic climate (5/10/10)	Reduction factor[1]	1°C climate warming
20 GL Dunoon dam	9,750	0.858	8,366
50 GL Dunoon dam	20,450	0.858	17,546

Source: NSW Urban Water Services (2013)
1. Reduction factor was not calculated for the 20 GL option and the factor for the 50 GL option has been applied.

The secure yield will be re-assessed using the RCC Bulk Water Supply Security Model to optimise transfer and operating rules. The 2020, 2030 and 2060 secure yield of the Dunoon dam options is shown in Figure 11, using a similar approach as for the current system (Section 6.2).

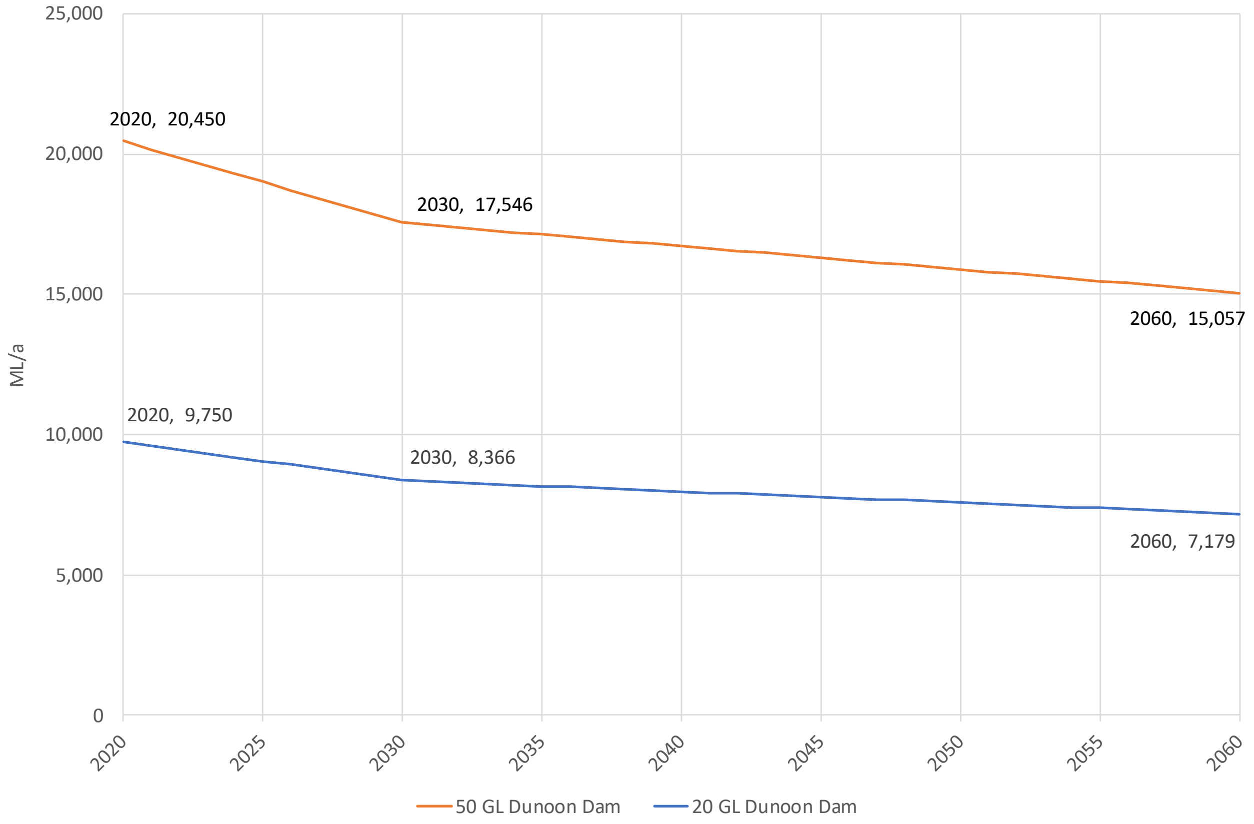

Figure 11: Secure yield estimates – Dunoon dam options

8.10 Cost Estimates

Preliminary cost estimates have been developed by NSW Public Works Advisory (2020b) for the capital and operating costs of the 50 GL and 20 GL Dunoon dam options as detailed in Table 14. Net present value (NPV) calculations are included in Appendix 1. The cost estimates for the 20 GL dam assume that it will be raised in future to a 50 GL dam (i.e. transfer systems and other infrastructure are sized for the 50 GL dam). The cost of a 20 GL dam without provision for the dam raising has not been estimated.

Table 14: Dunoon dam preliminary cost estimate

Component	20 GL dam, (2020 $)	50 GL dam, (2020 $)
Roller compacted concrete dam	$80,473,250	$112,275,735
Pumping station	$16,091,790	$16,091,790
Rising main	$18,901,740	$18,901,740
Roadworks	$17,345,900	$17,345,900
Indirect costs	$55,384,835	$55,384,835
Total initial capital cost	$188,197,515	$220,000,000
Renewal costs (80 years)	$53,660,100	$54,280,200
Maintenance costs (80 years)	$11,750,275	$12,190,755
Operating costs (80 years)	$110,083,461	$110,515,416
Whole-of-life (80 years)	$363,691,351	$396,986,371
NPV (80 years @ 5%)	$204,345,989	$234,596,513
NPV (40 years @ 5%)	$196,325,548	$226,526,974
Yield benefit (2020 – 2060) ML/a	7,179	15,057
NPV/ML secure yield (40 years)	$27,347	$15,045

8.11 Power Consumption

The total estimated power consumption for the dam options is shown in the following table.

Table 15: Power consumption – dam options

Component	Production (average 2030 – 2060, ML/a)	Consumption (kWhr/kL)	Energy use (average 2030 – 2060, MWhr/a)
Dam (20 GL or 50 GL)	3,906	1.60	6,250
Nightcap WTP upgrade	3,906	0.91	3,554

Source: MWH (2014)

8.12 Data Gaps and Key Risks

To progress the development of the Dunoon dam option, data gaps and risks need to be addressed as discussed in the following table. These would be undertaken as part of planning stages and would be completed prior to a decision to proceed with the planning and approvals for the dam option (outlined in Section 8.3).

Table 16: Data gaps and project risks – Dunoon dam

Item	Discussion	Action required
Additional concept design	• Preliminary longitudinal elevation plans for the proposed rising main and construction and easement acquisition costs. • Infrastructure maintenance and renewal requirements. • Design basis for all aspects of the project to provide the basis for detailed design. • Destratification options. • Review of capacity of Corndale quarry to supply aggregate. • Dam amenities, site security landscaping and revegetation. • Confirmation of power supply arrangements. • Environmental monitoring requirements. • Construction strategy. • Procurement and contracting strategy. • Detailed project program.	RCC has commenced these investigations.
Dam break study	• Dam design in accordance with the latest (2019) Dam Safety Regulations and ANCOLD Guidelines.	RCC has commenced these investigations.
Road upgrade requirements	• Assessment of road transport network and road improvements required.	RCC has completed these investigations.
Cost estimates	• Review of total project (capital) cost estimations for both the 20 GL and 50 GL dam. • Peer review of capital and recurrent costings. • Identification of RCC costs. • Risk and opportunity assessment to identify contingency allowances.	RCC has commenced these investigations.
Hydrology	• Revised flood hydrology to provide updated loading on the dam structures for the dam break study with additional hydrographs to assess downstream flood impact. • A review of all hydrology in accordance with Australian Rainfall and Runoff (2016/2019). • Flood impact assessment.	RCC has commenced these investigations.
Mini hydropower	• Assessment of economic viability of downstream discharge structure to incorporate mini-hydroelectricity generation plant feeding power to the site and/or the electricity grid.	RCC has commenced these investigations.
Geotechnical investigations	• Comprehensive geotechnical investigations are required for the storage basin and the roller compacted concrete wall and all appurtenant structures to refine the geological model and to prove the properties of construction materials. • Geotechnical investigations are also required for the raw water rising main and new access road.	Detailed design stage - while the geotechnical conditions of the site represent significant risk to the project, the intrusive nature of the investigations precludes further work at this stage.

Item	**Discussion**	**Action required**
Community engagement	• Development and implementation of a community engagement strategy is required.	RCC has commenced consultation activities as part of the assessment of supply scenarios (Section 14). An ongoing engagement strategy will be developed as part of the outputs of the Future Water Project 2060.
Survey	• Detailed survey of the pipeline route, access road and dam infrastructure locations is required. • Downstream development data would also be required for the dam break study.	Detailed design stage.
Detailed design	• Detailed design of all infrastructure. • An updated seismic hazard assessment and time history analysis should be obtained from the Seismic Research Centre from which appropriate earthquake load accelerations and parameters could be derived.	Detailed design phase
Biodiversity offset strategy	• Preparation of Biodiversity Development Assessment Report in accordance with *the Biodiversity Conservation Act, 2016*. • Review of offset requirements to include mitigation of potential impacts on aquatic and riparian habitat. • Development of an offset strategy and potential stewardship arrangements.	Specialist studies
Aquatic ecology and environmental flows	• A fishway is not currently included in the concept design. More detailed investigation of fish species within the subject site and connected aquatic environments, the interactions between the environmental flow regime, upstream and downstream environments and aquatic ecology is required. • Development of a balanced system of synergistic operating rules and environmental flow releases from RCD to Dunoon dam may provide benefits for Rocky Creek in the reach between the two dams. • The ELA (2012b) recommends further study of the increase in the peak magnitude of flood events given that the current modelling of flow regimes that included RCD and Dunoon dam at full capacity indicated that some flow events may lead to increased flood peaks above those that might have occurred in a natural regime. This model should include capacity to model water temperature, sediment and other water quality parameters to provide for a detailed hydro-dynamic assessment of the proposed dam. • Consultation with DPI-Fisheries.	Specialist studies

Item	Discussion	Action required
Buffer zone planning	• Land acquisition of buffer zone area. • Vegetation survey to confirm the level of rehabilitation work required in the area. • Development of management plans for the water quality protection areas and for the remaining catchment outside of the buffer zone. • Development of a water quality management system for the Rocky Creek/Dunoon dam system.	Specialist studies
Cultural heritage	• Ainsworth Heritage (2013b) recommends that further investigations of the burials with limited excavation is undertaken, subject to relevant approvals and not before all other water augmentation options have been considered. • Areas for future assessment for PADS have also been identified. • Continued consultation with Aboriginal stakeholder groups.	Specialist studies

8.13 Recommendation

Council's preliminary investigations to date show that the proposed Dunoon Dam is technically viable and would provide a significant yield increase although cultural heritage and ecological concerns are key considerations. Further detailed studies would be required prior to a decision to proceed with the dam option. These studies are expected to take three years to complete.

9. OPTION 2: MAROM CREEK WTP

9.1 Background

The Marom Creek water supply and WTP are owned and operated by BaSC. The Marom Creek water supply serves Meerschaum Vale, Wardell, Cabbage Tree Island and some rural customers. Water is sourced from a weir pool on Marom Creek. The water access licence entitles BaSC to extract 200 ML/a. The Ellis Road and Lindendale bores were formerly used to supply drinking water however they have been decommissioned. BaSC has existing licences to extract groundwater from these supplies (350 ML/a and 200 ML/a respectively).

Marom Creek WTP currently supplies a population of approximately 830 people with a maximum demand of up to 550 kL/d. The WTP has a capacity of 2.3 ML/d, limited by the capacity of the clear water pumps (CWT, 2018). The existing plant and raw water source have the capacity to supply the existing BaSC service area until 2036 (750 kL/d), however the WTP requires upgrading in order to be able to meet water quality targets. The existing surface water licence (548 kL/d) is sufficient to supply the current demand.

BSC has developed a 20-year Master Plan for the Marom Creek WTP (Master Plan) and related assets (CWT, 2018). The Master Plan identifies WTP improvements required to address operational issues, process performance and monitoring, maintaining compliance with drinking water quality standards, refurbishment or replacement of existing assets and maintaining capacity to meet current and future demands. The Master Plan covers the Marom Creek catchment and supply from Marom Creek Weir including demand requirements for existing Wardell customers and potential servicing of Alstonville and Wollongbar (currently served by the RCC bulk supply system).

Use of the Marom Creek weir and WTP are listed as a potential emergency supply options in the *Regional Water Supply Drought Management Plan* (Section 3).

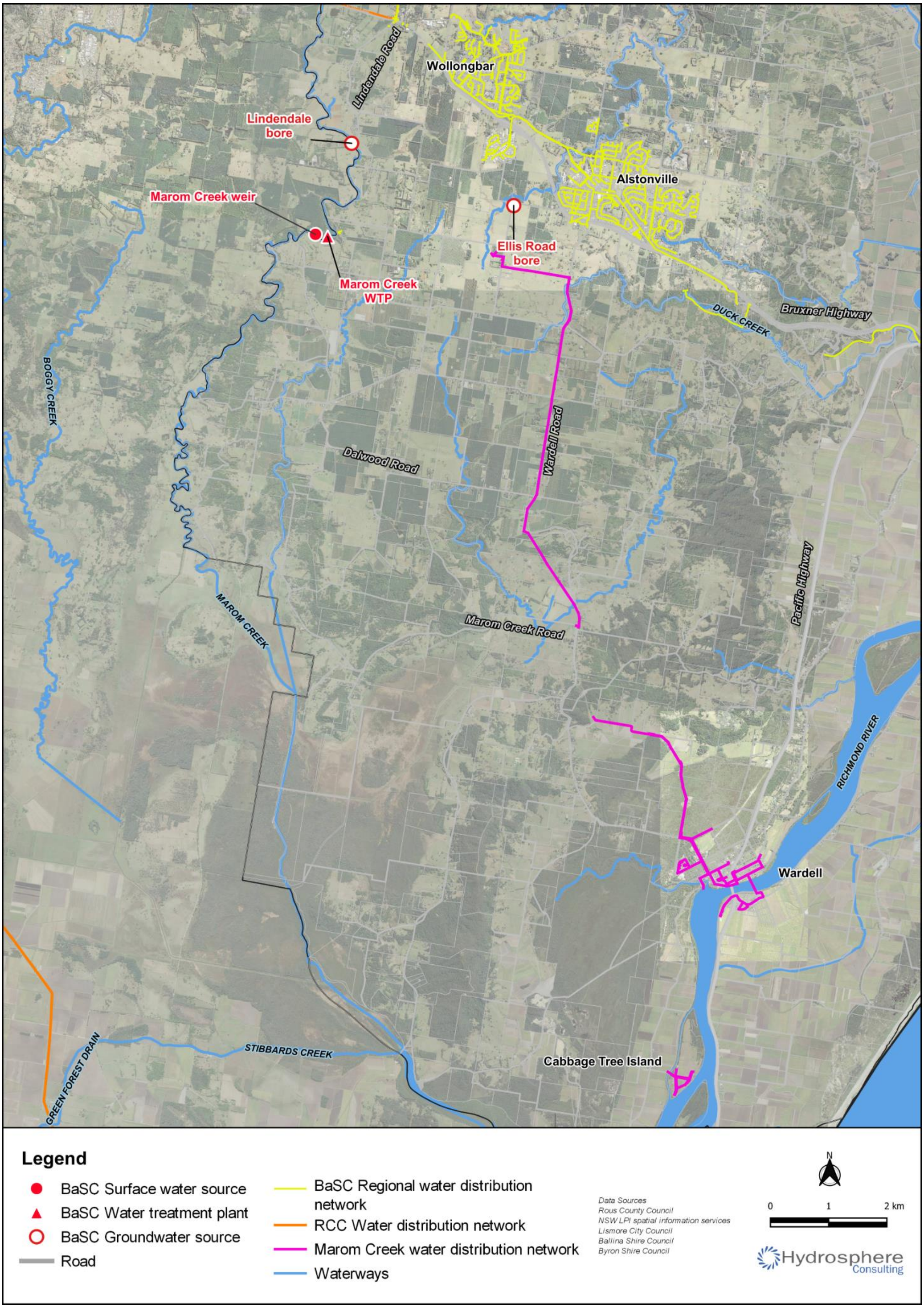

Figure 12: Marom Creek water supply

GIS data for the groundwater transfer and treated water distribution pipelines provided by BaSC appear to be incomplete.

9.2 Secure Yield

Data on current secure yield of Marom Creek Weir assumed in the Master Plan was based on a secure yield study (NSW Urban Water Services, 2017). This study assesses the current and future secure yield from the weir storage with capacity of 66 ML and 420 ML (based on two different estimates of existing storage capacity), Marom Creek WTP capacity (existing 225 kL/d and upgraded to 4.75 ML/d) and the licence extraction limit (200 ML/a).

The yield of the existing Marom Creek weir has been assessed as sufficient to service Wardell into the future (CWT, 2018). The yield of the surface water with storage capacity of 66 ML with no limit on raw water transfer was found to be 417 ML/a, reducing to 299 ML/a with climate change (NSW Urban Water Services, 2017). However, the yield is limited by the existing licence limit of 200 ML/a. Source augmentation would be required to service other areas e.g. Alstonville or parts of Lismore. The existing yield of the Marom Creek water supply is shown on Figure 13.

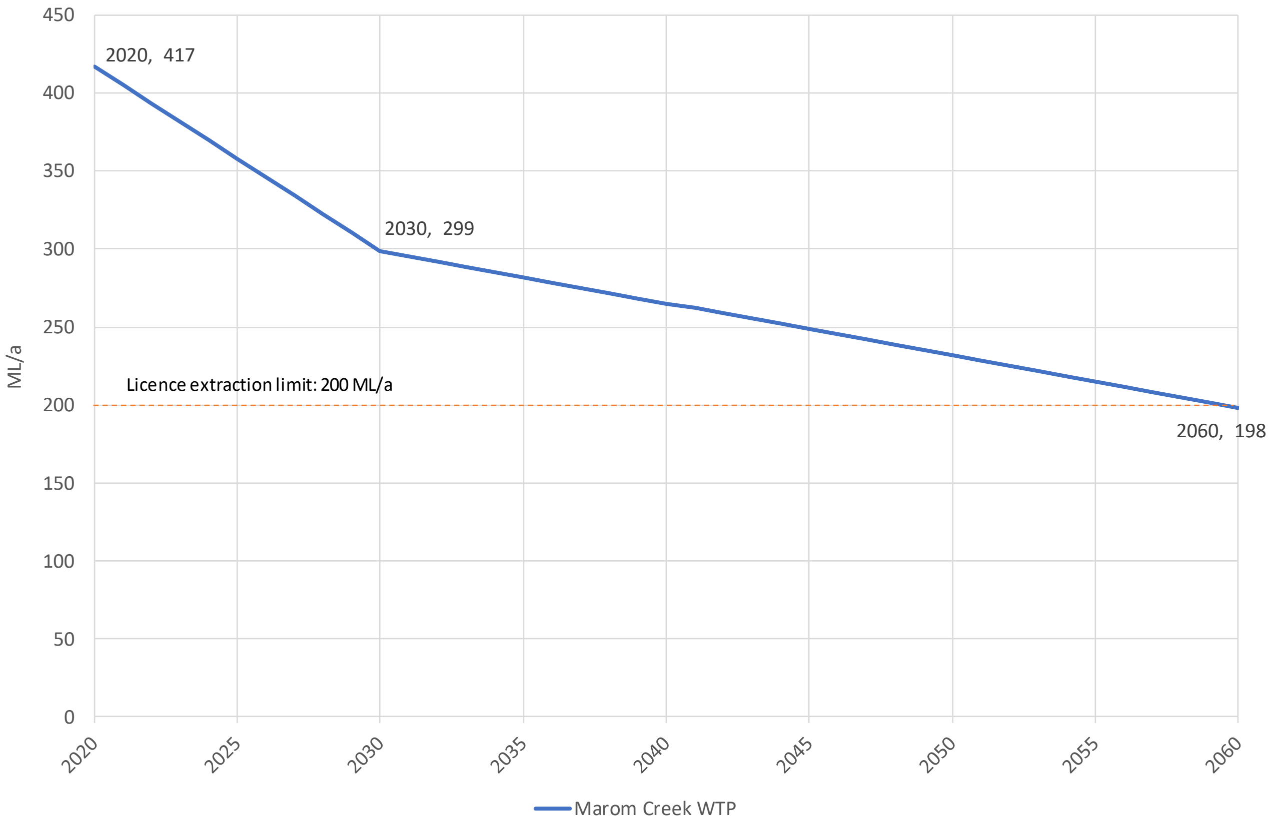

Figure 13: Secure yield estimates – Marom Creek

Options considered in the Master Plan (CWT, 2018) to increase the supply of water were:

- Raising Marom Creek weir to increase storage to 420 ML. There has been limited investigation into the feasibility of this option.
- Gum Creek Weir - a small, disused weir located near the intersection of Gum Creek and Dalwood Road.
- Lindendale and Ellis Road bores - aquifer supplies previously used for drinking water (and included in the RCC operating rules when RCD reaches 30%).

The Master Plan recommended a supply strategy including raising Marom Creek Weir and increasing the licence extraction limit to 1,258 ML/a (future demand of Wardell, Alstonville and Wollongbar is predicted to be 1,126 ML/a) and refurbishment of Ellis Road bore and connection to Marom Creek WTP (to be upgraded).

The RCC yield study report (NSW Urban Water Services, 2018) assessed the yield of the RCC bulk supply system with Marom Creek water supply included and found that the secure yield with historic climate would increase by 932 – 1,011 ML/a depending on the Wardell demand (not considering the existing licence limit or WTP capacity).

The option considered in this report involves transfer of the Marom Creek WTP to RCC with the excess capacity used to serve Alstonville, Wollongbar and potentially Lismore. The current spare capacity of the WTP is 0.8 ML/d (198 ML/a). Future augmentation of the Marom Creek WTP is possible (e.g. to 4.3 ML/d as proposed by CWT (2018)). This relies on increasing the surface water licence limit to supply the extra raw water demand. WTP upgrades would also be required to meet water quality requirements.

9.3 Cost Estimates

Preliminary cost estimates have been developed by CWT (2018) for the capital and operating costs of the Marom WTP upgrade as detailed in Table 17. NPV calculations are included in Appendix 1.

Table 17: Marom Creek WTP upgrade preliminary cost estimate

Component	Cost Estimate (2020 $)
Engineering	$1,831,750
WTP upgrade	$7,327,000
Total initial capital cost	$9,158,750
Renewal costs (80 years)	$5,641,791
Maintenance costs (80 years)	$49,365,702
Operating costs (80 years)	$19,402,383
Whole-of-life (80 years)	$83,568,626
NPV (80 years @ 5%)	$24,561,843
NPV (40 years @ 5%)	$22,088,688
Yield benefit (2020 – 2060) ML/a	198
NPV/ML secure yield (40 years)	$111,559

9.4 Power Consumption

The total estimated power consumption for the Marom Creek WTP option is shown in the following table.

Table 18: Power consumption – Marom Creek WTP option

Component	Production (ML/a)	Consumption (kWhr/kL)	Energy use (MWhr/a)
Marom Creek WTP upgrade	1,570	0.91	1,421

Source: CWT (2018)

9.5 Data Gaps and Key Risks

To progress the development of the Marom Creek option, data gaps and risks need to be addressed as discussed in the following table. These would be undertaken as part of planning stages and would be completed prior to a decision to proceed with the planning and approvals for the option.

Table 19: Data gaps and project risks – Marom Creek

Item	Discussion	Action required
Licence limit	• Increased extraction limit will be required to meet future demand	RCC has had preliminary discussions with DPIE – Water which indicate that it will be possible to increase the extraction limit. Further liaison with DPIE-Water is required.
Asset ownership	• Assets are currently owned by BaSC.	RCC will liaise with BaSC regarding the potential for transfer of assets.
Secure yield	• Existing system – storage volume is to be confirmed and yield to be re-assessed if required. • Groundwater options – requires assessment. • Weir raising – requires re-assessment following detailed storage survey. • Optimisation of yield with connection to existing regional supply.	RCC will liaise with BaSC regarding the investigations required.
Concept development	• Confirmation of water source, WTP, service area and transfer system concept.	RCC will liaise with BaSC and regulatory agencies regarding the investigations required.
Community engagement	• Development and implementation of a community engagement strategy is required.	RCC has commenced consultation activities as part of the assessment of supply scenarios (Section 14). An ongoing engagement strategy will be developed as part of the outputs of the Future Water Project 2060.
Detailed design	• Detailed design of all infrastructure.	Detailed design phase
Cost estimates	• Review of total project cost estimates	Detailed design phase

9.6 Recommendation

The use of Marom Creek weir and WTP as part of the RCC regional supply system, to service Alstonville and Wollongbar in addition to Wardell (the current BaSC service area) is considered viable with a short lead time and therefore should be considered as an initial stage of potential regional supply scenarios.

10. OPTION 3: GROUNDWATER

10.1 Background

Detailed investigations into the identification and assessment of groundwater sources were undertaken in 2015 (Jacobs, 2015a; Jacobs, 2015b; Jacobs, 2015c; Jacobs, 2015d; Jacobs, 2015e) to review the available data and information on regional groundwater sources. Based on an assessment of the geology and hydrogeology, the initial studies identified three areas with the potential to host groundwater supply schemes at North Lennox Head-Newrybar (coastal sands aquifer), Woodburn (coastal sands aquifer) and Dunoon (basalt). In 2016, three stages of drilling programs were undertaken in these three areas to further investigate the groundwater yields and water quality (Jacobs, 2017a; Jacobs, 2017b; Jacobs, 2017c). As a result, the investigations were expanded to include the Tyagarah area and the basalt aquifer in the Alstonville area. Further desktop, surface geophysical and hydrogeological investigations of the areas identified at Tyagarah and Newrybar were undertaken to identify the areas with the potential to provide groundwater supply (Groundwater Imaging, 2017).

The final locations for groundwater supply options have been identified in the detailed investigations as follows:

1. Woodburn.
2. Newrybar.
3. Tyagarah.
4. Alstonville.

The water quality risk assessment carried out for each of these areas provided guidance for development of these options including the appropriate drinking water treatment processes that should be applied in each area to deliver water that complies with the Australian Drinking Water Guidelines and the level of risk mitigation required to address the potential hazards identified due to the location of the bores and the nature of the borefield recharge areas.

10.2 Environmental, Land Use and Heritage Considerations

Jacobs (2015b) provided a high-level review of environmental, land use and heritage issues within the study area to provide context to potential source areas and schemes. Issues covered included:

- Planning and statutory requirements – there were no issues identified that would present a risk to approvals for investigation or development stages for the final locations.
- Land contamination – no areas of contamination were identified that would make the final sources unsuitable as a source of water.
- Heritage – potential impacts on known heritage sites were considered.
- Environmental issues that may impact on the sustainability of different sources. Environmental issues considered for the development of the permanent bores were:
    - Potential impact on groundwater dependent ecosystems (GDEs) and flows in waterways where groundwater contributes significantly. While these impacts can generally be managed, potential impacts were avoided.
    - Proximity to acid sulphate soil areas – lowering of groundwater tables may result in the oxidation of these soils and associated impacts.

- Direct and indirect impacts of supporting infrastructure to permanent bores. This includes pipelines to connect the bores to regional water reticulation networks, pumping stations, water treatment facilities etc. In terms of direct impacts, the supporting infrastructure may have more substantial impacts than the actual bore infrastructure. This may include impacts on threatened ecological communities, flora and fauna, Aboriginal heritage and cultural sites, non-Aboriginal heritage sites, acid sulphate soils and sensitive receptors for noise and waterways.

Jacobs (2015d) provided a multi-criteria assessment of all potential groundwater options considering the impact on GDEs at the proposed depth, the likelihood of increasing acid sulfate soil risk and known heritage issues. The results of the assessment for the Woodburn, Newrybar, Tyagarah and Alstonville options are summarised in Table 20. Further assessment will be required, however significant impacts can be avoided through site selection.

Table 20: Environmental and heritage assessment outcomes – groundwater options

Criteria	Woodburn	Newrybar	Tyagarah	Alstonville
Impact on GDEs at the proposed depth	Few GDEs but impacts manageable	Some GDE impacts, management unknown	Several GDEs, management difficult	Some GDE impacts, management unknown
Likelihood of increasing acid sulfate (ASS) soil risk	Medium probability of ASS <3m. Receptors >300m distance. Management required	Low probability of ASS <3m. Receptors >500m distance. Minor management required	Medium probability of ASS <3m. Receptors >300m distance. Management required	No known ASS to occur, no nearby receptors, no management required
Known heritage issues	No listed heritage sites, no management required	Known heritage in source area but impacts can be managed	No listed heritage sites, no management required	Some heritage areas but not adjacent to bore sites, no management required

Source: Jacobs (2015d)

The groundwater options are discussed in the following sections.

10.3 Option 3-1: Woodburn

There is an existing bore supply at Woodburn consisting of three bores (No. 1, No. 2 and No. 3) in the coastal sands aquifer which augments the supply to the Lower Richmond River supply area (Woodburn, Broadwater, Evans Head and Coraki) during dry periods (Section 3). In 2007/08 the borefield produced 46 ML. The existing borefield has a licence entitlement of 726 ML/a. Bores 1 and 2 have been compromised by the development of the Pacific Highway and are no longer used. Bore 3 has been replaced and is used as an emergency supply (introduced when RCD is at 60% full) in the current RCC supply regime.

Based on the findings of the initial groundwater investigations, desktop investigations were undertaken for a potential new borefield scheme at Woodburn. Jacobs (2017d) provided preliminary aquifer modelling and determined borefield production estimates for the coastal sands aquifer in the Woodburn area and found that the Woodburn aquifer is capable of supplying the 2060 annual day demand for the Lower Richmond River supply area. Water quality was determined to be suitable for drinking water if appropriate treatment is implemented (iron and manganese removal) (Jacobs, 2018a). A concept design and capital cost estimate have been prepared for the scheme (Jacobs, 2018b).

The concept design for the Woodburn borefield includes four production bores (existing No. 3 and new No. 4, No. 5 and No. 6) which would operate 22 hours per day at 16 L/s providing a maximum borefield capacity of 5.0 ML/d. Bore pumps would be designed to operate with a 10 m maximum draw down in each bore (Jacobs, 2018b).

Treated water would be transferred to the existing Lower Richmond River supply system. The groundwater WTP would be located on the site of the existing chlorination facility and have a daily production capacity of 5.0 ML/d (Figure 14). The WTP would require the following treatment processes:

- Aeration unit with provision for pre-chlorination.
- Pre lime dosing for pH correction and alkalinity (if necessary) for reliable coagulation.
- Chemical coagulation with alum and flocculation.
- Upflow clarification to settle and remove floc (as waste sludge).
- Filtration of clarified water through multi-media gravity filter with filter air and water backwash.
- Collection of clarifier waste sludge and filter backwash water to enable recovery of washwater for blending.
- Thickening and disposal of sludge.
- UV disinfection designed for 4.0 log removal for Cryptosporidium.
- Post soda ash dosing for pH correction, and fluoridation.
- Chlorination to provide effective disinfection and a free chlorine residual to protect the treated water transfer system against recontamination.

If required ozonation and biologically activate carbon (BAC) filtration would be included between filtration and UV disinfection as a barrier to potential organic pollutant and taste and odour precursors.

Figure 14: Woodburn groundwater WTP inlet and layout

Source: Jacobs (2018b)

10.4 Option 3-2: Newrybar

Two options for groundwater supply at Newrybar have been identified (north and south) which may be combined to reduce capital costs. Concept designs and cost estimates for the Newrybar groundwater scheme are provided in Jacobs (2020b). The groundwater supply from these two sources would be combined with existing supplies to the Knockrow reservoir.

Based on the results from test bores in the vicinity, the total dissolved solids (TDS) of the water drawn from continuous operation of bores at the Newrybar south site would be around 5,000 mg/L resulting in the need for brackish water desalination of the groundwater to produce drinking water quality. The groundwater would require conventional treatment to clarify the water before reverse osmosis (RO) to remove salinity (Jacobs, 2020b). The method and costs associated with waste disposal from this treatment process have not yet been determined.

Up to 5 production bores and a standby bore each capable of producing 15 L/s (75 L/s in total) for a period of 22 hrs/day resulting in a daily brackish groundwater production of capacity of 6.0 ML/d from the south borefield. The estimated final output is 5.4 ML/d of drinking water discharged to the Knockrow reservoir and 0.6 ML/d of brine. A supply of low TDS groundwater is proposed in north Newrybar from 5 production bores and one standby bore each capable of producing 5 L/s (25 L/s in total) for 22 hrs/day with a daily production capacity of 2.0 ML/d. It is proposed to combine the two borefield supplies with treatment at a single WTP. The integrated Newrybar groundwater scheme would require a WTP comprised of a conventional clarifier and RO.

10.5 Option 3-3: Tyagarah

Concept designs and cost estimates for the Tyagarah groundwater scheme are provided in Jacobs (2020b). There are two schemes which have been identified for utilising the groundwater produced at Tyagarah. Scheme 1 would transfer the treated groundwater to the Ocean Shores reservoirs (Saddle Road, Yamble and Warrambool) and Rous retail customers and Scheme 2 to the St Helena reservoir.

Jacobs (2020b) considered that the schemes could be constructed in two stages:

- Scheme 1:
    - Stage 1 - supply 6.4 ML/d of treated water from four production bores and one standby bore. Groundwater treated at a new WTP with the capacity to treat both stages.
    - Stage 2 - construction of an extra bore to supply 7.5 ML/d.
- Scheme 2:
    - Stage 1 - supply 10.8 ML/d of treated water from six production bores and one standby bore. Groundwater treated at a new WTP with the capacity to treat both stages.
    - Stage 2 - construction of an extra bore to supply 12.5 ML/d.

The option considered in this report includes initial construction of Scheme 1, Stage 1 with future expansion to include Scheme 2 with an ultimate groundwater supply of 12.5 ML/d. The future scheme would supply all of the Byron Shire apart from Bangalow with treated water distributed to the Ocean Shores reservoirs, retail customers along the Brunswick 300 trunk main and St Helena reservoir (servicing Byron Bay and Rous retail customers).

10.6 Option 3-4: Alstonville

The existing Alstonville borefield consists of 2 production bores, one at Lumley Park and one at Converys Lane which extract groundwater from fractured basalt to augment supply during dry periods (Section 3). The Converys Lane bore (introduced when RCD is at 60% full) and Alstonville plateau bores (introduced when RCD is at 30% full), are included in the current RCC supply regime. This option proposes that the bore at Lumley Park be retained while the bore at Converys Lane would be replaced with a new bore adjacent to the existing bore. Concept designs and cost estimates for the Alstonville groundwater scheme are provided in Jacobs (2020b). The two bores would operate 22 hours per day and a minimum of 320 days per year. This option proposes the construction of a standby bore at Elvery Lane to provide operational security. The existing water licence for the Converys Lane bore can be transferred to the replacement bore providing it is constructed within 20m of the existing bore. A new WTP and a transfer pump station and pipeline to transfer the groundwater to the Wollongbar reservoir would be required. The estimated long-term capacity of the two bores is 4.5 ML/d.

Jacobs (2020b) also considered the option of utilising the existing Marom Creek WTP (refer Section 8.13) to treat groundwater from the Alstonville borefield. The existing Marom Creek surface water supply would be blended with the groundwater supply. Cost savings would be achieved by utilising the existing Marom Creek WTP and the existing pipeline from the Marom Creek WTP to Wollongbar reservoir (not presently used) to transfer groundwater to the WTP. A new pipeline from the Marom Creek WTP to Wollongbar reservoir would be required.

The option considered in this report is the new bores at Wollongbar and Alstonville, with groundwater transferred to the Marom Creek WTP with distribution to customers from the Wollongbar reservoir.

10.7 Summary of Groundwater Options

10.7.1 Borefield and WTP capacity

A summary of the four groundwater options considered in this report is given in Table 21.

Table 21: Summary of groundwater options

Borefield	Groundwater inflow to WTP (ML/d)	WTP capacity (ML/d)	Treatment process
Woodburn	5.0	5.0	Conventional
Integrated Newrybar	8.0	7.2	Conventional and RO
Tyagarah (Scheme 1, Stage 1)	7.5	6.4	Conventional
Tyagarah (Scheme 2)	13.9	12.5	Conventional
Alstonville	4.5	4.0	Conventional

Source: adapted from Jacobs (2020b)

10.7.2 Secure yield

The secure yield of the groundwater schemes has been assessed using the RCC Bulk Water Supply Security Model (Engeny, 2021) with results shown in Table 22. The secure yield assessment assumed the groundwater sources would be operated once RCD reaches 95% full. The 2020, 2030 and 2060 secure yield of the groundwater options is shown in Figure 15, using a similar approach as for the current system (Section 6.2).

Table 22: Increase in system secure yield with groundwater schemes

Option	Transfer capacity (ML/d)	Historic climate (5/10/10)	Reduction factor[1]	1°C climate warming
Woodburn	4.0	800	0.932	745
Integrated Newrybar	Stage 1: 6.0 Stage 2: 1.2	2,100		1,956
Tyagarah (Stage 1)	7.5	2,050		1,910
Tyagarah (Stage 2)	5.0	3,950		3,679
Alstonville	3.5	1,050		978

Source: Engeny (2021)

1. Reduction factor was only calculated for the combined groundwater schemes and has been applied to each scheme.

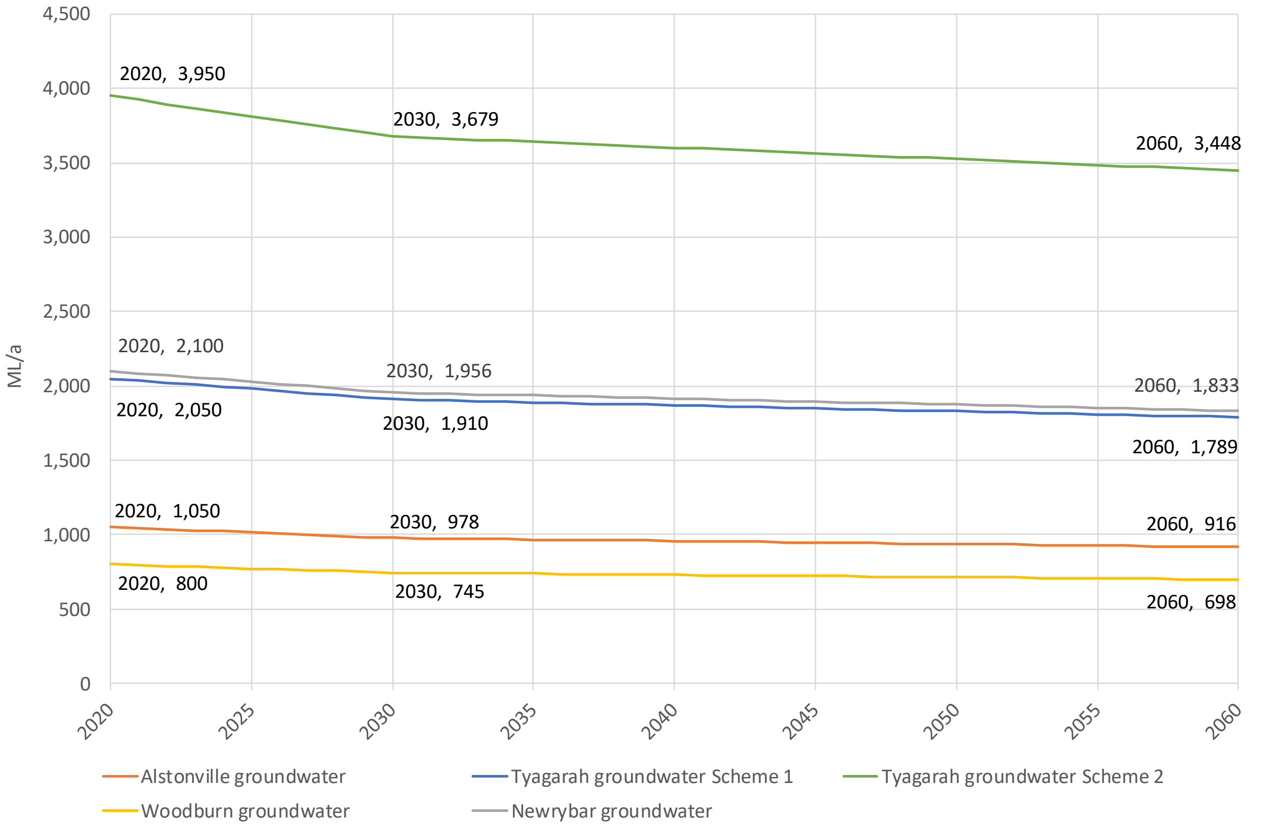

Figure 15: Secure yield estimates – groundwater options

10.7.3 Cost estimates

Preliminary cost estimates for each groundwater option have been provided by Jacobs (2020b) as detailed in Table 23. NPV calculations are included in Appendix 1.

Table 23: Groundwater preliminary cost estimate

Component	Woodburn (2020 $)	Integrated Newrybar (2020 $)	Tyagarah (Scheme 1, Stage 1) (2020 $)	Tyagarah (Scheme 2) (2020 $)[1]	Alstonville (2020 $)
Pre-construction costs	$3,812,000	$14,535,000	$11,355,000	$2,930,000	$7,612,000
Construction costs	$31,685,000	$47,160,000	$37,250,000	$25,206,250	$17,344,000
Integration costs	$985,000	$1,460,000	$1,175,000	$635,000	$985,000
Total initial capital cost	$36,482,000	$63,155,000	$50,852,000	$30,462,250	$25,941,000
Renewal costs (80 years)	$67,928,077	$79,534,935	$96,773,395	$127,695,494	$67,433,077
Maintenance costs (80 years)	$13,104,300	$18,984,800	$9,242,510	$23,261,600	$4,546,510
Operating costs (80 years)	$52,288,000	$113,316,000	$72,420,960	$108,479,120	$45,843,200
Whole-of-life (80 years)	$169,802,377	$274,990,195	$229,288,865	$277,659,139	$143,763,787
NPV (80 years @ 5%)	$55,817,346	$98,566,607	$76,008,100	$70,231,337	$44,109,829
NPV (40 years @ 5%)	$51,230,292	$91,091,988	$69,888,062	$61,558,652	$40,065,265
Yield benefit (2020 – 2060) ML/a	698	1,883	1,789	3,448	916
NPV/ML secure yield (40 years)	$73,396	$49,696	$39,065	$38,213	$43,739

1. RCC has adjusted costs presented in Jacobs (2020b) to allow for the staged construction of the Tyagarah scheme. The ultimate scheme would provide a yield benefit of 3,448 ML/a with costs from both stages.

10.8 Power Consumption

The total estimated power consumption for the groundwater options is shown in the following table.

Table 24: Power consumption – groundwater options

Component	Ultimate production (ML/a)	Consumption (kWhr/kL)	Energy use (MWhr/a)
Alstonville	1,280	0.52	666
Woodburn groundwater	1,600	0.30	1,929
Woodburn treatment		0.91	
Tyagarah Scheme 1 groundwater	2,048	0.70	3,288
Tyagarah Scheme 1 treatment		0.91	
Tyagarah Scheme 2 groundwater	4,000	0.70	6,422
Tyagarah Scheme 2 treatment		0.91	
Newrybar groundwater	2,304	0.40	5,095
Newrybar treatment		1.82	

Source: groundwater - MWH (2014), treatment - CWT (2018), additional power consumption allowed for RO at Newrybar

10.9 Data Gaps and Key Risks

To progress the development of these four groundwater options, the items outlined in Table 25 should be addressed by RCC. These would be undertaken as part of planning stages and would be completed prior to a decision to proceed with the planning and approvals for the groundwater options.

Table 25: Data gaps and project risks – groundwater

Item	Discussion	Action required
Concept development	• Further bore testing to confirm the sustainable yields, impacts on other water users within the aquifers and water quality.	Bore testing
Wastewater disposal	• Development of options for disposal of brine waste from Newrybar RO plant.	Concept development
Concept design	• Concept designs for Newrybar, Tyagarah and Alstonville groundwater options (bores, collector systems, treatment and integration with existing network) are required.	Concept designs
Detailed design	• Detailed design of all infrastructure.	Detailed design phase
Cost estimates	• Review of total project cost estimates.	Detailed design phase
Environmental investigation	• Detailed investigation of the environmental impacts of bore construction and associated infrastructure.	Specialist studies
Land acquisition	• Assessment of property acquisition costs (land and administration charges) under the *Land Acquisition (Just Terms Compensation) Act 1991*. • Subsequent purchase of land.	Land valuation and acquisition

Item	Discussion	Action required
Community engagement	• Development and implementation of a community engagement strategy is required.	RCC has commenced consultation activities as part of the assessment of supply scenarios (Section 14). An ongoing engagement strategy will be developed as part of the outputs of the Future Water Project 2060.

10.10 Recommendation

Groundwater supplies at Woodburn, Tyagarah, Newrybar and Alstonville servicing the key RCC demand centres are technically viable and would provide significant yield benefit when implemented in stages. Staging should consider the benefits of each option as follows:

1. Alstonville (3.5 ML/d) – existing groundwater entitlements with treatment available as part of the Marom Creek WTP option. The existing operating rules include groundwater from Converys Lane and Lumley Park (1.2 ML/d) implemented when RCD reaches 60% supply level.
2. Woodburn (5.0 ML/d) – existing groundwater entitlements, land and transfer infrastructure for bore 3 but requires a new conventional treatment facility along with new groundwater bores to meet demand requirements. The existing operating rules include groundwater from Woodburn implemented when RCD reaches 60% supply level although the bores are not currently operational.
3. Tyagarah (12.5 ML/d) – no existing entitlement and requires new conventional treatment facility and transfer infrastructure. The priority bore locations and hence staging would be determined following additional assessment of impacts on GDEs.
4. Newrybar (7.2 ML/d) – no existing entitlement and requires new conventional and RO treatment facility and transfer infrastructure.

11. OPTION 4: DESALINATION

Desalination is the process of removing salt and other minerals from water. Desalination of seawater provides an unlimited, climate independent and reliable new water supply. However, energy consumption is very high.

Temporary desalination plants are listed as a potential emergency supply options in the *Regional Water Supply Drought Management Plan* (Section 3).

11.1 Site and Treatment Options

Detailed investigations into desalination options were undertaken by GANDEN (2020). The investigations included a review of previous studies, confirmation of plant capacity and identification and assessment of potential locations of the plant considering network connectivity, power supply, social and environmental factors. Various desalination technologies, intake and outlet structures were considered. Single facilities of 5-10 ML/d capacity were considered to ensure economic viability.

The following three potential site locations were identified for the assessment based on previous information and in consultation with RCC:

- Byron Bay (adjacent to the existing West Byron wastewater treatment plant (WWTP)).
- Lennox Head (adjacent to the existing WWTP).
- South Ballina.

These locations were selected based on the following considerations:

- Proximity to seawater sources.
- Water supply demand in areas of large population growth or existing high population to justify the capital expenditure.
- Proximity of electrical infrastructure and water reticulation networks that can support the proposed facilities.

The opportunities, risks and constraints identified for each location in the desktop study are outlined in Table 26.

Table 26: Risk and opportunities of different desalination plant locations

Location	Opportunities	Risks and Constraints
Lennox Head	Location of large population growth. Likely good access to land adjacent to existing WWTP. Co-location of existing WWTP ocean outfall. Simple to connect to power.	Expensive to connect intake underneath Skennars Head properties. Connection to East Ballina reservoirs would be required as current population does not warrant a new 5 – 10 ML/d plant. Emigrant Creek WTP and Knockrow reservoir already provide more supply redundancy than other LGAs (e.g. Byron Shire).

Location	Opportunities	Risks and Constraints
South Ballina	Large baseline population in Ballina Shire. Cheaper land compared to alternative locations. 5 ML/d would serve current population and 10 ML/d would serve Ballina, Skennars Head and Lennox Head.	Expensive to connect power and treated water pipeline across the Richmond River, adding $5.0 - $10 million using horizontally direct drilling. Would require connection to Skennars Head and Lennox Head to justify 10 ML/d capacity. Location at risk of inundation and being isolated during floods. Intake/outfall in area of high erodibility. Water quality risk due to flood waters creating sediment plume at the Richmond River mouth. Additional expense to extend intake/outfall past observed Richmond River sediment plume.
Byron Bay	High demand area with high population growth. RCC may operate the facility to deal with additional potable demand associated with seasonal events and tourism influx. Simple connection to existing electrical infrastructure and potable water mains. No perceived risk of flood inundation.	Potentially expensive building envelope. Tyagarah Nature Reserve runs along coast and is highly sensitive to erosion. Community perception would need to be managed carefully.

Source: GANDEN (2020)

Based on the risks and opportunities identified in Table 26, Byron Bay was chosen as the preferred location as it located in an area with large projected growth with the future projected demand of the wider area (Byron Bay, Suffolk Park, Ocean Shores, Brunswick Heads and Bangalow) predicted to grow to 11 ML/d by 2036 making it a suitable area to be served by a 10 ML/d desalination plant (Figure 16). Furthermore, the site is located close to power supplies and the existing water reticulation network (GANDEN, 2020).

Multi-criteria analysis was undertaken to compare a range of desalination technologies and a range of seawater intake technologies able meet the following three mandatory criteria:

- Achieves water quality objectives (i.e. will meet the Australian Drinking Water Guidelines).
- Possible to implement in Rous regional supply area.
- Practical to implement in Rous regional supply area.

The MCA assessed the technologies on their whole life cost, proof of the technology, resourcing, support and process resilience (considering environmental changes such as beach erosion, salinity and turbidity resulting from heavy rain) and their value for money. Seawater Reverse Osmosis (SWRO) was chosen over Electrodialysis Reversal as the preferred desalination technology. Offshore Open Intake was chosen over a Subsurface Ranney Collector as the preferred seawater intake technology. Other desalination (nanofiltration, Capacitive Deionisation/ Membrane assisted Capacitive Deionisation, Ion exchange and thermal and solar distillation) and seawater intake technologies were assessed by GANDEN (2020) however they did not meet the mandatory criteria.

Figure 16: Proposed desalination plant location in Byron Bay

Source: GANDEN, 2020

A cost comparison was used to compare conventional pre-treatment (coagulation-flocculation-media filtration) and microfiltration (MF) and ultrafiltration (UF) systems. MF/UF filtration was provisionally recommended by GANDEN (2020) however the report acknowledges this preference is based on limited data on feedwater quality.

11.2 Preliminary Concept Design

A concept design layout and cost estimates were provided by GANDEN (2020) for the preferred option which includes a seawater desalination plant with a production capacity of 10 ML/d. The plant would be constructed in stages of 5 ML/d initially followed by two incremental increases of 2.5 ML/d to achieve the ultimate capacity of 10 ML/d.

The preliminary concept design was developed by GANDEN using Suez Water Technologies & Solutions' 'skid-based' technology to allow for a staged construction approach. The concept design comprises the following components:

- Ocean offshore seawater intake system.
- Pre-treatment screens.
- Chemical dosing.
- UF/MF pre-treatment filtration.
- 4 x 2.5 ML/d scalable 'SeaPAK' (A Suez Water product) trains.
- High pressure pumps, membrane pressure vessels and energy recovery devices.

- Post treatment systems, including pH adjustment and fluoridation requirements.
- Backwash wastewater settling tank, belt press and sludge disposal systems.
- Brine outfall systems.
- Building and amenities.

The concept design for the seawater intake and waste outfall has not been finalised as these are dependent on the final site selection. However, as they would be located in the Cape Byron Marine Park, potential impacts and approval requirements would need to be addressed. The intake would most likely comprise a directionally drilled pipeline with a dual intake/outfall system.

Chemicals such as sodium hypochlorite, anti-scalant, biocide, sodium bisuplphite, sulphuric acid, remineralisation chemicals and ‘clean in place’ solution are required for dosing and would be stored in either 20 L drums, itemised bulk containers or small tanks and directly dosed from the storage device. Disinfection of the treated water would be undertaken at the treated water reservoir/chlorine contact tank. Concentrate disposal would be achieved by depositing the reject concentrated brine water though the outfall system and hence treatment chemicals would be selected to allow for environmental discharge (to be confirmed during detailed environmental assessment and monitoring). Pre- filtration of the intake water would be achieved using membrane ultrafiltration. Cartridge filters would be situated between the UF units and RO membranes to act as a second line of defence in case of UF filtration failure.

The SWRO membranes would be fixed inside fiberglass reinforced plastic pressure vessels (normally between 5 and 7 membranes per vessel). Multiple pressure vessels would be located on a rack, called “arrays” or modules. The RO permeate would then be transferred to post treatment and the concentrate to disposal via an ocean outfall. The feed water would pass through the RO membranes once (i.e. a one-pass system) to produce approximately 40% RO permeate and 60% concentrate. Approximately 252 membranes and 36 RO pressure vessels would be required for each 2.5 ML/d train.

The desalination plant concept design is shown in Figure 17. The concept design includes future filtration and RO membranes which would be installed when the capacity of the plant is required to be increased.

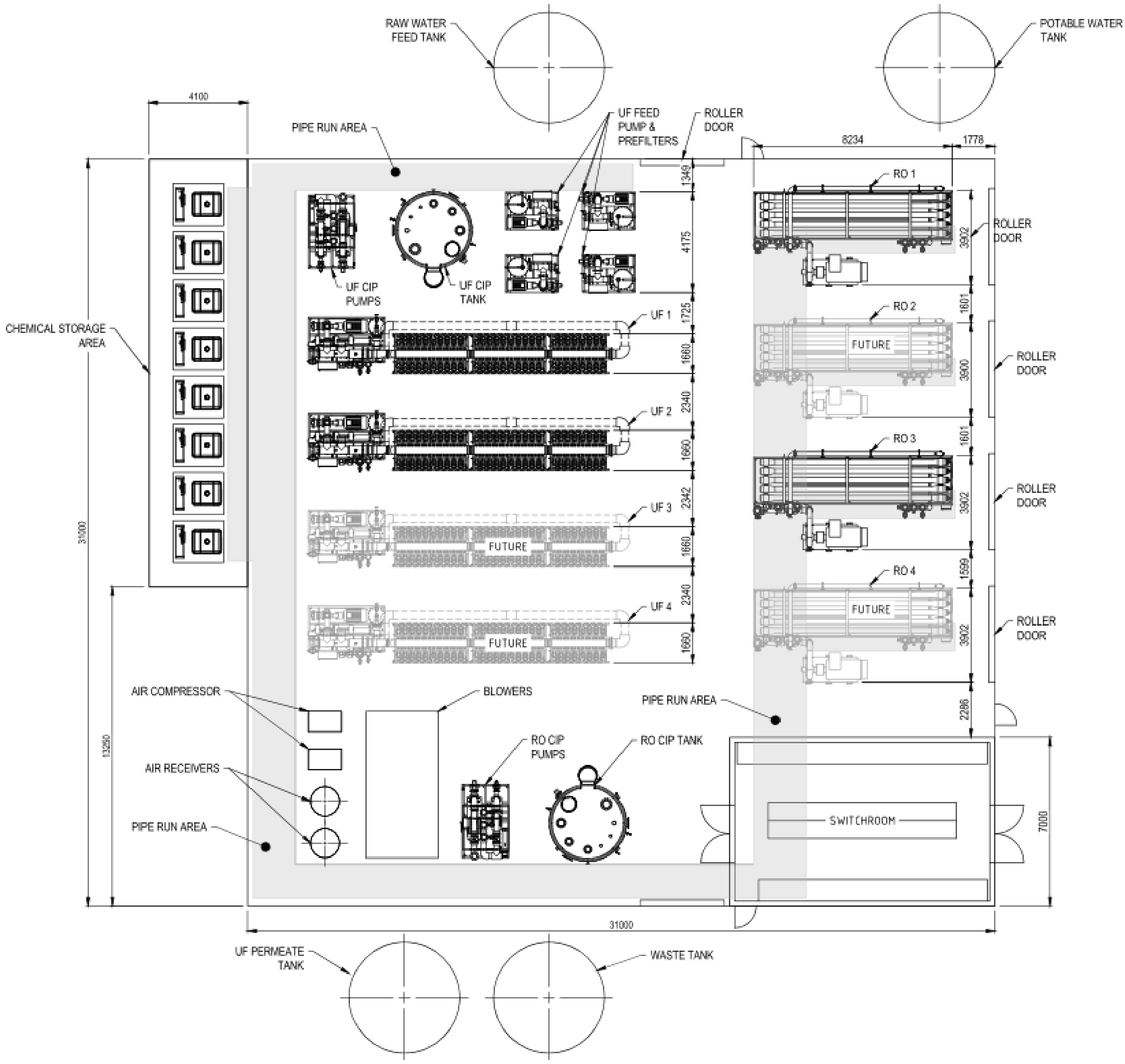

Figure 17: Concept design plant layout

Source: GANDEN, 2020

11.3 Environmental and Social Considerations

Desalination schemes that have been implemented in Australia have generally been met with significant community resistance and criticism (GeoLink, 2011, GANDEN, 2020). GeoLink (2011) suggested that for a desalination scheme in the Rous supply area to be accepted by the community, a multi-criteria assessment that is effectively communicated to the community would be necessary.

A desalination option was included in the IWP (MWH, 2014) which identified desalination as a potential new source to be considered as a safeguard should other sources prove unviable and insufficient. The IWP included desalination as a future component in a scenario in combination with groundwater sources to be implemented when demand exceeded the additional supply provided by the groundwater sources.

Based on a review of existing literature GANDEN (2020) identified and documented the following environmental challenges and potential impediments associated with developing desalination facilities:

- Potential ecological impacts associated with seawater intakes.
- Potential environmental and ecological impacts associated with brine discharge.

- Potential environmental impacts on coastal land.
- Native title considerations.
- Energy consumption.

An environmental impact assessment would be required to assess environmental conditions and establish design parameters. A Marine Parks permit would be required to construct an intake/outfall pipeline at the Byron Bay site (permissibility of this activity has been assumed).

The *Northern Rivers Regional Bulk Water Supply Study* (Hydrosphere Consulting, 2013) found that the incorporation of marine water desalination would be an attractive source augmentation option for a regional scheme (including interconnection with the Tweed Bray Park system) as this is easily scalable to match demand and is independent of climate, thus providing a highly secure water supply. Desalination provides climate independence that is currently missing from the region's water supplies. Desalination schemes have been successfully developed elsewhere and improvements in technology are likely to improve the attractiveness in future.

11.4 Secure yield

The secure yield of the desalination option has been assessed using the RCC Bulk Water Supply Security Model (Engeny, 2021) with results shown in Table 27.

Table 27: Increase in system secure yield with desalination

Option	Historic climate (5/10/10)	Reduction factor[1]	1°C climate warming
Desalination (10 ML/d)	1,550	1.0	1,550

Source: Engeny (2021)
1. Desalination is independent of climate.

11.5 Cost Estimates

The capital cost for the proposed plant was developed by GANDEN (2020) by benchmarking against a desalination plant in Agnes Waters as the most representative example of a similar sized desalination project executed in Australia (Table 28). NPV calculations are included in Appendix 1.

Table 28: Desalination preliminary cost estimate

Component	Cost Estimate (2020 $)
Stage 1 – 5 ML/d capital cost	$47,000,000
Stage 2 – 2 x 2.5 ML/d capital cost	$7,000,000
Renewal costs (80 years)	$36,794,547
Maintenance costs (80 years)	$20,765,000
Operating costs (80 years)	$103,138,940
Whole-of-life (80 years)	$214,698,487
NPV (80 years @ 5%)	$84,662,855
NPV (40 years @ 5%)	$78,991,236
Yield benefit (2020 – 2060) ML/a	1,550
NPV/ML secure yield (40 years)	$50,962

11.6 Power Consumption

The total estimated power consumption for the desalination options is shown in the following table.

Table 29: Power consumption – dam options

Component	Ultimate production (ML/a)	Consumption (kWhr/kL)	Energy use (MWhr/a)
Lennox Head or Byron Bay (10 ML/d)	3,650	4.00	14,600

Source: GANDEN (2020)

11.7 Data Gaps and Key Risks

To progress the development of Byron Bay desalination option, the items outlined in Table 30 should be addressed by RCC. These would be undertaken as part of planning stages and would be completed prior to a decision to proceed with the planning and approvals for the desalination options.

Table 30: Data gaps and project risks – Byron Bay desalination

Item	Discussion	Action required
Location	• Further investigation is required to confirm the most suitable plant location including further environmental assessment.	Detailed design phase
Integration	• Further assessment of network integration and electrical headworks is required.	Detailed design phase
Cost estimates	• Review of total project cost estimates.	Detailed design phase
Environmental investigation	• Investigation of the environmental impacts	Specialist studies
Marine Park impacts	• Investigation and consultation regarding impacts on Cape Byron Marine Park and approvals required.	Specialist studies
Land acquisition	• Assessment of property acquisition costs (land and administration charges) under the *Land Acquisition (Just Terms Compensation) Act 1991*. • Subsequent purchase of land.	Land valuation and acquisition
Community engagement	• Development and implementation of a community engagement strategy is required.	RCC has commenced consultation activities as part of the assessment of supply scenarios (Section 14). An ongoing engagement strategy will be developed as part of the outputs of the Future Water Project 2060.
Detailed design	• Detailed design of all infrastructure.	Detailed design phase

11.8 Recommendation

Desalination is a climate-independent source option that could be implemented at some key RCC demand centres and would provide significant yield benefit when implemented in stages. However, there is a large energy demand and potential environmental impacts associated with the seawater intake and wastewater disposal. Further detailed studies would be required prior to a decision to proceed with the desalination option but RCC considers that community opposition to desalination on the basis of high energy consumption is a significant risk.

Desalination would not be required as a primary source where a new groundwater source is implemented as only one of the sources would be required to meet the demand of each RCC supply area. Investment in a smaller groundwater scheme as well as a desalination option that services the same area would not be economically viable due to the duplication of assets. However, temporary desalination plants could be implemented as an emergency supply option if required.

12. OPTION 5: INDIRECT POTABLE REUSE

12.1 Scheme Options

Indirect potable reuse (IPR) involves reusing advanced treated wastewater effluent by transferring it to the surface water sources. The feasibility of IPR options was explored in a desktop study which considered opportunities to reuse wastewater effluent to reduce or replace potable water demand within the bulk supply area (CWT, 2020a). The study considered the following six WWTPs for their potential to provide effluent for water reuse:

- Ballina WWTP (BaSC).
- Lennox Head WWTP (BaSC).
- Alstonville WWTP (BaSC).
- Bangalow WWTP (BySC).
- South Lismore WWTP (LCC).
- East Lismore WWTP (LCC).

CWT (2020a) considered the current wastewater production, existing recycled water schemes and the location of each of the plants to consider how a reuse scheme could be configured. The potential quantity of source wastewater provided by each WWTP is provided in Table 31.

Table 31: Current wastewater production and recycling levels at WWTPs

Treatment plant	Annual wastewater production (ML)	Current water reuse scheme	Current reuse rate/amount	Additional wastewater yield
Ballina WWTP	2,400 – 3,400	Dual reticulation recycled water scheme	NA	1,300 ML/a[1]
Lennox Head WWTP	1,400 – 1,700		10-80%	
Alstonville WWTP	600 – 750	Local recycled water scheme	Average- 50% Dry weather periods- 70-90%	70-120 ML/a[2]
Bangalow WWTP	140 - 170	Previous scheme- recycled water for bamboo crop irrigation	0% Previously 13%	70-110 ML/a[2]
South Lismore WWTP	800 – 1,200	None	0	2,700 ML/a[1]
East Lismore WWTP	1,500 – 3,000		0	

Source: CWT (2020a), MWH (2014)
1. These values were assumed in the IWP process (MWH, 2014) but should be confirmed through further investigation.
2. These values have been estimated by CWT.

Based on the potential additional yield, Ballina and Lennox Head (combined) and South Lismore and East Lismore (combined) were considered to be potential options for providing source effluent. The treated effluent from these sources may be transferred to a potable water supply source (ECD or Wilson River Source) where it would be further treated in an advanced recycled water plant (ARWP) or the existing WWTPs could be upgraded and the effluent treated to a high standard before being transferred to the water supply source. Table 32 outlines the potentially feasible schemes for utilising these effluent sources to provide additional potable water supply (CWT, 2020a). Cost estimates have not been prepared for the schemes.

Table 32: Summary of potentially feasible scheme options

Water source	Scheme description	Source(s)	Infrastructure cost
WRS	Treat in a common ARWP and pump recycled water to WRS	East Lismore and South Lismore WWTP	Medium
	Individual ARWP upgrades at existing WWTPs then pumping recycled water to WRS	South Lismore WWTP	Medium
		East Lismore WWTP	Medium
ECD	Treat in a common ARWP and pump recycled water to ECD	Ballina and Lennox Head WWTP	High
	Individual ARWP upgrades at existing WWTPs then pump recycled water to ECD	Ballina WWTP	Medium
		Lennox Head WWTP	Medium

Source: CWT (2020a)

CWT (2020a) identified the preferred Ballina Shire IPR scheme to be the transfer of treated effluent from Ballina WWTP to Lennox Head WWTP where the two effluent sources would be combined and further treated in an upgraded ARWP at Lennox Head before being transferred to ECD. This arrangement was considered to result in the lowest infrastructure cost for the most potable water replacement. Figure 18 shows the arrangement of the proposed Ballina IPR scheme. The treated effluent transferred to ECD would undergo further treatment at Emigrant Creek WTP. The impact on capacity and treatment processes at Emigrant Creek WTP due to the increased throughput has not yet been assessed.

CWT (2020a) concluded that the best Lismore IPR option would be to transfer effluent from East Lismore WWTP to South Lismore WWTP where the combined effluent would undergo advanced treatment before being transferred upstream of the WRS (Eltham gauge). The existing infrastructure would be used to transfer treated effluent from the WRS into RCD. Figure 19 shows the arrangement of the proposed Lismore IPR scheme. The treated effluent transferred to RCD from the WRS would undergo further treatment at Nightcap WTP. The impact on capacity and treatment processes at Nightcap WTP due to the increased throughput has not yet been assessed, although a planned augmentation of Nightcap WTP from 68 to 100 ML/day has been allowed for in 2034.

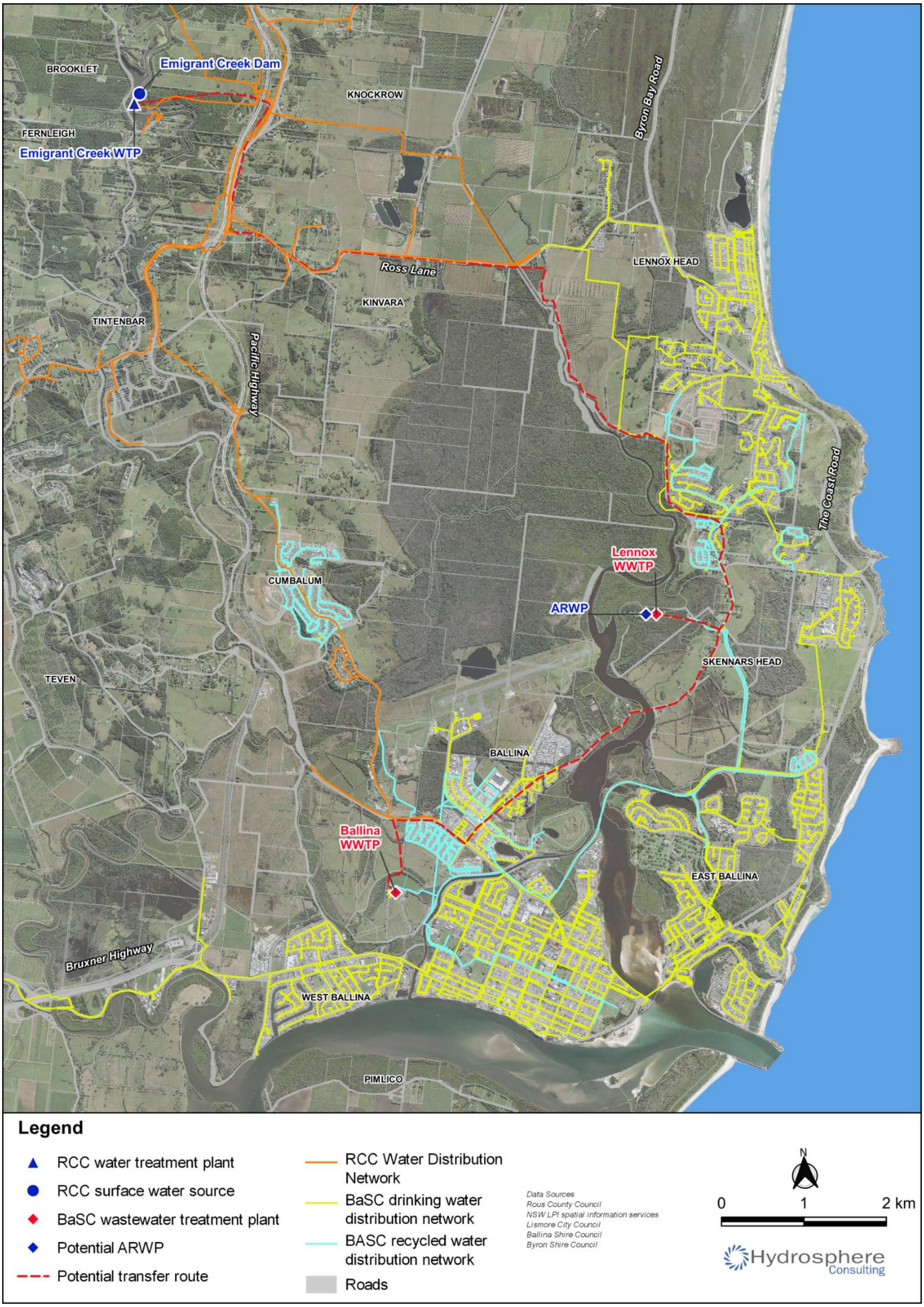

Figure 18: Potential Ballina IPR scheme

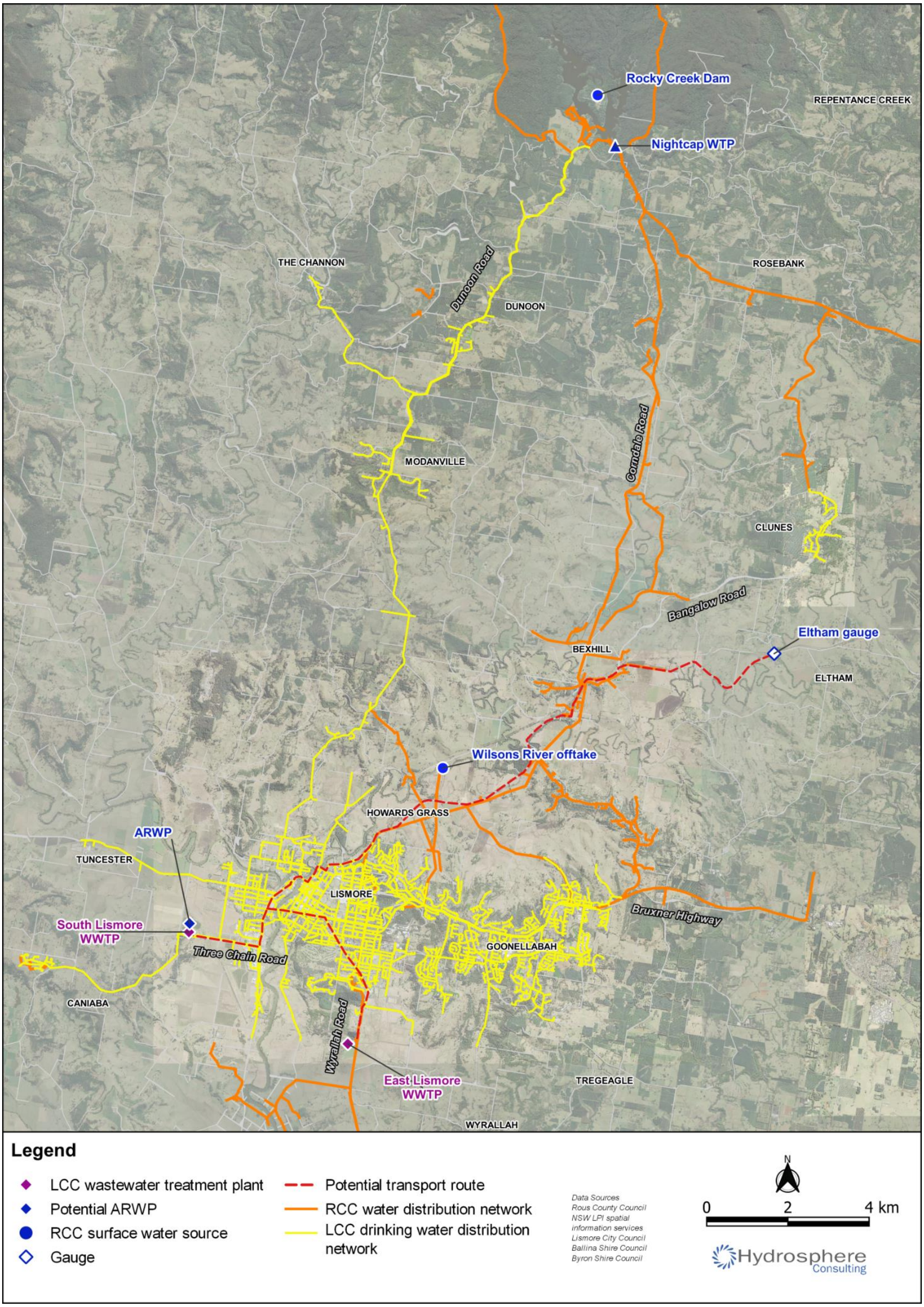

Figure 19: Potential Lismore IPR scheme

12.2 Secure Yield

The secure yield of the IPR options has been assessed using the RCC Bulk Water Supply Security Model (Engeny, 2021) with results shown in Table 33. The 2020, 2030 and 2060 secure yield of the IPR options is shown in Figure 20, using a similar approach as for the current system (Section 6.2).

Table 33: Increase in system secure yield with IPR

Option	Historic climate (5/10/10)	Reduction factor[1]	1°C climate warming
Lismore IPR scheme (5 ML/d to WRS)	750		727
Ballina IPR scheme (5 ML/d to ECD)	900	0.969	872
Combined schemes	1,350		1,308

Source: Engeny (2021)

1. Reduction factor was only calculated for the combined IPR schemes and has been applied to each scheme.

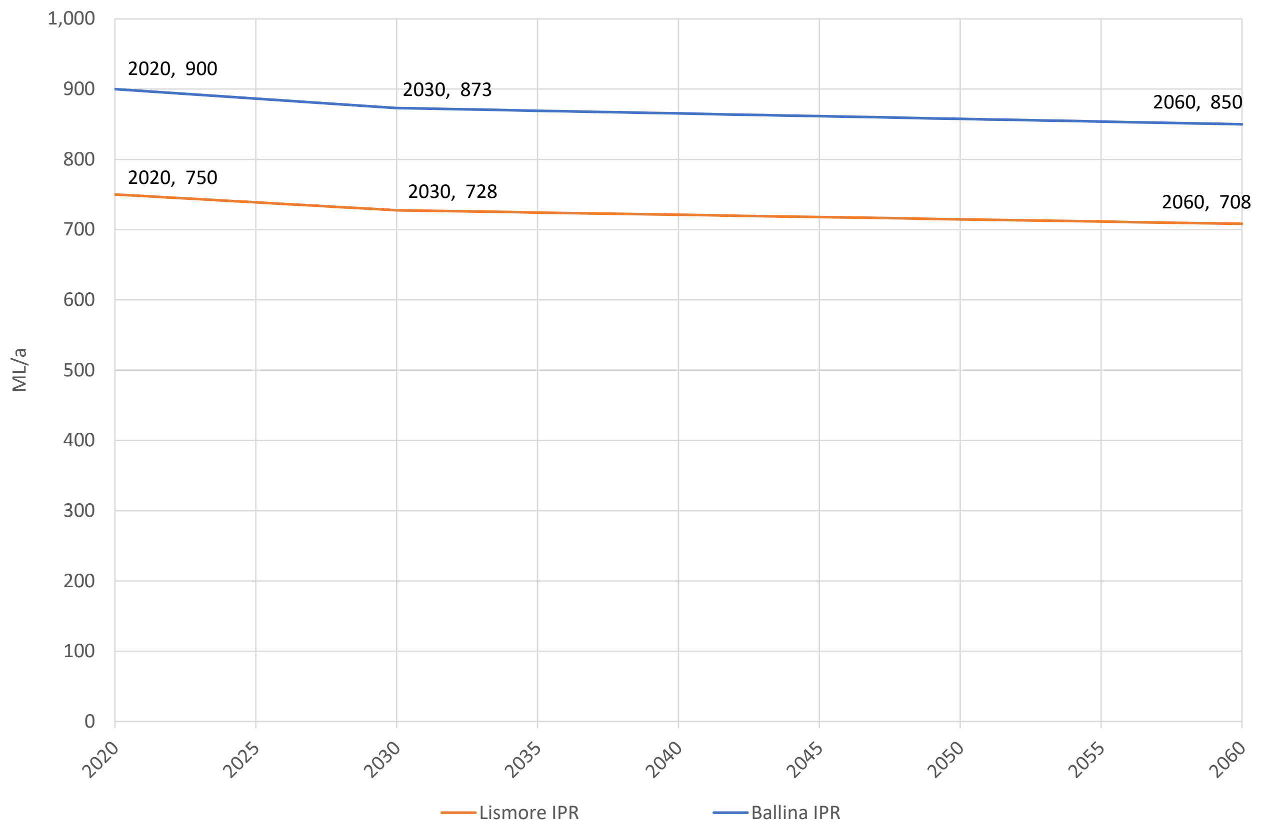

Figure 20: Secure yield estimates – IPR options

12.3 Cost Estimates

Detailed cost estimates are not available for the IPR options. The IWP (MWH (2014) assumed the capital cost for the Ballina and Lismore IPR schemes would be $15.8 million and $22.6 million respectively (escalated to 2020$).

12.4 Power Consumption

The total estimated power consumption for the IPR schemes is shown in the following table (not including any additional treatment at the RCC-owned WTPs).

Table 34: Power consumption – IPR

Component		Consumption (kWhr/kL)	Energy use (kWhr/a)
Ballina scheme			
Treatment	• Lennox Head WWTP advanced treatment	N/A	3,212,687
Transfer	• Ballina WWTP to Lennox Head WWTP	N/A	994,873
	• Lennox Head WWTP to ECD	N/A	1,724,406
Total – Ballina scheme (5 ML/d)		*3.25*	*5,931,966*
Lismore scheme			
Treatment	• South Lismore WWTP advanced treatment	N/A	4,859,004
Transfer	• East Lismore WWTP to South Lismore WWTP	N/A	561,691
	• South Lismore WWTP to WRS license point (Eltham gauge)	N/A	932,064
Total – Lismore scheme (5 ML/d)		*3.48*	*6,352,759*

Source: CWT (2020b)

12.5 Data Gaps and Key Risks

To progress the development of the IPR options, the items outlined in Table 35 should be addressed by RCC. These would be undertaken as part of planning stages and would be completed prior to a decision to proceed with the planning and approvals for the IPR options.

Table 35: Data gaps and project risks – IPR

Item	Discussion	Action required
Concept development	• Confirmation of wastewater volumes • ARWP concepts • Transfer system concepts	Concept design
WTP requirements	• Capacity and treatment upgrades for Emigrant Creek and Nightcap WTPs	Concept design
Cost estimates	• Development of total project cost estimates. The cost of the scheme is likely to be high.	Concept design
Detailed design	• Detailed design of all infrastructure.	Detailed design
Environmental investigation	• Investigation of the environmental impacts including the impact on water quality.	Specialist studies

Item	Discussion	Action required
Regulator consultation	• Investigation of compliance with the *Public Health Act, 2010* and ADWG. One of the critical considerations for this option is the approval by NSW Health that the scheme complies with public health requirements.	RCC has commenced consultation with NSW Health.
Community engagement	• Development and implementation of a community engagement strategy is required.	RCC has commenced consultation activities as part of the assessment of supply scenarios (Section 14). An ongoing engagement strategy will be developed as part of the outputs of the Future Water Project 2060.

12.6 Recommendation

IPR can be used for all drinking and non-drinking purposes as well as replenishing natural water sources in drinking water catchments and does not require the construction and operation of a dedicated reticulation system to consumers. However, there are significant implementation and operational costs due to the treatment and transfer system requirements, challenges managing the concentrated waste streams, large energy demand and significant regulatory and planning requirements. The expected yield of the systems is also low when compared to other options. The safety of the water produced needs to be rigorously tested and validated and the approvals process would be lengthy, costly and uncertain. Broad community acceptance would be needed and this cannot be guaranteed. RCC considers that community opposition to IPR on the basis of public health concerns is a significant risk. For these reasons, IPR is currently not currently considered a viable solution for securing the region's long-term water supply.

13. SOURCE AUGMENTATION SCENARIOS

13.1 Scenario Development

Despite the risks and data gaps identified in this report, Option 1 (Dunoon dam) and Option 3 (groundwater) are considered to be feasible and will be included in the source augmentation scenarios as the primary water source. There is currently detailed information available on these options to enable a robust comparison of source augmentation scenarios. Option 2 - Connection to the Marom Creek water supply has a low initial cost with minimal planning and development required. The WTP is an existing asset (requiring upgrade). However, asset ownership and future supply to Wardell will need to be resolved with BaSC. This option is considered to be worth pursuing to meet the short-term demand deficit.

Option 1 - implementation of Dunoon dam will have a lead time of approximately 9 years (to allow for additional investigations, approvals, construction and filling of the dam). Hence a scenario including Dunoon dam will require an interim solution to meet demand until approximately 2029. Option 3 - implementation of groundwater options will have a lead time of up to 6 years (to allow for additional investigations, approvals and construction). Groundwater options may be implemented in stages and the following have been considered in the development of staging for a groundwater scenario:

- Alstonville groundwater – optimises the Marom Creek WTP option and expands on an existing scheme and licences but has low yield.
- Woodburn groundwater – expands on an existing scheme, licences and land but has low yield and high cost. The Woodburn bore supply is also included as a dry period supply in the current operating regime.
- Tyagarah groundwater – relatively low-cost groundwater, with high yield and requires a new scheme. Potential impacts on GDEs need to be managed.
- Newrybar groundwater - relatively high-cost groundwater, high yield and requires a new scheme. Potential risks with wastewater disposal need to be addressed.

RCC considers that Option 4 (desalination) and Option 5 (IPR) are not as attractive due to operational constraints and expected stakeholder opposition:

- Option 4 - desalination has a high yield, is independent of climate but has a high cost. In addition, the energy consumption is very high due to the treatment processes required (2.5 times the energy consumption of a groundwater scheme with conventional treatment, based on data provided in MWH (2014)). Impacts on the Marine Park and approval requirements have not yet been determined.

  The preferred desalination scheme would supply Byron Shire. Hence a groundwater scheme in Tyagarah and a desalination scheme in Byron cannot be included in the same scenario as local demand would be provided by only one option. Investment in a smaller groundwater scheme as well as a desalination option that services the same area would not be economically viable due to the duplication of assets.

  As discussed in Section 11.3, a regional desalination facility with interconnection of the Tweed and Rous regional supplies may be considered in future. This provides additional options regarding service area, site location and capacity which may make this option more attractive.

- Option 5 - IPR schemes have a low yield benefit and a high cost. In addition, the energy consumption is very high due to the treatment and transfer processes required (2.5 times the energy consumption of a groundwater scheme with conventional treatment, not including additional potable water treatment). There is also a significant risk that the scheme would not meet public health requirements.

The preferred IPR scheme would supply Ballina Shire. Hence a desalination scheme in Ballina Shire cannot be included in the same scenario as local demand would be provided by only one option. The Lismore IPR scheme would not be required in addition to groundwater schemes that can supply the Lismore area.

Hence, desalination and IPR are not considered to be viable primary components of the source augmentation scenarios. However, RCC will continue to investigate these options as more data becomes available.

13.2 Source Augmentation Scenarios

This report compares two potential source augmentation scenarios to provide water security to 2060:

- Scenario 1 – Groundwater (with Marom Creek). Scenario 1 includes the connection of Marom Creek WTP to the Rous regional supply in the short-term with staged implementation of groundwater schemes and treatment plants until the required supply yield is achieved. The components of Scenario 1 are shown on Figure 21. The priority order of the medium to long-term groundwater schemes included in Scenario 1 may be varied in response to new information on each scheme.
- Scenario 2 – Dunoon dam. Scenario 2 includes the connection of Marom Creek WTP to the Rous regional supply in the short-term with construction of a new dam at Dunoon. Scenario 2A considers the 20 GL dam with potential future augmentation to 50 GL. Scenario 2B considers the 50 GL dam. Both scenarios include initial implementation of the Marom Creek and Alstonville groundwater options. The Dunoon dam scenarios include the upgrade of Nightcap WTP in 2034 from 70 ML/d to 100 ML/d. The components of Scenario 2 are shown on Figure 22.

If further investigations find that Marom Creek is not a viable option, the Woodburn groundwater scheme could be reinstated in the short-term.

The scenarios provide the required yield beyond 2060 (Section 13.3) and have been presented to enable comparison of the primary source options (Dunoon dam and groundwater). For Scenario 1, the staging of the groundwater schemes after the initial implementation of Marom Creek WTP, Alstonville and Woodburn groundwater sources can be varied in response to new information on yield, environmental impact and integration which may influence the prioritisation of these supplies from approximately 2032.

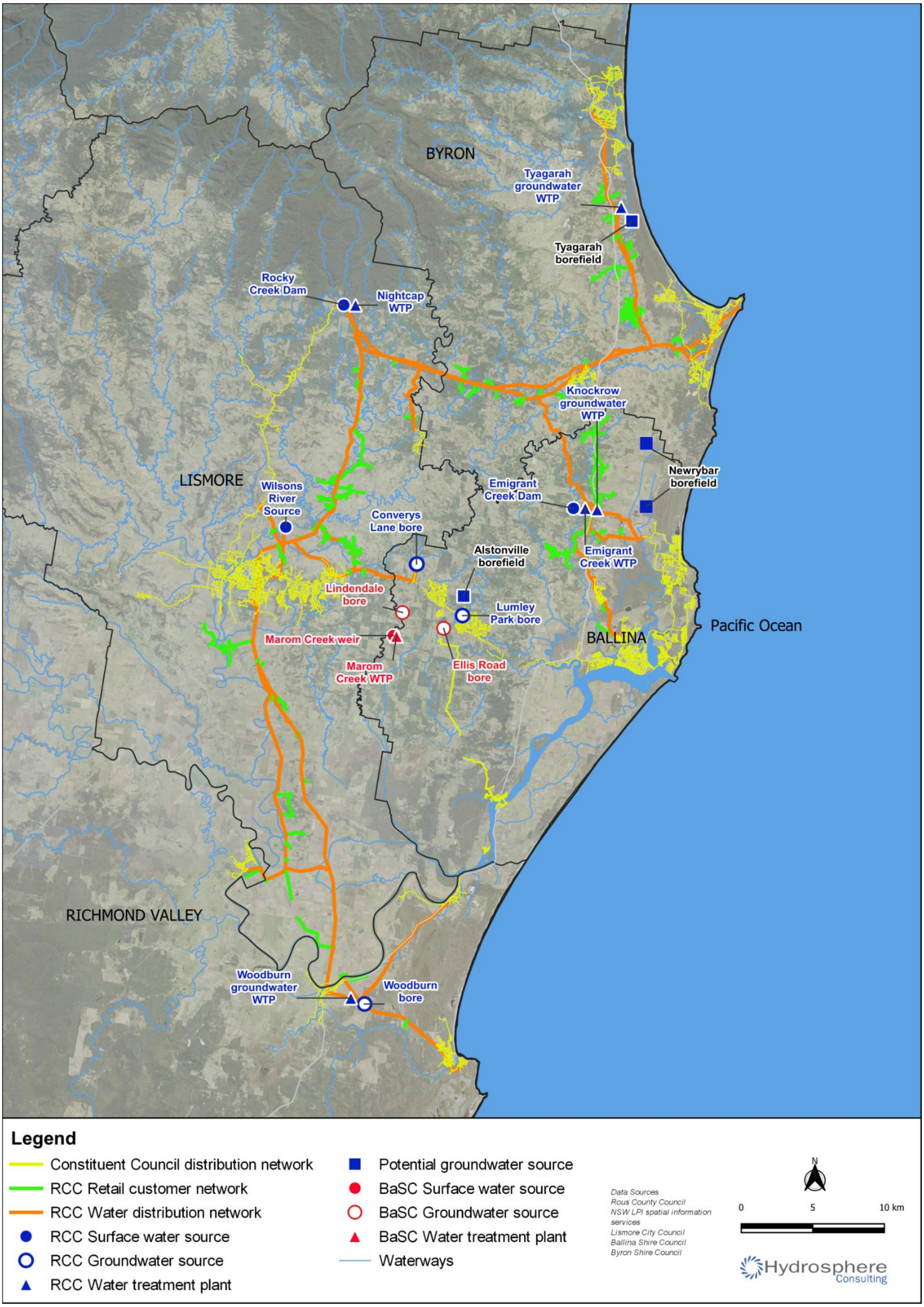

Figure 21: Scenario 1: Groundwater (with Marom Creek WTP)

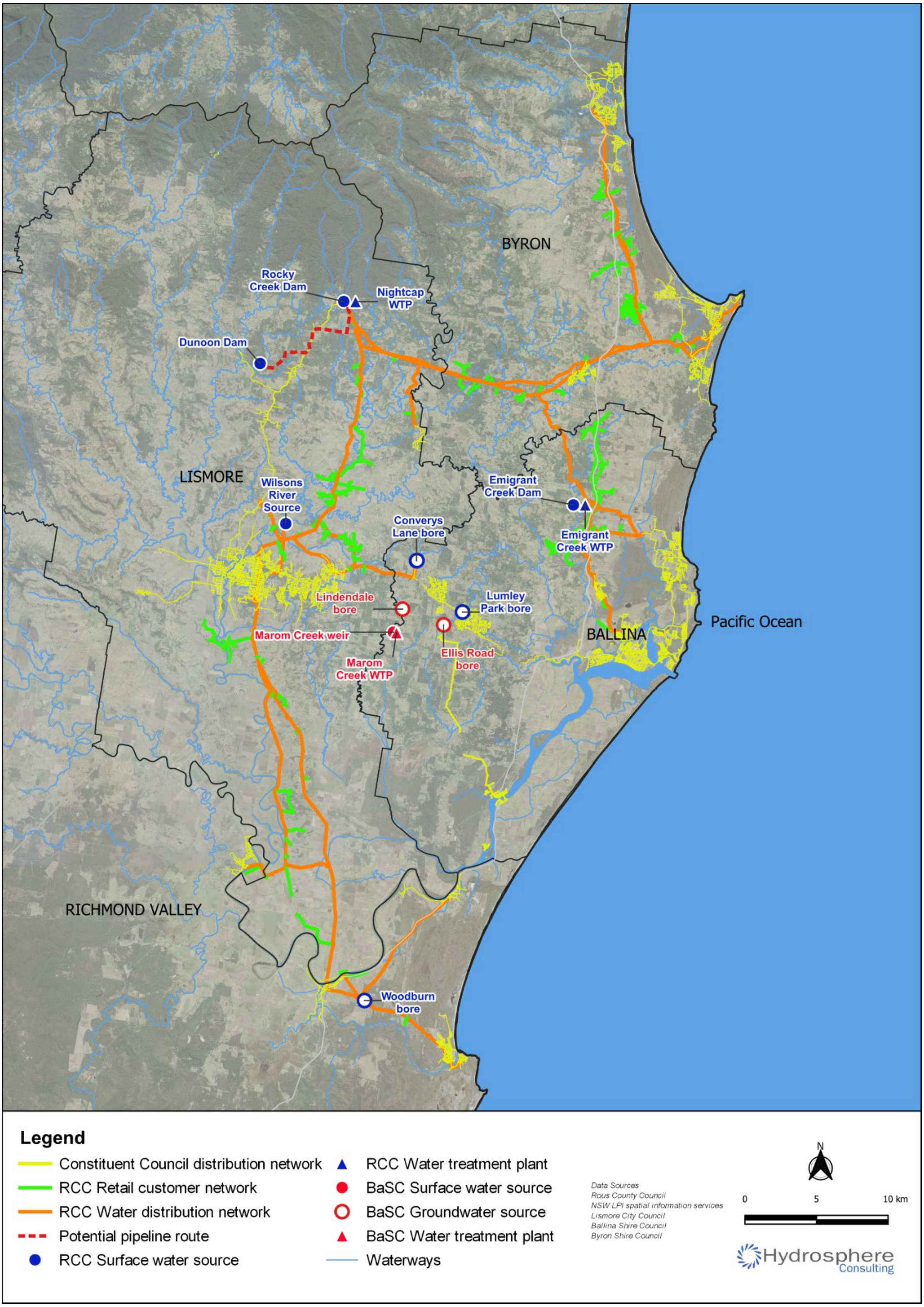

Figure 22: Scenario 2: Dunoon dam (with Marom Creek WTP)

13.3 Secure Yield

The staging and secure yield for each scenario are shown in the following figures compared to the dry year unrestricted demand forecast.

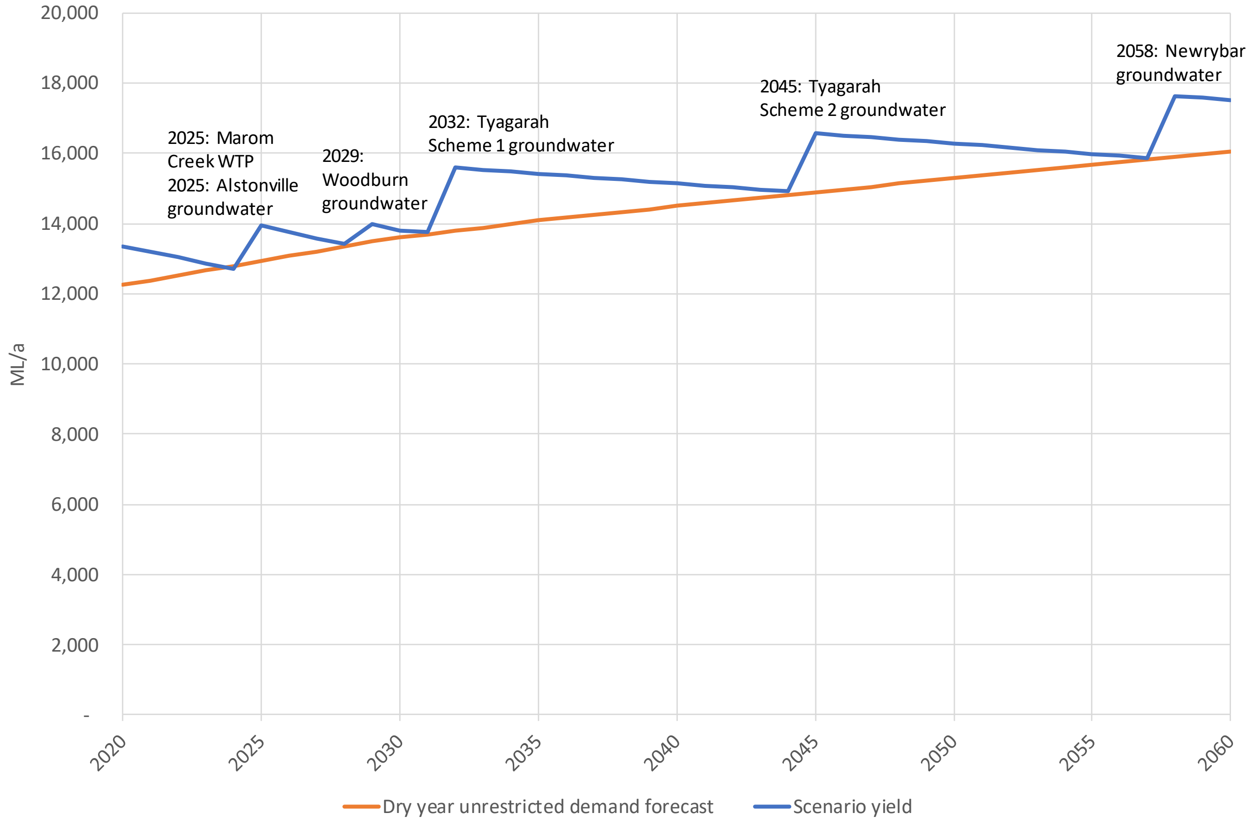

Figure 23: Secure yield and staging for scenario 1: groundwater

The groundwater schemes identified for Scenario 1 will be able to meet demand until approximately 2072 assuming a similar rate of growth in demand is experienced beyond 2060.

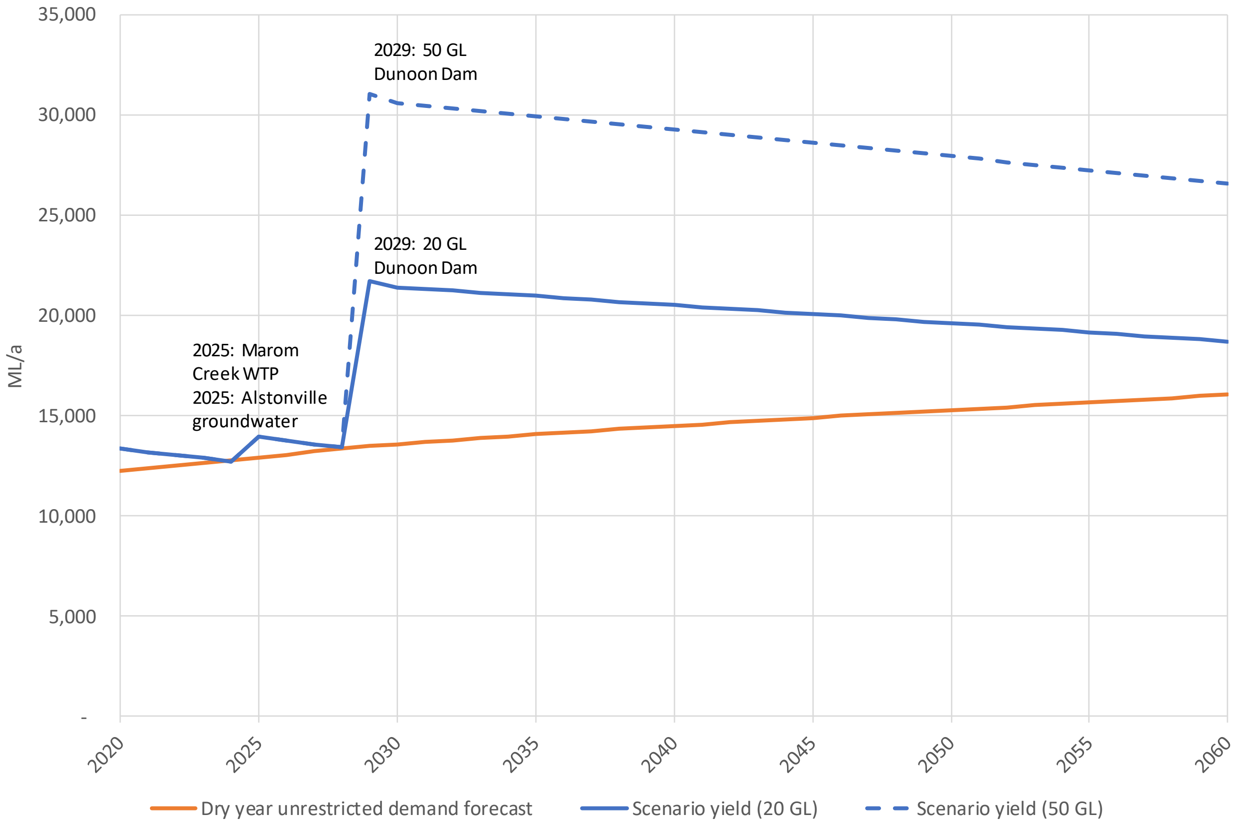

Figure 24: Secure yield and staging for scenario 2: Dunoon dam

Scenario 2A (20 GL Dunoon dam) would require augmentation to the 50 GL dam in approximately 2080 assuming a similar rate of growth in demand is experienced beyond 2060 and assumptions about future yield are realised. The 50 GL demand (Scenario 2B) will be able to meet demand until approximately 2115.

13.4 Multi-Criteria Analysis

13.4.1 Methodology

The multi-criteria analysis (MCA) methodology used in this project has been developed with consideration of previous studies undertaken by RCC in 2014, the coarse assessment (Section 7) and the IWCM Information Sheet 2 – *Evaluation of integrated water cycle management scenarios* (NSW Department of Industry, 2019).

The triple-bottom-line (TBL) assessment criteria are discussed in Table 36. Assessment criteria have been arranged into environmental and social groups.

Table 36: TBL assessment criteria

Criteria	Description	Information used
Environmental (ranked considering the biodiversity management hierarchy – avoid, minimise, rehabilitate, offset)		
Aquatic	Impact on groundwater and surface water quality and aquatic ecology and measures to offset those impacts.	Aquatic biodiversity impacts (e.g. high value aquatic ecosystems, threatened species, water quality, groundwater dependent ecosystems) and offsets proposed (e.g. environmental flows).
Terrestrial	Impact on terrestrial ecology and measures to offset those impacts.	Terrestrial biodiversity impacts (e.g. high value terrestrial ecosystems, threatened species) and offsets proposed (e.g. stewardship/ compensation).
Energy consumption	Operational energy consumption per kL of water produced (over 80 years).	Operational energy consumption (kWh/kL) and production rates.
Social		
Typical residential bill	Impact on the typical residential bills for each Council from the revised notional cost.	Change in notional cost of bulk water supplied ($/ML) and predicted impact on typical residential bills.
Water users	Impact on other water users and measures to offset those impacts.	Changes to groundwater and surface water flow regime and water available for other users.
Heritage	Impact on cultural heritage and measures to offset those impacts.	Aboriginal and European heritage impacts (sites, artefacts and significance) and management measures.
Economic		
NPV	NPV of capital and operating costs (80 years) at 5% discount rate.	Capital and operating costs.

The environmental and social criteria are further discussed in the following sections.

A weighted score has been calculated for each scenario. Ranking has been calculated as follows:

(Environmental Score + Social Score)/NPV

Weightings are assigned to each criterion based on relative importance so that the sensitivity of the weightings can be tested.

13.4.2 Environmental Criteria

Terrestrial and aquatic impacts have been based on the available information as summarised in this report. Detailed studies have been undertaken for the Dunoon dam options (Section 8) and significant impacts on terrestrial and aquatic ecology have been identified. Actions to reduce these impacts (environmental flow regime and terrestrial biodiversity offsets) and the costs of these actions have been included in the dam scenarios. RCC considers that suitable measures can be put in place to obtain planning approval and ensure stakeholder acceptance of the dam scenarios.

While limited environmental investigations have been undertaken for groundwater options, identified impacts are considered to be manageable (potential impacts on GDEs in Tyagarah area require further assessment). RCC considers that suitable measures can be put in place to obtain planning approval and ensure stakeholder acceptance of the groundwater scenarios.

The energy consumption for each option has been estimated from data used in previous reports and presented for each option in the previous sections.

13.4.3 Social Criteria

The impact on customer bills has been assessed using the estimated increase in the notional cost of bulk water (the charge applied to bulk water sales to the constituent councils) at 2060 as a result of funding requirements for the scenarios as estimated by RCC using its financial planning model. The impact of the increase in the cost of water on the typical residential bill charged by the constituent councils at 2060 has been estimated based on the current costs for purchase of water and total expenses for each council. This assumes that the portion of bulk sales to each council remains the same. Other changes to council expenses have also not been considered.

Water sharing plans under the *Water Management Act, 2000* govern the sharing of water in a water source between water users and the environment and rules for the trading of water in the water source. Water access licences (WALs) entitle licence holders to specified shares in the available water within a particular water management area or water source (the share component) and to take water at specified times, rates or circumstances from specified areas or locations (the extraction component). WALs may be granted to access the available water governed by a water sharing plan under the Act.

Rocky Creek is subject to the *Water Sharing Plan for the Richmond River Area Unregulated, Regulated and Alluvial Water Sources 2010*. Use of water captured by Dunoon dam would be subject to a WAL and may require a new or amended licence. The environmental flow regime proposed for the Dunoon dam options is a key consideration for the water use and works approvals. RCC considers that suitable measures can be put in place to obtain approval and ensure stakeholder acceptance of the dam scenarios.

Similarly, for groundwater use, water sharing plan provisions are in place for environmental water allocations, basic landholder rights, domestic and stock rights and native title rights. RCC considers that suitable measures can be put in place to obtain approval and ensure stakeholder acceptance of the groundwater scenarios.

Cultural heritage impact assessments undertaken for Dunoon dam have identified significant Aboriginal cultural heritage values and sites. This remains a key risk to be addressed for this scenario.

Preliminary assessment of cultural heritage impacts undertaken for the groundwater options have not identified any impacts that cannot be managed.

13.4.4 Cost Estimates and Expenditure Profile

Whole of life and NPV cost estimates for the water supply scenarios are shown in the following table. NPV calculations are included in Appendix 1.

Table 37: Scenario cost estimates

Component	Scenario 1: Groundwater (2020 $)	Scenario 2A: 20 GL Dunoon dam (2020 $)	Scenario 2B: 50 GL Dunoon dam (2020 $)
Whole-of-life (80 years)	$836,397,007	$619,141,183	$658,907,966
NPV (80 years @ 5%)	$195,922,792	$242,778,718	$267,518,613
NPV (40 years @ 5%)	$169,299,256	$228,151,363	$252,602,785
Yield benefit (2020 – 2060) ML/a	4,170	5,370	13,249
NPV/ML secure yield (40 years)	$40,597	$42,484	$19,066

The expenditure profile of each scenario and a comparison of the scenarios is shown in the following figures.

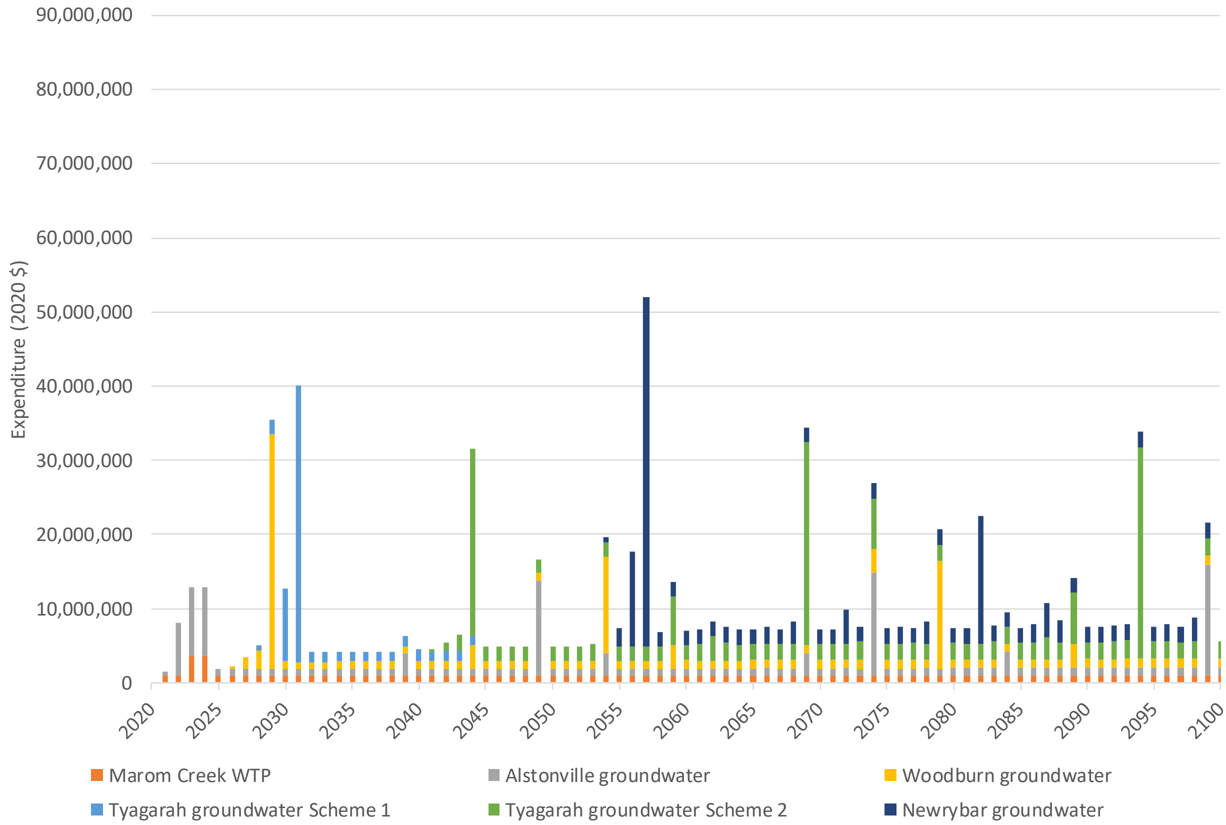

Figure 25: Expenditure profile – Scenario 1: groundwater

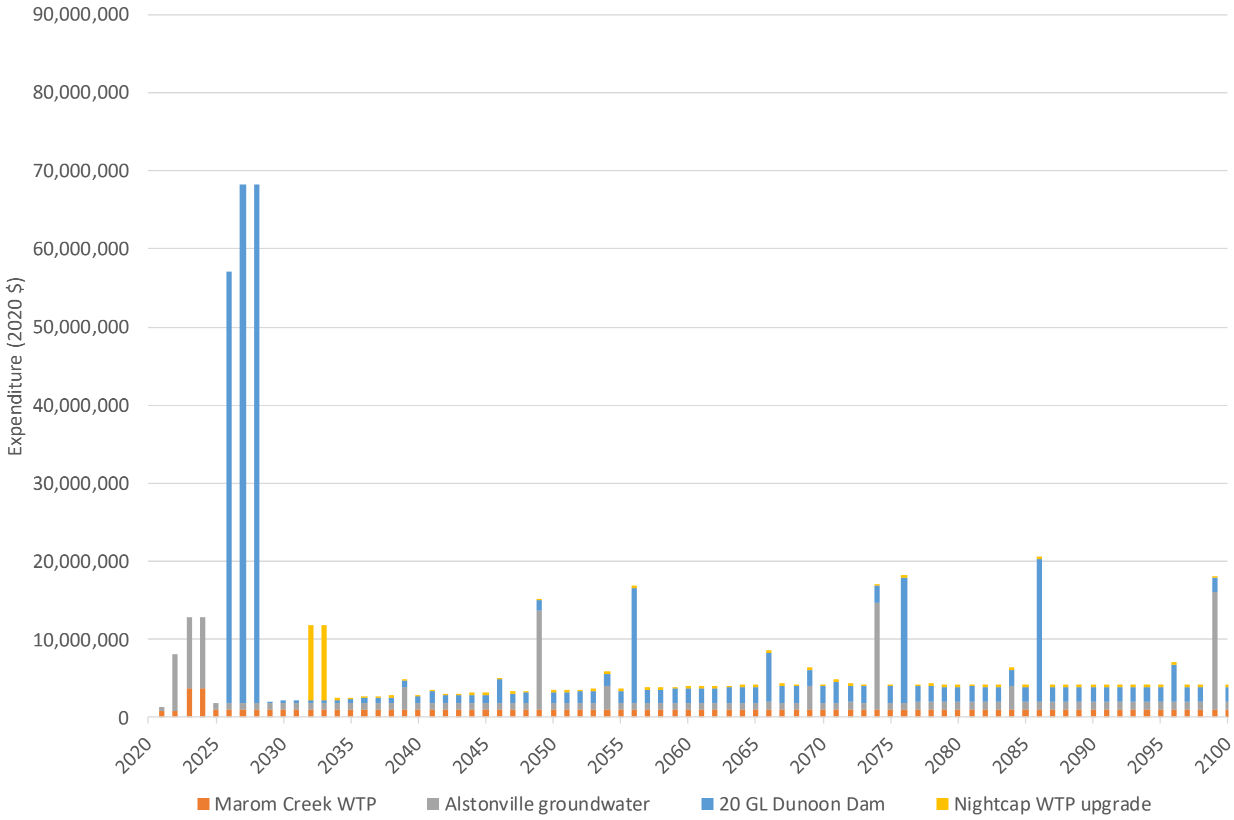

Figure 26: Expenditure profile – Scenario 2A: Dunoon dam (20 GL)

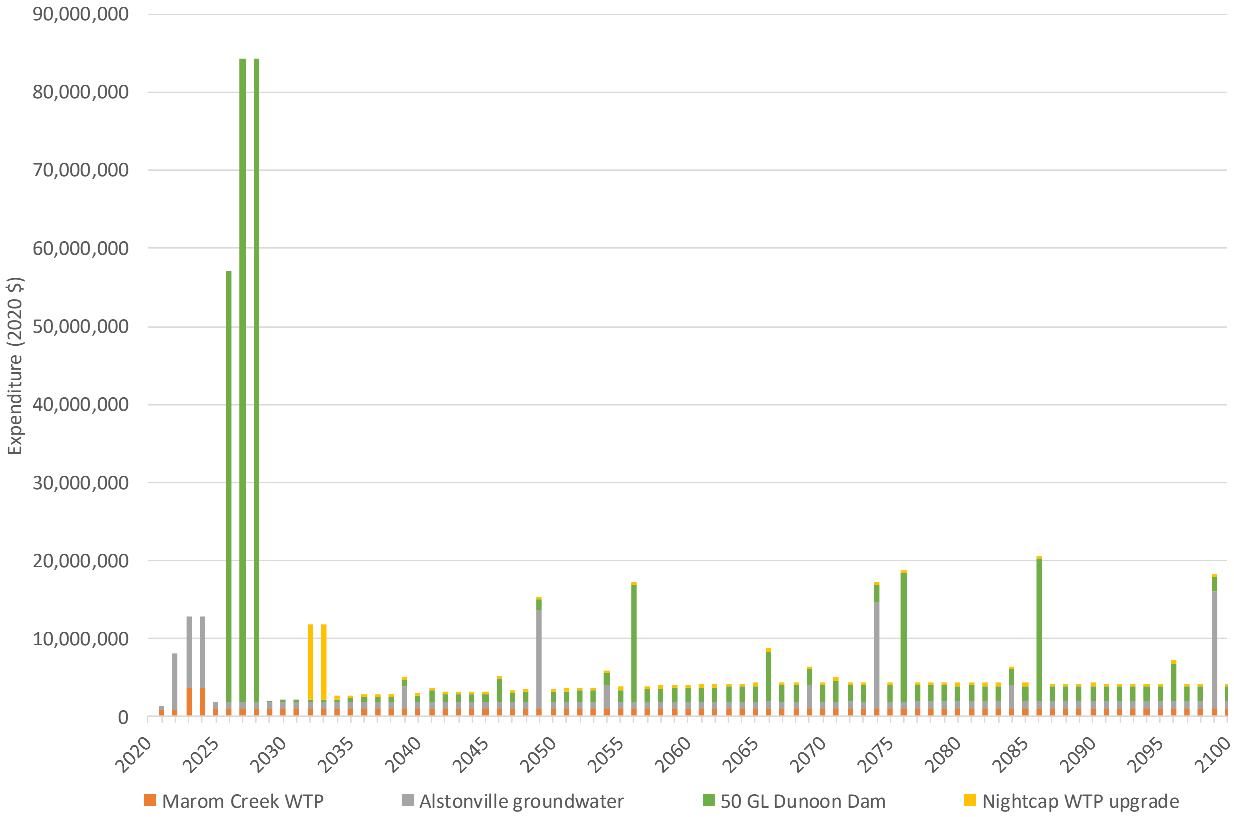

Figure 27: Expenditure profile – Scenario 2B: Dunoon dam (50 GL)

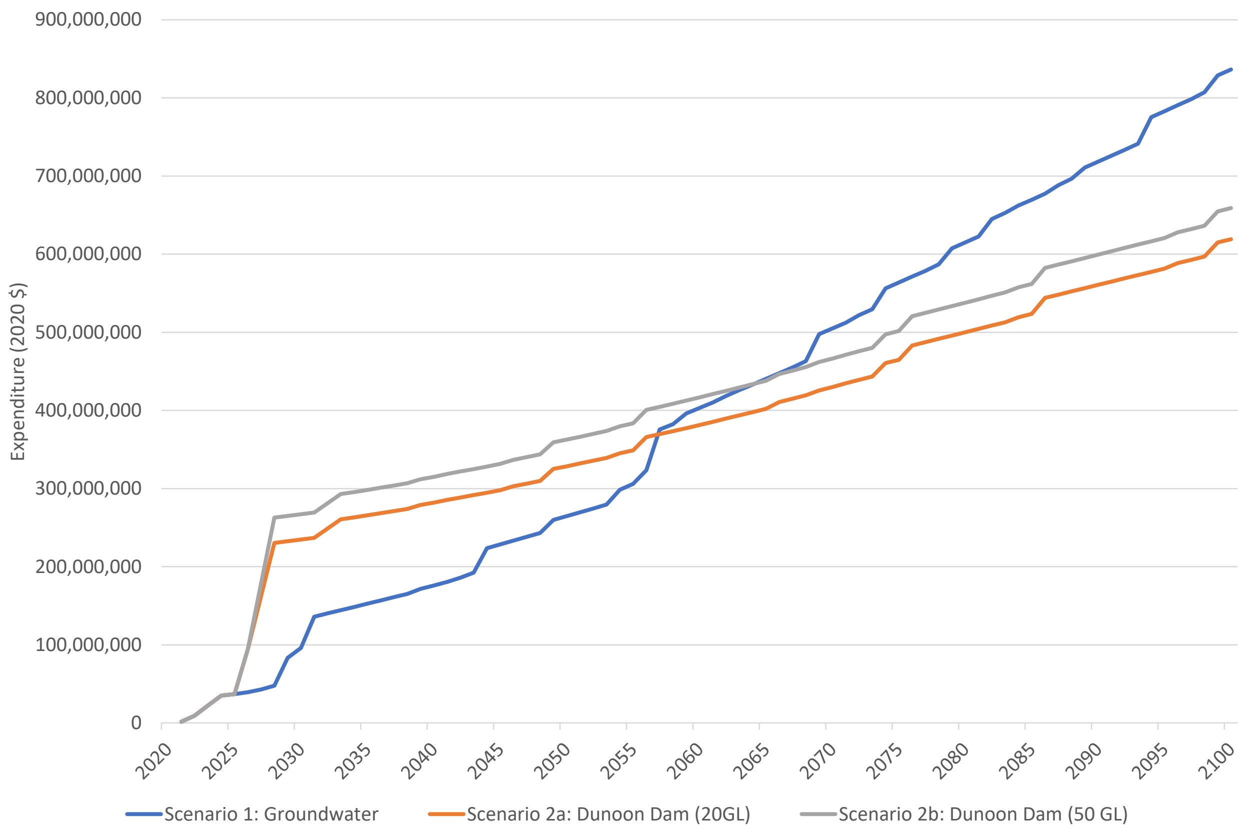

Figure 28: Expenditure profile (cumulative) – scenario comparison

13.4.5 Results

The full MCA is included in Appendix 2. A summary of MCA outcomes (with equal weighting for each criteria) is provided in the following table. Changing the weightings does not change the outcomes of the MCA ranking.

Table 38: Summary of MCA outcomes

Scenario	Environmental score (/5)	Social score (/5)	Total score (per $ NPV)	Rank (based on MCA)
1: Groundwater	3.05	3.50	16.2	1
2A: Dunoon dam (20 GL)	2.65	1.98	9.9	2
2B: Dunoon dam (50 GL)	2.30	1.65	7.8	3

Based on the MCA, the most favourable scenario is groundwater. The groundwater scenario has a lower NPV (lower initial capital cost but higher and increasing recurrent costs with implementation of each stage) as well as less significant environmental and social impacts. However, the groundwater scenario has a higher whole-of life cost (total cost over 80 years in present dollars) and a higher NPV per ML of secure yield as shown in Table 37 and Figure 28. Implementation of the groundwater scenario will require ongoing investigations (and associated costs and problem-solving) for the four groundwater schemes.

Although the MCA is informative, it is focussed on the 2060 planning horizon and RCC should consider longer-term issues such as potential source options beyond that timeframe and financial commitment and funding requirements imposed by the schemes. Dams have a long design life and there is excess secure yield in the Dunoon dam options well beyond the 2060 timeframe considered by this study. When the long-term yield benefit provided by the scenarios is considered, the 50 GL dam option (with high initial cost and lower recurrent costs) with the higher yield benefit is more cost-effective. Although there is a large upfront investment, the dam options can provide long-term certainty and cost efficiencies. The largest dam for the given physical constraints, with planned staging and upgrades, provides only a small incremental risk over the smaller dam. There is a trade-off between the high initial cost and environmental/social impact of the dam and the long-term cost-effectiveness and certainty provided.

14. CONSULTATION

RCC prepared a summary brochure with information for the community about the options for securing the region's water supply (*Future Water Project 2060* (RCC, 2020)). The summary brochure described RCC's proposed two-step action plan (in addition to adopted demand management actions):

1. Maximise the benefit of the existing Marom Creek WTP and better utilise the existing groundwater resources on the Alstonville plateau.
2. While the short-to-medium-term demand needs are being met through groundwater sources, the Dunoon dam project would be progressed through further detailed investigations to determine its prospects for approval. These investigations include cultural heritage investigations and consultation, landholder consultation, determining ecological offset requirements, State and Federal funding assistance options and geotechnical assessments.

The draft *Future Water Project 2060* (RCC, 2020) was endorsed by Council at its ordinary meeting in June 2020 for public exhibition from 1 July 2020 for a period of six weeks. Due to the impact of COVID-19 constraints as well as community feedback, the exhibition period was extended to 10 weeks with submissions accepted until 9 September 2020.

The aims of the public exhibition period were:

- To update the community on the outcome of RCC's new water source investigations undertaken since the FWS was adopted in 2014.
- Based on the outcome of these new water source investigations, to advise the community of RCC's proposed future strategy.
- To invite written submissions in relation to the project.

A range of public engagement, communication and other information resources were developed and deployed as part of the public exhibition period including:

- A dedicated project page on RCC's website that hosted all project documentation (including summaries for download).
- A 3D virtual water supply catchment tool.
- Council's Facebook social media account.
- Three YouTube videos.
- Media releases and public advertisements.
- Direct mail to key stakeholders.

Council elected not to host regional briefings or meetings based on COVID-19 restrictions and public health guidance. The community was provided with phone and email access to the project team.

A total of 1,298 online survey responses and other written submissions were received. Council also received a petition not in favour of the dam containing approximately 450 signatures on 16 November 2020, nine weeks after the public exhibition period had closed. Council engaged the Vaxa Group, a specialist stakeholder engagement and communications agency to independently review the feedback received and report to Council. The key themes in the feedback received are (Vaxa, 2020):

- The majority of respondents agree that it is important to act now to secure the long-term water supply for the region.
- There was a high level of objection to Dunoon dam based on concerns about environmental and cultural heritage impacts.

- The majority of respondents prefer water security achieved through:
  - Rainwater tanks and greater self-sufficiency, along with capture and re-use of stormwater.
  - Enhanced demand management.
  - Permanent water restrictions.
  - Water recycling, including IPR.
  - Addressing leaks and losses within the reticulation system.
- There was majority support expressed for the extraction, treatment and use of groundwater, provided this is sustainable and creates no unacceptable environmental impacts.
- The majority of respondents expressed support for the conservation of potable water (e.g. not watering gardens or washing cars with potable water), with alternatives made available for non-potable purposes.
- A smaller number of respondents recommended desalination as an option, particularly for coastal areas.

The majority of respondents recognise the important role of RCC and agreed that action is needed to secure longer-term water supply, but do not support a water supply strategy which includes Dunoon Dam.

Following the public exhibition period, Council acknowledged concerns about impacts on heritage and biodiversity with the Dunoon dam option and has resolved not to proceed with the dam. RCC resolved at its meeting of 16 December 2020 to:

1. Receive and note the public exhibition review document Rous County Council Future Water Project 2060 Public Exhibition Outcomes. Note that 90% of submissions opposed the Dunoon Dam and the receipt of the Traditional Owners statement of opposition. Note that submissions to the public exhibition process are available on the Rous County Council website.

2. Authorise the General Manager to cease all work on the Dunoon Dam and provide a report on the orderly exit from Dunoon Dam as an option in the future water project, including revocation of zoning entitlements and disposal of land held for the purpose of the proposed Dunoon Dam.

3. Direct the General Manager to revise the draft Integrated Water Cycle Management (IWCM) to reflect the following preferred strategy: a. Scenario 1 IWCM report – groundwater.

4. Schedule a special meeting of Council on Wednesday, 17 March 2021 to consider the revised draft IWCM Strategy for public exhibition for a period of eight (8) weeks.

5. Authorise the transfer $200,000 from bulk water reserves for the 2020/21 financial year to progress the above.

6. Undertake the following actions as described in Section 4 of this report:

i) Immediate actions

a) Water Loss Management Plan

b) Smart Metering

c) Marom Creek WTP and Alstonville groundwater site

d) Marom Creek WTP upgrade

e) Alstonville groundwater site

f) Woodburn groundwater coastal sand scheme *ii) Ongoing action*

a) Enhanced demand management and water efficiency program

iii) Innovative action

a) Progress Perradenya Estate pilot purified recycled water scheme and work with relevant stakeholders to design a long-term public education campaign to increase awareness and acceptance of indirect potable reuse (IPR) and direct potable reuse (DPR).

b) Investigate concurrently IPR and DPR schemes utilising effluent from Ballina, Lennox, south and east Lismore wastewater treatment plants (preferred options for water reuse identified in the CWT report).

7. Note that environmental, ecological, cultural heritage and economic impacts were identified during the development of the IWCM and were also raised as concerns during the public exhibition period and will remain key considerations going forward.

8. Note the progress of discussions with Ballina Shire Council regarding the potential transfer or lease of Marom Creek WTP and that a further report will be provided.

9. Authorise the General Manager to write to the constituent councils inviting participation in the Rous Smart Metering project commencing 1 July 2021.

10. Seek a meeting with relevant State Government Ministers and Local MPs to expedite any regulatory and legislative or funding approvals required to implement IPR and DPR schemes.

15. PREFERRED SCENARIO

In response to the community feedback and key considerations for the regional water supply, the Future Water Project 2060 will include a diversified portfolio of actions to meet the region's water security needs:

- Immediate actions: to increase the system secure yield from 2024.
- Ongoing actions: business as usual actions including reducing potable water demand, improving knowledge of future demand and secure yield and drought management planning.
- Innovative actions: to investigate the increased use of recycled water.
- Long-term actions to confirm and develop the most appropriate long-term water supply scheme components to be implemented.

These components are discussed further in the following sections.

A secure water supply is critical to ensure the regional community's health and quality of life as well as a sustainable environment and continued economic prosperity. RCC has a duty to ensure that there is enough water available to meet the long-term needs of the Ballina Shire, Byron Shire, Lismore City and Richmond Valley Councils and their communities. By 2060, the secure yield of Council's existing bulk supply system is forecast to be 10,427 ML/a. Based on the forecast demand of 16,054 ML/a in 2060, this is a forecast annual yield deficit of 5,619 ML/a in 2060. Taking into account the forecast decline in the system secure yield, it is currently estimated the existing system secure yield will be sufficient to supply demand until 2024. After this time, the existing system cannot meet forecast demand without the potential for more frequent, longer and severe water restrictions. Based on Council's current demand and secure yield forecasts, investment in new water sources cannot be continuously deferred and eventually new sources of water will be required to meet the region's long-term water needs.

If the water security issues are not addressed in a logical, timely and coordinated manner, RCC will be required to:

- Develop new water sources with inadequate time and increased costs, resulting in unfavourable operational conditions and return on investment.
- Implement costly emergency drought works with potentially detrimental environmental impacts.
- Implement longer and more severe water restrictions that significantly impact the community, local businesses, including tourism and industries as well as overall regional investment.

15.1 Source Augmentation Staging

The augmentation of water supply sources will be undertaken in stages which have been selected based on the benefits, costs, lead time and expected success of each option in contributing to a secure water supply for the region.

The first stage of the preferred scenario includes Marom Creek WTP treating groundwater from Alstonville (Lumley Park and two new bores) in addition to surface water supplies from Marom Creek weir. This augmented supply would be operational by 2025 and would be expected to meet demand until 2028. The Alstonville groundwater supplies would be used to augment the regional water supply to Alstonville and Wollongbar when the level in RCD reaches 95%. The Marom Creek weir and WTP would continue to supply Wardell at all times.

Groundwater options available for Stage 2 (beyond 2028) include Woodburn (increased to 5.0 ML/d), Tyagarah and Newrybar. As Woodburn bore 3 is currently included as a dry period supply (Section 3) and is the most viable groundwater source that would be available within a short lead time if required in a drought (refer Section 10.10), the Woodburn option will be preserved as the dry period supply for when RCD reaches

60% as shown in Table 39. Stage 2 of the preferred scenario will include the implementation of the Tyagarah groundwater source as a primary supply. The location and capacity of the Tyagarah groundwater bores will be confirmed following assessment on GDEs although the preferred scenario assumes the bore will supply 7.5 ML/d (Tyagarah scheme 1 from 2029).

Stages 1 and 2 of the Future Water Project 2060 are shown on Figure 30. The proposed operating rules for the augmented supply following stage 1 and 2 are summarised in Table 39. RCC will continue to optimise the use of available water sources.

The yield increase for each stage of the preferred augmentation scenario to 2040 is shown in Figure 29. The secure yield is expected to continue to decline with the effects of climate change and additional source/s will be developed as required during stages 1 and 2.

Table 39: Proposed operating rules for regional water supply following stage 1 and 2 augmentation

RCD supply level (% of full supply volume)	Status	Sources in operation
100%	Normal operation	RCD only
95%		WRS, ECD, Marom Creek weir and Alstonville groundwater, Tyagarah groundwater
60%	Dry period operation	Woodburn bore 3
30%		BaSC plateau bores (Lindendale and Ellis Road)
20%	Emergency operation	Emergency supply source
15%		
10%		

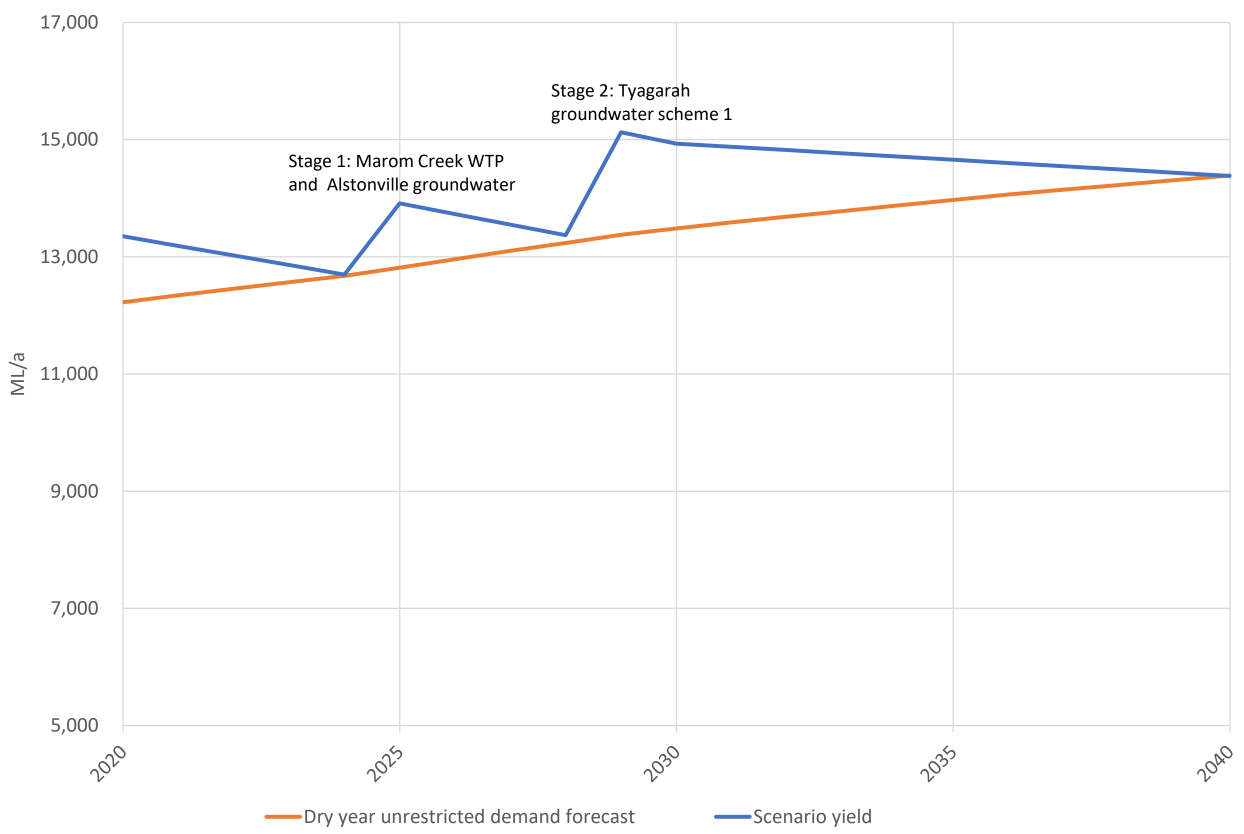

Figure 29: Preferred scenario: staging and secure yield

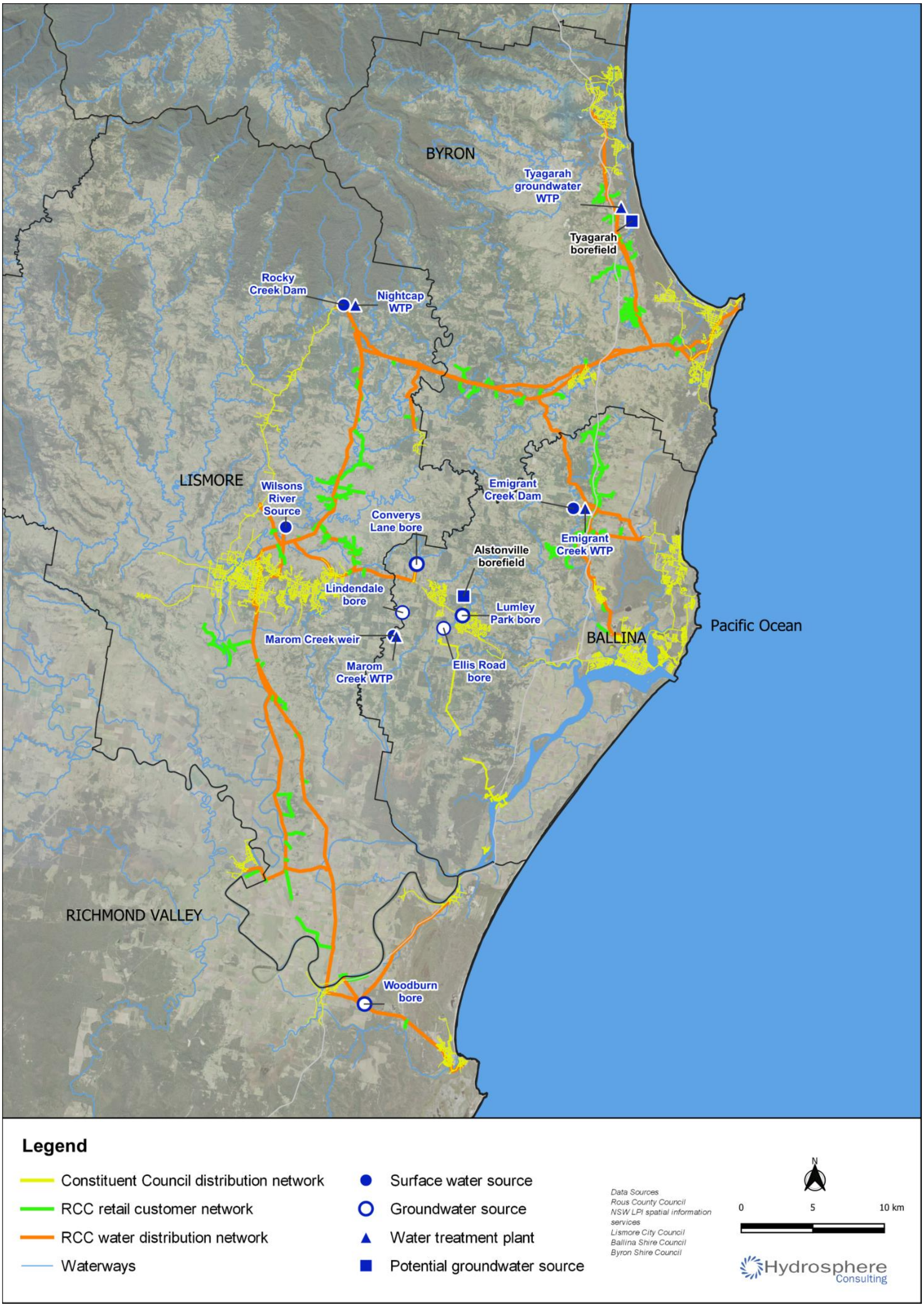

Figure 30: Preferred scenario: Marom Creek, stage 1 and 2 groundwater

Source augmentation options beyond 2040 into Stage 3 will require further investigation but may include additional groundwater schemes, desalination and/or water recycling. The development of water sources and treatment facilities is shown schematically on Figure 31.

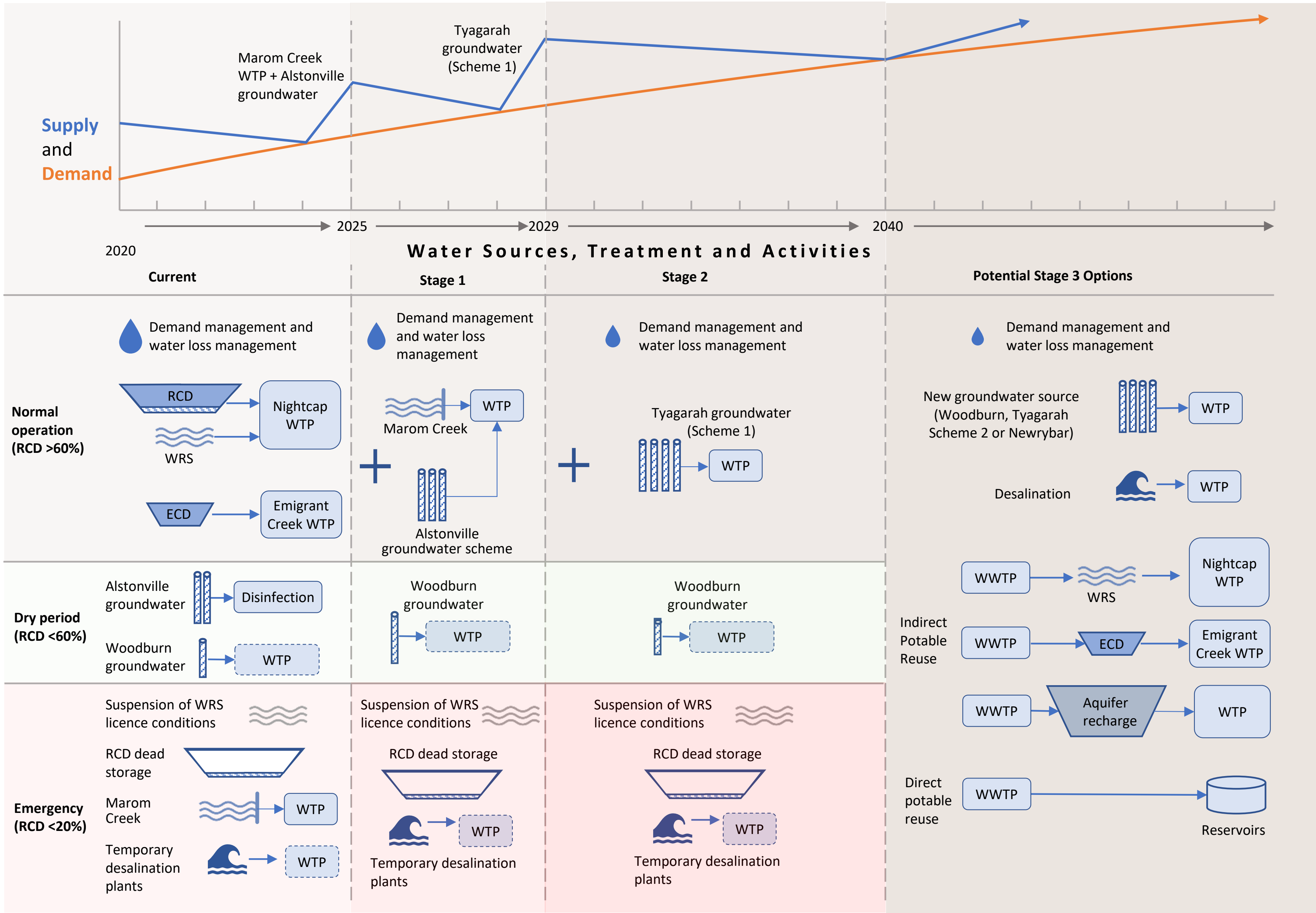

Figure 31: Staging of water source augmentation

15.2 Immediate Actions

15.2.1 Marom Creek WTP and Alstonville groundwater

The first step will be to maximise the benefit of the existing Marom Creek weir and WTP owned by BaSC and better utilise the existing groundwater resources on the Alstonville plateau. This requires RCC to:

- Secure Marom Creek WTP as a regional source option - at its meeting of 27 August 2020, BaSC agreed to negotiate with RCC in respect to either the transfer of the Marom Creek water supply assets to RCC or for a long-term agreement, which would facilitate the supply being used as proposed by RCC. RCC and BaSC will undertake a detailed study of the Marom Creek weir and WTP to identify a price for the transfer of assets including consideration of asset condition, operation, value, future income and other financial considerations.
- Consult with NRAR to increase the licence extraction limit (from Marom Creek weir) to supply Alstonville and Wollongbar in addition to Wardell.
- Complete WTP upgrade works to ensure it can meet the demands for water within the supply area - capital works to improve the operating and treatment efficiency of the plant are being implemented by BaSC in 2021. These works will allow the plant to meet current and future anticipated water quality requirements. The works include filter refurbishment, filter media replacement and ultraviolet disinfection.
- Environmental assessment and approvals.
- Concept development and detailed design of raw and treated water transfer systems.
- Redevelop the Alstonville groundwater bores to fully utilise the capacity of the Marom Creek WTP and provide increased drought resilience.

15.2.2 Woodburn groundwater

The Woodburn groundwater option requires new bores and treatment infrastructure as discussed in Section 10.3. To enable the use of Woodburn groundwater supplies as a dry-period source in the short term, RCC will investigate treatment requirements and commission a pump and package WTP for bore 3 if required during a drought.

15.3 Ongoing Actions

15.3.1 Demand management

The RDMP provides a series of demand management measures to be implemented by RCC and the constituent councils between 2019 and 2022 as discussed in Section 4. The Regional Water Supply Agreement Liaison Committee is overseeing the plan implementation and ensuring the actions specified in the RDMP are completed. The Committee is also responsible for assessing if the plan is meeting its objectives and how best to adapt the plan to incorporate the latest knowledge, experience and technology in a process of continuous improvement.

Success of the RDMP will be gauged through:

- Reporting of action implementation (including timing and completeness).
- KPIs as specified for each RDMP action (Section 4).
- Local and regional demand indicators and achievement of targets.

Annual review of the RDMP is undertaken by 30 September of each year and includes:

- A review of demand data.
- An evaluation of the effectiveness of RDMP actions.
- Review of the appropriateness of the KPIs.
- Feedback from the customers.
- An assessment of the impact of RDMP actions on RCC and the constituent councils in terms of costs, resourcing and operations.

The RDMP will be reviewed in four years (by June 2023) and a revised plan will be prepared with consideration of the outcomes of the annual reviews. The revised plan will specify demand management measures to be implemented over the four-year period between 1 July 2024 and 30 June 2028.

15.3.2 Water loss management

Action 2: Water loss management in the adopted RDMP (Section 4) includes the following tasks:

- Task 2.1: Develop and implement Water Loss Management Plans (WLMPs), actions and targets. RCC has assisted the constituent councils to develop WLMPs to be implemented by each council. The WLMPs identify actions and the expected reduction in water losses which has been incorporated in the demand forecast.
- Task 2.2: Develop local NRW targets for each service area/zone to support achievement of regional targets.
- Task 2.3: Develop and implement an electronic reporting tool to predict and identify leaks in the bulk water distribution system. Leak detection has been addressed in the RCC WLMP.
- Task 2.4: Monitor and report water losses in accordance with a standardised reporting procedure.

The RCC WLMP (Detection Services, 2019) provides recommendations for metering and pressure management, data collection, reporting and active leak detection. The estimated cost of the program is $1.4 million over four years.

RCC will continue to implement the water loss management actions, review progress and modify the actions if required as part of the review of the RDMP. RCC will continue to implement leakage reduction measures in its supply network and support the constituent councils with water loss reduction measures.

15.3.3 Smart metering

A smart meter is a normal water meter connected to a data logger. It can allow for the continuous monitoring of water consumption for the water utility and the customer to assist in demand management. Smart metering remotely collects water flow data that would otherwise require manual reading through a data logger. It sends the water data via a signal where it can be viewed in a web interface in near real time. Loggers can either be connected to existing meters or integrated purpose-built smart water meters that have mechanical or electronic flow measuring, volume recording and communications capabilities in one device. With developments in smart water metering technology, new opportunities have arisen to achieve water savings through better understanding of real-time water consumption.

BaSC has implemented a policy requiring all new connections greater than 20mm and properties with multiple tenancies to install automatic meter reading devices. Meters on all BaSC properties have also been retrofitted with the smart meter loggers. The devices will be analysed by a leak detection algorithm and results reported to the customer. Smart water meters are being trialled in the Byron Shire from November 2020 as part of a 12-month pilot project. Approximately 400 smart water metering devices have been installed on residential and commercial properties in East Mullumbimby and selected bulk recycled water clients in Byron Bay. BySC is considering the smart water meter technology for a potential Shire-wide rollout in the future and the pilot project will help assess its viability.

Action 4: Smart metering in the adopted RDMP (Section 4) includes the following tasks

- Task 4.1: Review program objectives and scope, technologies/suppliers for infrastructure, software and devices (complete). A detailed study undertaken for RCC and the constituent councils (Reid and ecodata, 2019) considers that the water utilities should not be committing to a smart metering solution in the short term due to the limited technologies and vendors with a proven track record at this time. However, in the near future there will be more mature and non-proprietary technology options and several service providers to choose from. The study found that RCC and the constituent councils should plan for and make changes for when the decision is made to proceed with smart metering. This will ensure that the data can be used in a planned and orderly manner with maximum value extracted from it for the benefit of all business units and customers. Comprehensive digital utility transformation and strategies need to be developed, approved and promulgated well before committing to a smart metering solution for the region (Reid and ecodata, 2019).
- Task 4.2: Develop a business case for investment in infrastructure including extension of the program to other operational requirements. Reid and ecodata (2019) recommended that a working group comprising representatives from RCC and constituent council business units should develop a program for implementation of smart water metering and digital transformation.
- Task 4.3: Develop funding and subsidy model based on supply of infrastructure and software and rebates/participant contributions for devices.
- Task 4.4: Identify preferred technology/supplier.
- Task 4.5: Roll-out of the preferred technology.
- Task 4.6: Develop and implement a communication and engagement strategy.

RCC will continue to implement the smart metering actions, review progress and modify the action if required as part of the review of the RDMP.

15.3.4 Drought management planning

The regional water supply operating rules identify water sources to be used during normal operation, dry periods and drought emergencies. The *Regional Water Supply Drought Management Plan* documents a regional restriction regime with triggers based on RCD storage level (Section 3). The plan also identifies emergency water supply options that can be implemented if required to provide a greater level of resilience in the event of a drought emergency. Of the identified emergency supplies, the Marom Creek weir and WTP option is included in RCC's preferred augmentation scenario as a normal operation source at stage 1. The most viable emergency supply options over the long term are the increased extraction from WRS and temporary desalination plants as they are technically feasible and can be implemented in relatively short timeframes. Additional groundwater supplies from the coastal sands groundwater sources (Newrybar or Tyagarah) and desalination (temporary potable plants) may also be implemented in the event of a drought emergency but will also be considered as future primary sources in the longer term.

Monitoring and evaluation are essential tools for the implementation and ongoing improvement of the *Regional Water Supply Drought Management Plan*. The Regional Water Supply Agreement Liaison Committee oversees the plan implementation and ensures the pre-drought and on-going actions defined in the Operational Readiness Plan are completed. The Committee is also responsible for assessing if the plan is meeting its objectives and how best to adapt the plan to incorporate the latest knowledge, experience and technology in a process of continuous improvement.

The drought management plan will be reviewed during Stage 1 of the Future Water Project (by June 2025) and a revised plan will be prepared with consideration of the outcomes of any post-drought reviews and the status of implementation of water supply sources by that time. The revised plan will specify revised operating rules and drought management measures to be implemented over the five-year period between 1 July 2025 and 30 June 2030. Further investigation of the emergency supply options will be required as part of the next update of the Drought Management Plan.

15.3.5 Review of the Future Water Project 2060

The Future Water Project 2060 will be reviewed and updated as follows:

- Annual review – by 30 June each year, RCC will review the progress of each action, particularly the implementation of new sources and review the strategy as required. RCC will review and update its capital works project and financial plan annually.
- Every four years (commencing in 2025), RCC will conduct a mid-term review of the strategy including review of the status of stage 2 and longer-term water supply options investigations. RCC will also review the notional cost of bulk water supply in consultation with the constituent councils to set the medium-term price of bulk water to be supplied.
- The implementation of the strategy relies on key data such as the water supply demand as well as assessment of secure yield. Every eight years, the strategy will be updated considering the findings of the mid-term reviews and updated information on demand, secure yield, the outcomes of stage 1 and 2 and any new information on water supply options. The major review of the strategy will be undertaken earlier if new information on future growth, water sharing rules or climate change impacts becomes available.

Demand forecasting

Council's current water demand forecast for 2020 – 2060 includes analysis of the properties connected to the bulk water supply, the demand of each property and temporal and spatial variations, changes in rainfall and climate patterns, industry and business development, tourism, population and housing growth, as well as the ongoing adoption of water efficient appliances and other water conservation measures. The demand forecast is based on historic water usage as well as forecast rainfall, climate, number of connections and demand management trends. In particular, Council has relied on the regional growth predictions determined by its four constituent councils to forecast how many properties will be connected to the bulk water supply in the future. The long-term predictions about future water demand always involve a degree of uncertainty and ongoing monitoring and modification of the forecast will be required. It is important that the appropriateness of these assumptions is monitored and reviewed regularly so that the future demand profile can be updated.

The RDMP included a monitoring, evaluation and reporting action with a standardised reporting program in accordance with the best-practice requirements with:

- Bulk water production by service area/zone.
- Number of connections by customer/connection type.
- Number of connections with alternative water supplies.
- Accurate estimation of the numbers of multi-residential and multi-non-residential connections and their consumption.
- Total consumption by connection type in each zone/service area.
- Total volume of metered water use by connection type.

Similar reporting requirements have been included in the Service Level Agreements between RCC and the constituent councils. In addition, definitive long-term growth strategies are required across the regional supply area to more accurately predict future demand.

The demand forecast will be reviewed and updated every eight years or more frequently if improved datasets are available.

Secure yield assessment

The Future Water Project 2060 also relies on the available information on stream flows, groundwater availability and the impacts of climate change on the secure yield of the regional water supply. In particular, assumptions have been made about the impacts of climate warming, the timeframe over which warming will occur in future and the resulting decline in yield experienced at 2030 and 2060. As new information becomes available and the methodology for assessment of future secure yield is refined, RCC will undertake a review of the secure yield assessment and implications for future supply planning.

15.4 Water Recycling

15.4.1 Direct non-potable reuse

Recycled water for non-potable supply to households and businesses is available in some parts of the region and is likely to contribute to a reduction in overall water demand across the region in the future. All houses in new developments in the Ballina and Lennox Head urban areas since 2003 have a dual water supply system (dual reticulation) in place with recycled water supplied through the system since 2017. Non-potable supplies in these areas are available for flushing toilets, washing clothes and watering gardens. Recycled water is also available in some parts of Byron Bay for toilet flushing to supplement potable supplies. The schemes are still in their infancy and will be further developed over time.

RCC offers a recycled water scheme rebate to residential properties for connection of recycled water for outdoor use, toilet flushing and cold water washing machine taps. Rebates are available for non-residential customers through the Sustainable Water Partner Program. Customers in Ballina Shire and Byron Shire are eligible for rebates where the property is not required to connect to an approved recycled water scheme as part of BASIX.

BySC also provides customers with the opportunity of funding the portion of the connection to the recycled water scheme that is not eligible for a rebate through increased future recycled water bills (rather than up-front payments).

Action 5: Recycled water in the adopted RDMP (Section 4) includes the following tasks within Byron and Ballina shires:

- Task 5.1: Develop procedures for implementation of rebates and reporting requirements (complete).
- Task 5.2: Implement rebate program within BaSC and BySC supply areas (ongoing).
- Task 5.3: Document strategy for connection to existing recycled water systems or expansion of existing systems (in progress).
- Task 5.4: Develop marketing strategy and promote opportunities for recycled water connections to existing and new customers (in progress).

RCC will continue to support the constituent councils with the implementation of recycled water schemes and rebates. RCC also has a longstanding commitment to provide the Perradenya Estate (168 lot under development by RCC) with access to a recycled water supply system which is discussed further below.

15.4.2 Direct Potable Reuse

Direct potable reuse (DPR) requires the treatment of sewage effluent from an existing or new WWTP to produce reclaimed water of a quality that would be suitable for drinking purposes. This water would then be provided direct to consumers. This option requires a very complex water treatment process, detailed monitoring and emergency contingency procedures. Currently there is a national framework providing guidelines for reuse but no state framework for the verification and approval of a DPR scheme. Based on experience around Australia, the preferred approach is a demonstration facility to develop broad community acceptance prior to seeking the formal approval. The 2014 IWP and the coarse screening assessment undertaken for the Future Water Project (Section 7) found that DPR is not a feasible short-term component of the Future Water Project but could be included with a watching brief for reconsideration in the future if circumstances change.

In June 2020, Council resolved to progress discussions with the NSW Government and Southern Cross University in relation to delivering a pilot recycled water supply scheme for the Perradenya Estate. Ultimately, partnering with the NSW Government and Southern Cross University would give Council access to the funding and expertise needed to successfully deliver the scheme. Council will continue to seek funding assistance to build a pilot treatment plant (potentially at South Lismore WWTP which has recently been upgraded with advanced treatment technology). It is proposed to initially construct and operate a pilot plant to test the treatment equipment’s capability to produce purified recycled water of a drinking standard. Should regulatory approval and community support be gained, the pilot plant’s purified recycled water would then be supplied for use throughout the Perradenya Estate.

The objectives of the pilot plant and, if approved, the supply scheme include:

- Early and ongoing community engagement – experience with recycled water schemes elsewhere in Australia illustrates the critical importance of engaging the community to gain acceptance of purified recycled water.
- Demonstrate safe operating protocols to assist development of the regulatory framework.
- Implement an evidence-based process (including socio-economic assessments) that drives a culture of transparency and community acceptance.
- Understand emerging health risks (such as with antimicrobial resistance) and continuously improve sustainable treatment options (for energy and nutrient recovery) as well as risk management approaches.
- Demonstrate improved understanding of the design and multiple barrier processes involved in the treatment train that delivers purified recycled water of acceptable quality.
- Embed feedback mechanisms from users to define acceptable quality, socio-economic outcomes and appropriate water safety management oversight.
- Incorporate the results of the pilot scheme into systems analysis of the Northern Rivers region to understand the economic and environmental values of purified recycled water schemes.
- Provide a better understanding of regional water security given climatic and demographic change scenarios, along with the potential regional health and well-being improvements the pilot scheme is expected to bring.
- Deliver rigorous testing and validation that provides the essential data needed before significant investment is considered in large-scale purified water recycling plants and the wider use of purified recycled water for drinking purposes (both regionally and across NSW).
- Engage with all relevant NSW agencies to develop a comprehensive management framework.

At this stage, it is expected that construction of the pilot recycled water treatment plant would take up to 18 months to complete and could commence following planning stages (consultation, design and approvals). The verification and operational approval process is expected to take a minimum 10 years. However, the start of construction would depend on the timeline for funding and discussions with the NSW Government.

15.4.3 Indirect Potable Reuse

Concurrent with the DPR pilot scheme discussed above, RCC will continue to investigate the potential for IPR schemes (most likely at Lismore and Ballina/Lennox Head as discussed in Section 12) to supplement the regional water supply. Whilst there are some significant barriers to overcome to enable IPR to be considered a viable solution for securing the region's long-term water supply, the investigations over the next four-year period (2022 to 2026) will focus on:

- Further development of the scheme concepts and establishing costs for the preferred schemes.
- Liaison with the BaSC and LCC to confirm the quantity of water potentially available from the WWTPs.
- Investigating the feasibility of the recharge of groundwater aquifers.
- Providing information to the NSW Government and industry to assist in the development of a policy on IPR in NSW.

Advances in wastewater treatment technology and potentially increased acceptance of recycling schemes resulting from the pilot scheme may increase the viability of IPR schemes. This will be considered in future reviews of the Future Water Project (Section 15.3.5).

15.5 Future Source Augmentation

A Stage 3 water source would be required by 2040. During Stages 1 and 2, RCC will continue investigations into the preferred long-term source augmentation strategy which may include:

- Expansion of the groundwater schemes to include additional Tyagarah bores (Scheme 2, 5.0 ML/d) or the Newrybar groundwater source (8.0 ML/d).
- Desalination of ocean feedwater (at Byron Bay or Lennox Head) as discussed in Section 11.
- A regional desalination facility with interconnection of the Tweed and RCC regional supplies. Tweed Shire Council's current strategy is to raise Clarrie Hall Dam which is expected to meet demand until 2046 and regional interconnection may be considered viable beyond that time.
- Direct or indirect potable reuse.

The key considerations will be:

- Outcomes of the implementation of stage 2 Tyagarah groundwater (scheme 1) and assessment of impacts on GDEs.
- Further bore testing at Newrybar to confirm the sustainable yields, impacts on other water users within the aquifers and water treatment and wastewater disposal requirements.
- The success of stage 1 and 2 source augmentation and requirements (yield and timing) for further augmentation.
- The outcomes of the DPR pilot scheme.
- The outcomes of the IPR investigations.
- Ongoing review and update of the Future Water Project 2060.

- The outcomes of other regional investigations including the planning for raising of Clarrie Hall Dam and the NSW Government's *Regional Water Strategy: Far North Coast.*

15.6 Stakeholder Engagement

Based on the feedback received during the public exhibition of the draft Future Water Project 2060, there is expected to be significant community interest in future stages of the strategy. RCC will develop a Stakeholder Engagement Strategy for the Future Water Project 2060 including the components listed in Table 40.

Table 40: Stakeholder engagement

Component	Timing	Aboriginal representatives	Constituent councils	Community groups and customers	Government agencies
Exhibition of the adopted Future Water Project 2060	Quarter 4, 2021	✓	✓	✓	✓
Outcomes of annual review of Future Water Project 2060	June each year	✓	✓	✓	
Marom Creek water supply asset study and operational agreement	Quarter 1, 2022 – Quarter 4, 2022		✓ (BaSC)		
Marom Creek WTP upgrade	Quarter 1, 2022 – Quarter 4, 2022		✓ (BaSC)		✓
Marom Creek weir supply licence and approvals	Quarter 1, 2022 – Quarter 4, 2023	✓	✓ (BaSC)	✓	✓
Alstonville groundwater licences and approvals	Quarter 1, 2022 – Quarter 2, 2023	✓	✓ (BaSC)	✓	✓
Alstonville groundwater construction and commissioning	Quarter 3, 2023 – Quarter 3, 2024	✓	✓ (BaSC)		✓
Review of RDMP	Every 4 years		✓		
Water loss management	Ongoing		✓		
Smart metering	Ongoing		✓	✓	
Review of Drought Management Plan	Every 5 years		✓		
Mid-term review of Future Water Project 2060	Every 4 years	✓	✓	✓	✓
Review of demand forecast	Every 8 years		✓		
Review of secure yield assessment	Every 8 years		✓		✓
Major review of Future Water Project 2060	Every 8 years	✓	✓	✓	✓

Component	Timing	Aboriginal representatives	Constituent councils	Community groups and customers	Government agencies
DPR pilot scheme	Ongoing	✓	✓	✓	✓
IPR investigations	Quarter 1, 2022 – Quarter 4, 2025	✓	✓	✓	✓
Stage 3 source investigations	Ongoing	✓	✓	✓	✓

15.7 Implementation Plan

The delivery of the preferred scenario over the next ten years is shown in Table 41 and illustrated schematically in Figure 32. Cost estimates are included in Table 42 and Figure 33. RCC costs have been estimated based on available information. These estimated costs will be continually reviewed as the IWCM Strategy is implemented.

Table 41: Future Water Project 2060 implementation (2022 – 2031)

			Stage 1				Stage 2				Stage 3	
Delivery Program year			Year 5	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2
Stage	**Task/ year**		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Stage 1	Marom Creek		Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Operation	Operation	Operation	Operation	Operation	Operation
	Alstonville groundwater		Source planning, design and approvals	Source planning, design and approvals	Construction	Construction	Operation	Operation	Operation	Operation	Operation	Operation
	Woodburn groundwater	New bores	Source planning, design and approvals	Source planning, design and approvals	Construction							
		Existing bore 3 + WTP	Source planning, design and approvals	Source planning, design and approvals	Construction	Operation						
Stage 2	Tyagarah groundwater		Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Construction	Construction	Operation	Operation
Stage 2 & 3	Groundwater source land acquisition		Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals						
Stage 3	IPR investigations		Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals						
	Stage 3 source planning										Source planning, design and approvals	Source planning, design and approvals
	DPR pilot scheme		Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals	Construction	Construction	Verification	Verification	Verification	Operation	Operation
-	Dunoon dam land disposal		Source planning, design and approvals	Source planning, design and approvals	Source planning, design and approvals							
Ongoing	RCC Demand management planning		Demand management				Demand management				Demand management	
Ongoing	Water loss management		Construction	Construction	Construction	Construction	Operation	Operation	Operation	Operation	Operation	Operation
Ongoing	Smart metering		Construction	Construction	Operation	Operation	Operation	Operation	Operation	Operation	Operation	Operation
Ongoing	Stakeholder engagement		Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning
Ongoing	Drought management planning		Strategic planning					Strategic planning				
Ongoing	Demand forecasting (incl. data acquisition)			Strategic planning			Strategic planning			Strategic planning		
Ongoing	Secure yield assessment				Strategic planning			Strategic planning			Strategic planning	
Ongoing	IWCM Strategy review		Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning	Strategic planning

Source planning, design and approvals	Construction	Demand management	Strategic planning	Verification	Operation

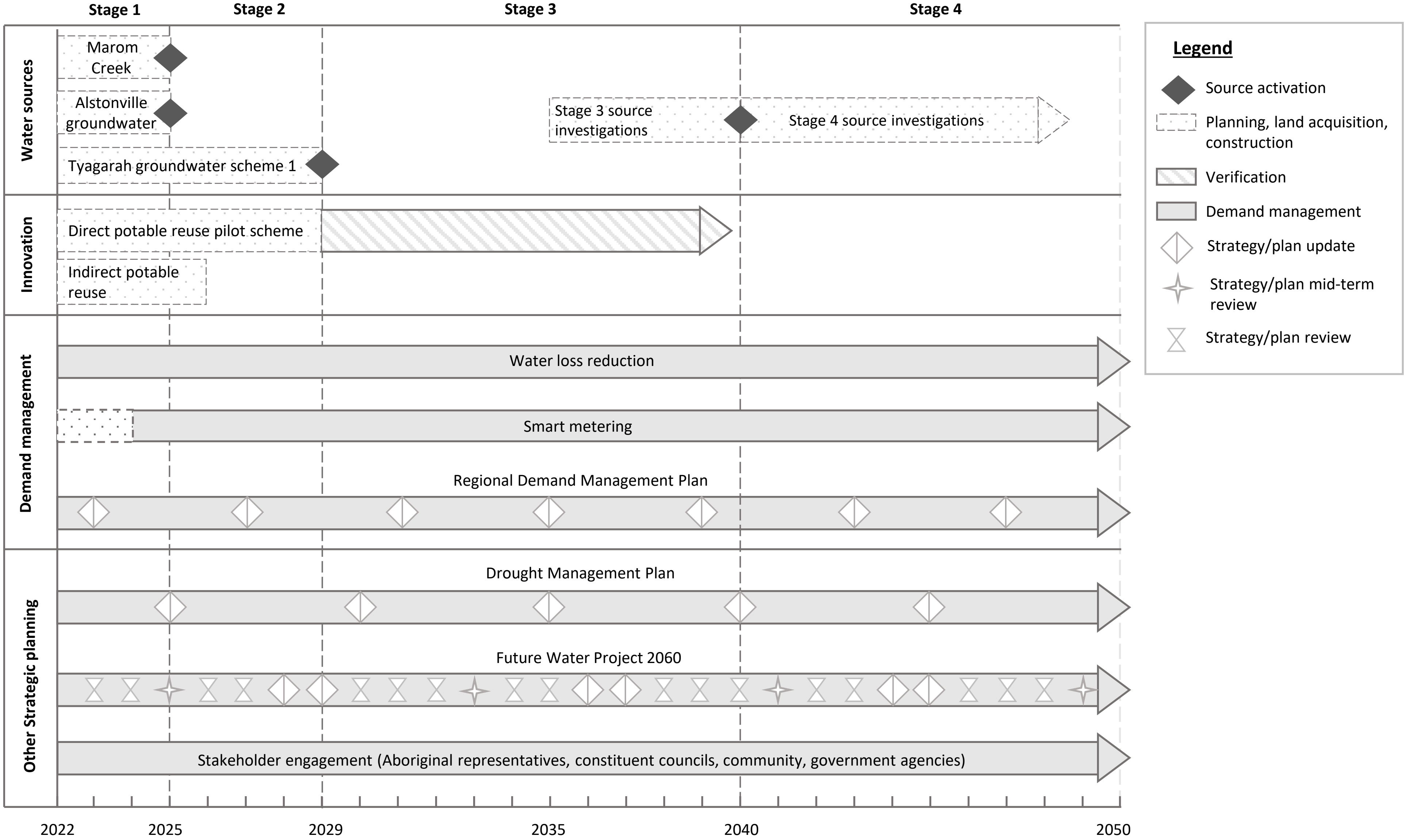

Figure 32: Future Water Project implementation planning

Table 42: Future Water Project 2060 capital and operating cost estimates (2022 – 2031)

	Delivery Program year		**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 1**	**Year 2**
	Year		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Stage	**Task/cost (2021 $'000)[1]**	**Total cost**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
1	Marom Creek	15,220	1,000	1,000	3,700	3,700	970	970	970	970	970	970
1	Alstonville groundwater	30,660	500	7,200	9,200	9,200	760	760	760	760	760	760
1	***Woodburn groundwater (subtotal)***	***3,105***	***1,035***	***1,035***	***1,035***							
	Woodburn existing bore 3 + WTP	400	200	200								
	Woodburn new bores	2,705	835	835	1,035							
2	Tyagarah groundwater	45,800	900	900	1,000	1,000	5,000	9,000	18,700	6,700	1,300	1,300
2 & 3	Groundwater source land acquisition	17,500	500	7,300	4,700	5,000						
3	IPR investigations	1,000	250	250	250	250						
3	Stage 3 source planning	2,600									1,000	1,600
3	DPR pilot scheme	7,050	600	600	600	2,000	2,000	250	250	250	250	250
-	Dunoon Dam land disposal	500	150	150	200							
Ongoing	***RCC demand management (subtotal)***	***8,000***	***1,900***	***1,200***	***1,100***	***1,000***	***600***	***600***	***600***	***600***	***600***	***600***
	Recurrent spending	5,000	500	500	500	500	500	500	500	500	500	500
	Water loss management	1,900	500	500	500	400						
	Smart metering	1,900	900	200	100	100	100	100	100	100	100	100
Ongoing	Drought management planning	250	125					125				
Ongoing	Demand forecasting (incl. data acquisition)	160		40			40			80		
Ongoing	Secure yield assessment	150			50			50			50	
Ongoing	IWCM Strategy review	1,200				200			500	500		
Ongoing	Other - total Principal's program costs	20,165	2,937	2,939	2,782	2,589	3,091	1,442	1,507	1,529	674	674
	Totals	**154,160**	**9,897**	**22,614**	**24,617**	**24,939**	**12,461**	**13,197**	**23,287**	**11,389**	**5,604**	**6,154**

1. Asset renewal costs have been excluded from this table. These costs will be included in future versions of RCC's long-term financial plan.

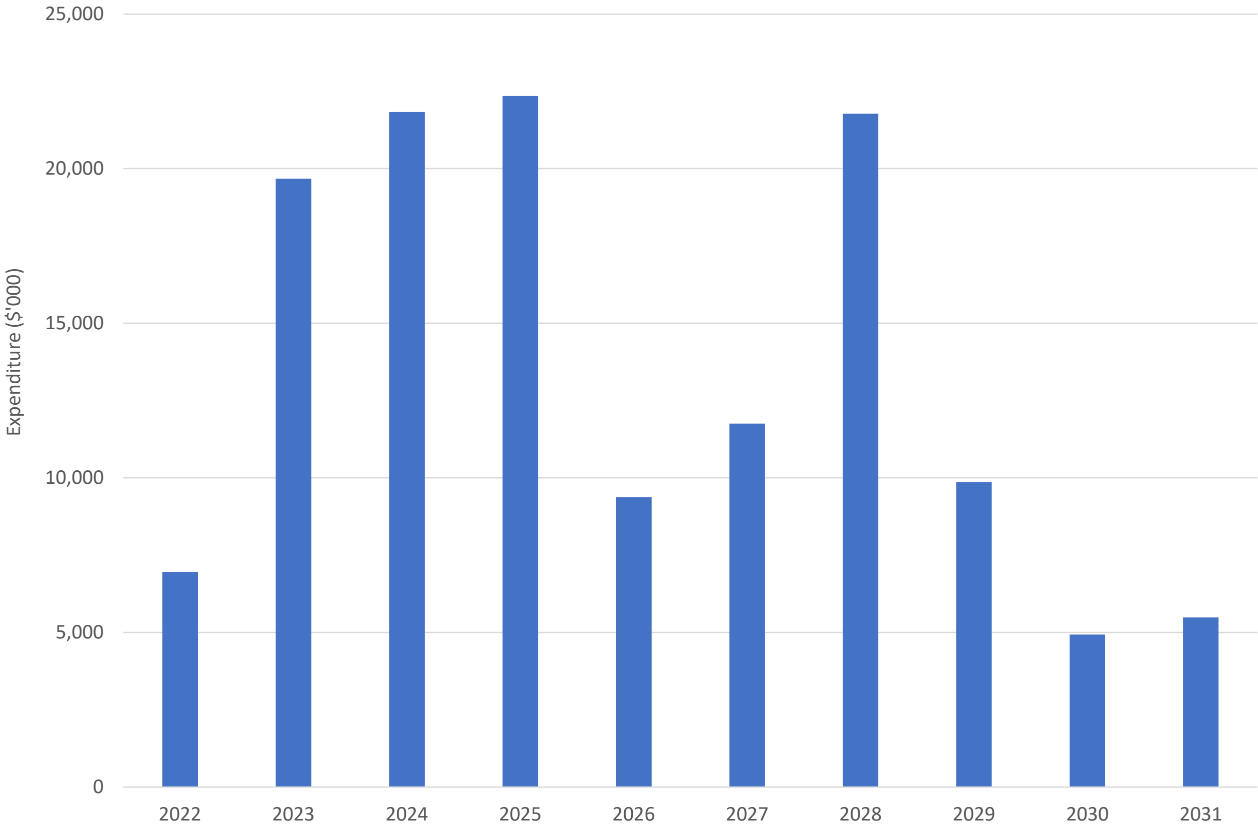

Figure 33: Future Water Project 2060 expenditure (2022 – 2031)

15.8 Adaptive Management

Implementation risks have been identified in this report for the adopted stage 1 and 2 water source options. RCC will continue to conduct detailed investigations for the preferred scenario and address these risks. Although definitive action is required in the short-term, adaptive management approaches have also been identified. RCC will consider alternative approaches as identified in Table 43 if any components of the preferred scenario become unfeasible.

Table 43: Risk assessment and adaptive management approach

Stage	Potential risk	Likelihood	Risk mitigation measures	Risk treatment options
1	BaSC does not agree to transfer ownership of Marom Creek weir and WTP to RCC for use in the regional water supply.	Possible – BaSC has expressed concern about the impact on groundwater supplies on the Alstonville plateau.	RCC has conducted a hydrogeological review including test bores at the proposed Alstonville and Converys Lane bore sites and developed a concept design (Jacobs, 2020a; 2020b). Further site investigations (bore construction and pumping tests) are required to establish the sustainable yield, however, investigations to date indicate that the sites are sustainable. The bore development would be undertaken under *State Environmental Planning Policy (SEPP) Infrastructure 2007* and would be assessed by RCC under Part 5 of the *Environmental Planning and Assessment Act 1979*. RCC would prepare a Review of Environmental Factors addressing biodiversity, heritage, groundwater, surface water, social and other relevant aspects.	• RCC and BaSC enter a long-term deed of agreement where the asset continues to be owned and operated by BaSC and the supply is formally included in the management of the regional water supply. • Convert the Woodburn dry period supply (bore 3) to a primary source with three new bores, WTP and distribution to the Lower Richmond River supply system. The stage 2 supply would be required earlier to compensate for the reduced yield benefit and an alternative dry period supply would be required. Additional initial capital expenditure (approximately $10 million) and operating costs (approximately $200,000 p.a.) would be required. • Modify the proposed Alstonville groundwater scheme to include a separate RCC owned and operated WTP at an initial capital cost of approximately $12 million (Jacobs, 2020b).
1	The construction of new bores at Converys Lane and Alstonville is not approved.	Possible – The existing Converys Lane bore can be replaced within 20 m of the existing bore under the existing works approval. RCC is required to purchase a new licence or transfer any unused existing allocations for the proposed new Alstonville bore.		• The Woodburn groundwater scheme would be implemented as Stage 1 (as above).

Stage	Potential risk	Likelihood	Risk mitigation measures	Risk treatment options
1	Severe drought is experienced.	Possible – dry periods are becoming more frequent and intense with climate change.	RCC will operate RCD, WRS and ECD until the level in RCD falls to 60% when restrictions will be introduced. The source operating rules identify alternative water sources which can be made operable within a short time frame including Woodburn bore 3, existing Alstonville bores and BaSC bores. RCC will review the drought management plan and consider the adequacy of the existing operating rules and emergency supply options. Package WTPs to be scoped for availability for treatment of existing groundwater sources at Alstonville and Woodburn.	Drought restrictions will be increased if the level in RCD continues to fall. Emergency supply options include: • Increased extraction from WRS with temporary suspension of licence requirements (potentially increasing supply for 2.5 years at restricted demand). • Supply from Marom Creek WTP to Wollongbar reservoir. • Temporary desalination plants deployed at coastal locations (e.g. South Ballina, Lennox Head and Byron Bay).
2	The construction of new bores at Tyagarah is not approved.	Possible – The impact on GDEs has not yet been fully assessed.	Although concept designs have been developed for a borefield with capacity of 20 ML/d, the preferred scenario assumes the Tyagarah Scheme 1 borefield capacity is 7.5 ML/d. Various bore locations have been identified and RCC will continue to assess the impacts of bore construction to identify the preferred bore locations and confirm the sustainability of the scheme.	The Newrybar groundwater scheme would be implemented as Stage 2. Additional initial capital expenditure (approximately $13 million) and operating costs (approximately $640,000 p.a.) would be required.

Stage	Potential risk	Likelihood	Risk mitigation measures	Risk treatment options
3	A stage 3 water source is not included in the preferred scenario.	Certain – the preferred long-term source has not been determined.	The stage 1 and 2 source augmentation strategy is expected to meet demand until 2040. RCC will continue to investigate alternative supply options for stage 3 and 4. Detailed investigations have been undertaken into potential groundwater schemes (Tyagarah and Newrybar) and these are considered feasible pending detailed assessment and approval. RCC has also undertaken detailed investigations of an expanded groundwater scheme at Woodburn which is also considered feasible. RCC will also continue to investigate recycling and desalination options to confirm feasibility and community acceptance.	In addition to ongoing demand management and water loss reduction activities, RCC will undertake detailed assessment of potential long-term source options from 2029 to ensure availability from 2040 including: • Development of additional groundwater sources at Tyagarah (Scheme 2), Newrybar or Woodburn. • Desalination at Byron Bay or Lennox Head. • Regional interconnection with Tweed (Bray Park) water supply including desalination. • Direct or indirect potable reuse (pending feasibility, approval and community acceptance).

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GLOSSARY AND ABBREVIATIONS

ADD	Average day demand
AHD	Australian height datum
ASS	Acid sulfate soil
BASIX	Building Sustainability Index
BaSC	Ballina Shire Council
BySC	Byron Shire Council
DPIE	(NSW) Department of Planning, Infrastructure and Environment
ECD	Emigrant Creek Dam
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC	*Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act)
FSL	Full supply level
FWS	Future Water Strategy
GDE	Groundwater dependent ecosystem
GL	Gigalitres (one million litres)
IWP	Integrated Water Planning (process)
kL	Kilolitres
kL/a	Kilolitres per annum
kWhr	Kilowatt hours
kWhr/a	Kilowatt hours per annum
L	Litres
L/d	Litres per day
LCC	Lismore City Council
LEP	Local Environmental Plan
MCA	Multi-criteria analysis
MFL	Maximum flood level
ML	Megalitres
ML/a	Megalitres (one thousand litres) per annum
ML/d	Megalitres per day
NOROC	(former) Northern Rivers Regional Organisation of Councils
NPV	Net present value - the present value of a series of future payments
OEH	Office of Environment and Heritage
PADs	Potential archaeological deposits
PDD	Peak day demand
RCC	Rous County Council
RCD	Rocky Creek Dam
RDMP	Regional Demand Management Plan
RL	Reduced level (relative to Australian height datum)

RO	Reverse osmosis
RoTAP	Rare or Threatened Australian Plants
RVC	Richmond Valley Council
Secure yield	The highest annual water demand that can be supplied from a water supply headworks system while meeting the ‘5/10/10 design rule’
SEPP	State Environmental Planning Policy
SEQ	South-east Queensland
TSC	Tweed Shire Council
WRS	Wilsons River Source
WTP	Water treatment plant
WWTP	Wastewater treatment plant

Appendix 1. NET PRESENT VALUE CALCULATIONS

Life cycle cost analysis - 50 GL Dunoon Dam

Estimated costs (2020 $)	Source	Total 80 years	1	2	3	4	5	6	7	8	9	10
Initial acquisition costs (non-recurring)												
Capital costs												
Construction costs (asset renewal life)		$ -										
RCC Dam (incl. destratifier)	PWA	$ 112,275,735		56,137,868	56,137,868							
Pumping station	PWA	$ 16,091,790		8,045,895	8,045,895							
Rising main	PWA	$ 18,901,740		9,450,870	9,450,870							
Roads	PWA	$ 17,345,900		8,672,950	8,672,950							
34% Indirect costs	RCC (includes pre-construction etc)	$ 55,384,835	55,384,835									
Total initial capital costs		**$ 220,000,000**	**$ 55,384,835**	**$ 82,307,583**	**$ 82,307,583**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)	PWA	$ 9,906,000										
Pumping station	PWA	$ 25,875,200										
Rising main	PWA	$ 10,093,200										
Roads	PWA	$ 8,405,800										
Total renewal costs		**$ 54,280,200**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs		**$ 274,280,200**	**$ 55,384,835**	**$ 82,307,583**	**$ 82,307,583**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Ongoing operating and maintenance (recurring)												
Maintenance costs												
RCC Dam (incl. destratifier)	PWA	$ 3,062,207	-	18,069	18,069	18,069	18,069	18,069	18,069	18,069	18,069	18,069
Pumping station	PWA	$ 5,075,287	-	35,333	35,333	35,333	35,333	35,333	35,333	35,333	35,333	35,333
Rising main	PWA	$ 1,918,620	-	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540
Roads	PWA	$ 1,960,402	-	11,255	11,255	11,255	11,255	11,255	11,255	11,255	11,255	11,255
Total maintenance costs		**$ 12,190,755**	**$ -**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**
Operating costs												
DAM		$ -										
Annual Operation/ Inspection	PWA	$ 4,680,000		60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	PWA	$ 8,580,000		110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	PWA	$ 600,000						40,000				
20-yearly Dam safety review	PWA	$ 600,000										
PUMPING STATION		$ -										
Water pumping cost	PWA	$ 94,403,891		45,977	45,977	45,977	45,977	45,977	95,226	144,474	193,720	242,965
Total operating costs		**$ 110,515,416**	**$ -**	**$ 215,977**	**$ 215,977**	**$ 215,977**	**$ 215,977**	**$ 255,977**	**$ 265,226**	**$ 314,474**	**$ 363,720**	**$ 412,965**
Total operating and maintenance costs		**$ 122,706,171**	**$ -**	**$ 293,174**	**$ 293,174**	**$ 293,174**	**$ 293,174**	**$ 333,174**	**$ 342,423**	**$ 391,671**	**$ 440,917**	**$ 490,162**
Total Costs		**$ 396,986,371**	**$ 55,384,835**	**$ 82,600,757**	**$ 82,600,757**	**$ 293,174**	**$ 293,174**	**$ 333,174**	**$ 342,423**	**$ 391,671**	**$ 440,917**	**$ 490,162**

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
Total initial capital costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)						221,000				
Pumping station						343,200				
Rising main										
Roads										
Total renewal costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 564,200**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 564,200**	**$ -**	**$ -**	**$ -**	**$ -**
RCC Dam (incl. destratifier)	18,069	36,138	36,138	36,138	36,138	35,348	35,743	35,743	35,743	35,743
Pumping station	35,333	70,666	70,666	70,666	70,666	68,218	69,442	69,442	69,442	69,442
Rising main	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	11,255	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510
Total maintenance costs	**$ 77,197**	**$ 154,394**	**$ 154,394**	**$ 154,394**	**$ 154,394**	**$ 151,156**	**$ 152,775**	**$ 152,775**	**$ 152,775**	**$ 152,775**
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review										
Water pumping cost	292,209	341,452	390,694	439,934	489,174	538,412	587,649	636,886	686,121	735,355
Total operating costs	**$ 502,209**	**$ 511,452**	**$ 560,694**	**$ 609,934**	**$ 659,174**	**$ 748,412**	**$ 757,649**	**$ 806,886**	**$ 856,121**	**$ 905,355**
Total operating and maintenance costs	**$ 579,406**	**$ 665,846**	**$ 715,088**	**$ 764,328**	**$ 813,568**	**$ 899,568**	**$ 910,424**	**$ 959,661**	**$ 1,008,896**	**$ 1,058,130**
Total Costs	**$ 579,406**	**$ 665,846**	**$ 715,088**	**$ 764,328**	**$ 813,568**	**$ 1,463,768**	**$ 910,424**	**$ 959,661**	**$ 1,008,896**	**$ 1,058,130**

Estimated costs (2020 $)	21	22	23	24	25	26	27	28	29	30
Total initial capital costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)										
Pumping station	832,000									
Rising main										
Roads	821,600									
Total renewal costs	**$ 1,653,600**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs	**$ 1,653,600**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
RCC Dam (incl. destratifier)	35,743	41,558	41,558	41,558	41,558	41,558	41,953	41,953	41,953	41,953
Pumping station	68,162	98,702	98,702	98,702	98,702	98,702	99,926	99,926	99,926	99,926
Rising main	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	21,246	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878
Total maintenance costs	**$ 150,231**	**$ 187,218**	**$ 187,218**	**$ 187,218**	**$ 187,218**	**$ 187,218**	**$ 188,837**	**$ 188,837**	**$ 188,837**	**$ 188,837**
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review	200,000									
Water pumping cost	784,587	833,819	883,050	932,279	981,508	1,030,735	1,079,962	1,129,187	1,178,411	1,227,634
Total operating costs	**$ 1,194,587**	**$ 1,003,819**	**$ 1,053,050**	**$ 1,102,279**	**$ 1,151,508**	**$ 1,240,735**	**$ 1,249,962**	**$ 1,299,187**	**$ 1,348,411**	**$ 1,397,634**
Total operating and maintenance costs	**$ 1,344,818**	**$ 1,191,037**	**$ 1,240,268**	**$ 1,289,497**	**$ 1,338,726**	**$ 1,427,953**	**$ 1,438,799**	**$ 1,488,024**	**$ 1,537,248**	**$ 1,586,471**
Total Costs	**$ 2,998,418**	**$ 1,191,037**	**$ 1,240,268**	**$ 1,289,497**	**$ 1,338,726**	**$ 1,427,953**	**$ 1,438,799**	**$ 1,488,024**	**$ 1,537,248**	**$ 1,586,471**

Estimated costs (2020 $)	31	32	33	34	35	36	37	38	39	40
Total initial capital costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)	2,369,900									
Pumping station	8,552,700									
Rising main										
Roads	2,463,500									
Total renewal costs	**$ 13,386,100**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs	**$ 13,386,100**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
RCC Dam (incl. destratifier)	27,368	45,437	45,437	45,437	45,437	45,437	45,437	45,437	45,437	45,437
Pumping station	14,753	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086
Rising main	25,080	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620
Roads	18,088	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343
Total maintenance costs	**$ 85,289**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review										
Water pumping cost	1,276,857	1,326,078	1,375,298	1,424,517	1,473,735	1,522,952	1,572,168	1,621,383	1,670,597	1,719,810
Total operating costs	**$ 1,486,857**	**$ 1,496,078**	**$ 1,545,298**	**$ 1,594,517**	**$ 1,643,735**	**$ 1,732,952**	**$ 1,742,168**	**$ 1,791,383**	**$ 1,840,597**	**$ 1,889,810**
Total operating and maintenance costs	**$ 1,572,146**	**$ 1,658,564**	**$ 1,707,784**	**$ 1,757,003**	**$ 1,806,221**	**$ 1,895,438**	**$ 1,904,654**	**$ 1,953,869**	**$ 2,003,083**	**$ 2,052,296**
Total Costs	**$ 14,958,246**	**$ 1,658,564**	**$ 1,707,784**	**$ 1,757,003**	**$ 1,806,221**	**$ 1,895,438**	**$ 1,904,654**	**$ 1,953,869**	**$ 2,003,083**	**$ 2,052,296**

80 year whole-of-life cost	**$ 396,986,371**					
80 year NPV	**$ 263,580,730**	3%	40 year NPV	**$ 241,060,953**	2060 yield	15,057 ML/a
	$ 234,596,513	5%		**$ 226,526,974**	NPV/ML yield	$ 15,045
	$ 219,388,230	7%		**$ 216,340,071**		

Life cycle cost analysis - 50 GL Dunoon Dam

Estimated costs (2020 $)	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50
Initial acquisition costs (non-recurring)												
Capital costs												
Construction costs (asset renewal life)		$ -										
RCC Dam (incl. destratifier)	PWA	$ 112,275,735										
Pumping station	PWA	$ 16,091,790										
Rising main	PWA	$ 18,901,740										
Roads	PWA	$ 17,345,900										
34% Indirect costs	RCC (includes pre-construction etc)	$ 55,384,835										
Total initial capital costs		**$ 220,000,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)	PWA	$ 9,906,000						221,000				
Pumping station	PWA	$ 25,875,200	2,216,500					343,200				
Rising main	PWA	$ 10,093,200										
Roads	PWA	$ 8,405,800	1,835,600									
Total renewal costs		**$ 54,280,200**	**$ 4,052,100**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 564,200**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs		**$ 274,280,200**	**$ 4,052,100**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 564,200**	**$ -**	**$ -**	**$ -**	**$ -**
Ongoing operating and maintenance (recurring)												
Maintenance costs												
RCC Dam (incl. destratifier)	PWA	$ 3,062,207	45,437	50,697	50,697	50,697	50,697	49,907	50,302	50,302	50,302	50,302
Pumping station	PWA	$ 5,075,287	37,706	70,070	70,070	70,070	70,070	70,070	67,622	68,846	68,846	68,846
Rising main	PWA	$ 1,918,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620
Roads	PWA	$ 1,960,402	25,739	29,046	29,046	29,046	29,046	29,046	29,046	29,046	29,046	29,046
Total maintenance costs		**$ 12,190,755**	**$ 146,502**	**$ 187,433**	**$ 187,433**	**$ 187,433**	**$ 187,433**	**$ 186,643**	**$ 184,590**	**$ 185,814**	**$ 185,814**	**$ 185,814**
Operating costs												
DAM		$ -										
Annual Operation/ Inspection	PWA	$ 4,680,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	PWA	$ 8,580,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	PWA	$ 600,000	40,000					40,000				
20-yearly Dam safety review	PWA	$ 600,000	200,000									
PUMPING STATION		$ -										
Water pumping cost	PWA	$ 94,403,891	1,766,444	1,758,495	1,750,581	1,742,704	1,734,862	1,727,055	1,719,283	1,711,546	1,703,844	1,696,177
Total operating costs		**$ 110,515,416**	**$ 2,176,444**	**$ 1,928,495**	**$ 1,920,581**	**$ 1,912,704**	**$ 1,904,862**	**$ 1,937,055**	**$ 1,889,283**	**$ 1,881,546**	**$ 1,873,844**	**$ 1,866,177**
Total operating and maintenance costs		**$ 122,706,171**	**$ 2,322,946**	**$ 2,115,928**	**$ 2,108,014**	**$ 2,100,137**	**$ 2,092,295**	**$ 2,123,698**	**$ 2,073,873**	**$ 2,067,360**	**$ 2,059,658**	**$ 2,051,991**
Total Costs		**$ 396,986,371**	**$ 6,375,046**	**$ 2,115,928**	**$ 2,108,014**	**$ 2,100,137**	**$ 2,092,295**	**$ 2,687,898**	**$ 2,073,873**	**$ 2,067,360**	**$ 2,059,658**	**$ 2,051,991**

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
Total initial capital costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)	3,398,200									
Pumping station	988,000									
Rising main	10,093,200									
Roads										
Total renewal costs	**$ 14,479,400**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs	**$ 14,479,400**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
RCC Dam (incl. destratifier)	36,510	44,589	44,589	44,589	44,589	44,589	44,984	44,984	44,984	44,984
Pumping station	66,566	98,466	98,466	98,466	98,466	98,466	98,466	99,690	99,690	99,690
Rising main	-	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540
Roads	29,046	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458
Total maintenance costs	**$ 132,122**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,448**	**$ 187,672**	**$ 187,672**	**$ 187,672**
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review										
Water pumping cost	1,688,544	1,680,946	1,673,381	1,665,851	1,658,355	1,650,892	1,643,463	1,636,068	1,628,705	1,621,376
Total operating costs	**$ 1,898,544**	**$ 1,850,946**	**$ 1,843,381**	**$ 1,835,851**	**$ 1,828,355**	**$ 1,860,892**	**$ 1,813,463**	**$ 1,806,068**	**$ 1,798,705**	**$ 1,791,376**
Total operating and maintenance costs	**$ 2,030,666**	**$ 2,036,999**	**$ 2,029,434**	**$ 2,021,904**	**$ 2,014,408**	**$ 2,046,945**	**$ 1,999,911**	**$ 1,993,740**	**$ 1,986,377**	**$ 1,979,048**
Total Costs	**$ 16,510,066**	**$ 2,036,999**	**$ 2,029,434**	**$ 2,021,904**	**$ 2,014,408**	**$ 2,046,945**	**$ 1,999,911**	**$ 1,993,740**	**$ 1,986,377**	**$ 1,979,048**

Estimated costs (2020 $)	61	62	63	64	65	66	67	68	69	70
Total initial capital costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)	3,474,900									
Pumping station	9,384,700									
Rising main										
Roads	3,285,100									
Total renewal costs	**$ 16,144,700**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs	**$ 16,144,700**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
RCC Dam (incl. destratifier)	27,849	37,973	37,973	37,973	37,973	37,973	37,973	37,973	37,973	37,973
Pumping station	13,237	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761
Rising main	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	25,404	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931
Total maintenance costs	**$ 79,030**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review	200,000									
Water pumping cost	1,614,080	1,606,817	1,599,586	1,592,388	1,585,222	1,578,089	1,570,987	1,563,918	1,556,880	1,549,874
Total operating costs	**$ 2,024,080**	**$ 1,776,817**	**$ 1,769,586**	**$ 1,762,388**	**$ 1,755,222**	**$ 1,788,089**	**$ 1,740,987**	**$ 1,733,918**	**$ 1,726,880**	**$ 1,719,874**
Total operating and maintenance costs	**$ 2,103,110**	**$ 1,913,562**	**$ 1,906,331**	**$ 1,899,133**	**$ 1,891,967**	**$ 1,924,834**	**$ 1,877,732**	**$ 1,870,663**	**$ 1,863,625**	**$ 1,856,619**
Total Costs	**$ 18,247,810**	**$ 1,913,562**	**$ 1,906,331**	**$ 1,899,133**	**$ 1,891,967**	**$ 1,924,834**	**$ 1,877,732**	**$ 1,870,663**	**$ 1,863,625**	**$ 1,856,619**

Estimated costs (2020 $)	71	72	73	74	75	76	77	78	79	80
Total initial capital costs	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Renewals RCC Dam (incl. destratifier)						221,000				
Pumping station	2,871,700					343,200				
Rising main										
Roads										
Total renewal costs	**$ 2,871,700**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 564,200**	**$ -**	**$ -**	**$ -**	**$ -**
Total acquisition costs	**$ 2,871,700**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 564,200**	**$ -**	**$ -**	**$ -**	**$ -**
RCC Dam (incl. destratifier)	37,973	45,833	45,833	45,833	45,833	45,043	45,438	45,438	45,438	45,438
Pumping station	39,134	73,707	73,707	73,707	73,707	71,259	72,483	72,483	72,483	72,483
Rising main	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	27,931	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238
Total maintenance costs	**$ 130,118**	**$ 175,858**	**$ 175,858**	**$ 175,858**	**$ 175,858**	**$ 172,620**	**$ 174,239**	**$ 174,239**	**$ 174,239**	**$ 174,239**
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review										
Water pumping cost	1,542,900	1,535,957	1,529,045	1,522,164	1,515,314	1,508,496	1,501,707	1,494,950	1,488,222	1,481,525
Total operating costs	**$ 1,752,900**	**$ 1,705,957**	**$ 1,699,045**	**$ 1,692,164**	**$ 1,685,314**	**$ 1,718,496**	**$ 1,671,707**	**$ 1,664,950**	**$ 1,658,222**	**$ 1,651,525**
Total operating and maintenance costs	**$ 1,883,018**	**$ 1,881,815**	**$ 1,874,903**	**$ 1,868,022**	**$ 1,861,172**	**$ 1,891,116**	**$ 1,845,946**	**$ 1,839,189**	**$ 1,832,461**	**$ 1,825,764**
Total Costs	**$ 4,754,718**	**$ 1,881,815**	**$ 1,874,903**	**$ 1,868,022**	**$ 1,861,172**	**$ 2,455,316**	**$ 1,845,946**	**$ 1,839,189**	**$ 1,832,461**	**$ 1,825,764**

80 year whole-of-life cost	**$ 396,986,371**		
80 year NPV	**$ 263,580,730**	3%	40 year NPV
	$ 234,596,513	5%	
	$ 219,388,230	7%	

Life cycle cost analysis - 20 GL Dunoon Dam

Estimated costs (2020 $)	Source	Total 80 years	1	2	3	4	5	6	7	8	9	10
Initial acquistion costs (non-recurring)												
Capital costs												
Construction costs (asset renewal life)		$ -										
RCC Dam (incl. destratifier)	PWA	$ 80,473,250		40,236,625	40,236,625							
Pumping station	PWA	$ 16,091,790		8,045,895	8,045,895							
Rising main	PWA	$ 18,901,740		9,450,870	9,450,870							
Roads	PWA	$ 17,345,900		8,672,950	8,672,950							
assume same as 50 GL — Indirect costs	RCC (includes pre-construction etc)	$ 55,384,835	55,384,835									
Total initial capital costs		$ 188,197,515	$ 55,384,835	$ 66,406,340	$ 66,406,340	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)	PWA	$ 9,285,900										
Pumping station	PWA	$ 25,875,200										
Rising main	PWA	$ 10,093,200										
Roads	PWA	$ 8,405,800										
Total renewal costs		$ 53,660,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total acquisition costs		$ 241,857,615	$ 55,384,835	$ 66,406,340	$ 66,406,340	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing operating and maintenance (recurring)												
Maintenance costs												
RCC Dam (incl. destratifier)	PWA	$ 2,744,234	-			16,343	16,343	16,343	16,343	16,343	16,343	16,343
Pumping station	PWA	$ 5,004,621	-			35,333	35,333	35,333	35,333	35,333	35,333	35,333
Rising main	PWA	$ 1,893,540	-			12,540	12,540	12,540	12,540	12,540	12,540	12,540
Roads	PWA	$ 1,937,892	-			11,255	11,255	11,255	11,255	11,255	11,255	11,255
Total maintenance costs		$ 11,750,275	$ -	$ -	$ -	$ 75,471	$ 75,471	$ 75,471	$ 75,471	$ 75,471	$ 75,471	$ 75,471
Operating costs												
DAM		$ -										
Annual Operation/ Inspection	PWA	$ 4,560,000				60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	PWA	$ 8,360,000				110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	PWA	$ 600,000						40,000				
20-yearly Dam safety review	PWA	$ 600,000										
PUMPING STATION		$ -										
Water pumping cost	PWA	$ 94,311,936				45,977	45,977	45,977	95,226	144,474	193,720	242,965
Total operating costs		$ 110,083,461	$ -	$ -	$ -	$ 215,977	$ 215,977	$ 255,977	$ 265,226	$ 314,474	$ 363,720	$ 412,965
Total operating and maintenance costs		$ 121,833,736	$ -	$ -	$ -	$ 291,448	$ 291,448	$ 331,448	$ 340,697	$ 389,945	$ 439,191	$ 488,436
Total Costs		$ 363,691,351	$ 55,384,835	$ 66,406,340	$ 66,406,340	$ 291,448	$ 291,448	$ 331,448	$ 340,697	$ 389,945	$ 439,191	$ 488,436

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)						221,000				
Pumping station						343,200				
Total renewal costs	$ -	$ -	$ -	$ -	$ -	$ 564,200	$ -	$ -	$ -	$ -
Total acquisition costs	$ -	$ -	$ -	$ -	$ -	$ 564,200	$ -	$ -	$ -	$ -
Maintenance — RCC Dam (incl. destratifier)	16,343	32,686	32,686	32,686	32,686	31,896	32,291	32,291	32,291	32,291
Pumping station	35,333	70,666	70,666	70,666	70,666	68,218	69,442	69,442	69,442	69,442
Rising main	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	11,255	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510
Total maintenance costs	$ 75,471	$ 150,942	$ 150,942	$ 150,942	$ 150,942	$ 147,704	$ 149,323	$ 149,323	$ 149,323	$ 149,323
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
Water pumping cost	292,209	341,452	390,694	439,934	489,174	538,412	587,649	636,886	686,121	735,355
Total operating costs	$ 502,209	$ 511,452	$ 560,694	$ 609,934	$ 659,174	$ 748,412	$ 757,649	$ 806,886	$ 856,121	$ 905,355
Total operating and maintenance costs	$ 577,680	$ 662,394	$ 711,636	$ 760,876	$ 810,116	$ 896,116	$ 906,972	$ 956,209	$ 1,005,444	$ 1,054,678
Total Costs	$ 577,680	$ 662,394	$ 711,636	$ 760,876	$ 810,116	$ 1,460,316	$ 906,972	$ 956,209	$ 1,005,444	$ 1,054,678

Estimated costs (2020 $)	21	22	23	24	25	26	27	28	29	30
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — Pumping station	832,000									
Roads	821,600									
Total renewal costs	$ 1,653,600	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total acquisition costs	$ 1,653,600	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maintenance — RCC Dam (incl. destratifier)	32,291	37,356	37,356	37,356	37,356	37,356	37,751	37,751	37,751	37,751
Pumping station	68,162	98,702	98,702	98,702	98,702	98,702	99,926	99,926	99,926	99,926
Rising main	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	21,246	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878
Total maintenance costs	$ 146,779	$ 183,016	$ 183,016	$ 183,016	$ 183,016	$ 183,016	$ 184,635	$ 184,635	$ 184,635	$ 184,635
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review	200,000									
Water pumping cost	784,587	833,819	883,050	932,279	981,508	1,030,735	1,079,962	1,129,187	1,178,411	1,227,634
Total operating costs	$ 1,194,587	$ 1,003,819	$ 1,053,050	$ 1,102,279	$ 1,151,508	$ 1,240,735	$ 1,249,962	$ 1,299,187	$ 1,348,411	$ 1,397,634
Total operating and maintenance costs	$ 1,341,366	$ 1,186,835	$ 1,236,066	$ 1,285,295	$ 1,334,524	$ 1,423,751	$ 1,434,597	$ 1,483,822	$ 1,533,046	$ 1,582,269
Total Costs	$ 2,994,966	$ 1,186,835	$ 1,236,066	$ 1,285,295	$ 1,334,524	$ 1,423,751	$ 1,434,597	$ 1,483,822	$ 1,533,046	$ 1,582,269

Estimated costs (2020 $)	31	32	33	34	35	36	37	38	39	40
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)	2,174,900									
Pumping station	8,552,700									
Roads	2,463,500									
Total renewal costs	$ 13,191,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total acquisition costs	$ 13,191,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maintenance — RCC Dam (incl. destratifier)	25,416	41,759	41,759	41,759	41,759	41,759	41,759	41,759	41,759	41,759
Pumping station	14,753	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086
Rising main	25,080	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620
Roads	18,088	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343
Total maintenance costs	$ 83,337	$ 158,808	$ 158,808	$ 158,808	$ 158,808	$ 158,808	$ 158,808	$ 158,808	$ 158,808	$ 158,808
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
Water pumping cost	1,276,857	1,326,078	1,375,298	1,424,517	1,473,735	1,522,952	1,572,168	1,621,383	1,670,597	1,719,810
Total operating costs	$ 1,486,857	$ 1,496,078	$ 1,545,298	$ 1,594,517	$ 1,643,735	$ 1,732,952	$ 1,742,168	$ 1,791,383	$ 1,840,597	$ 1,889,810
Total operating and maintenance costs	$ 1,570,194	$ 1,654,886	$ 1,704,106	$ 1,753,325	$ 1,802,543	$ 1,891,760	$ 1,900,976	$ 1,950,191	$ 1,999,405	$ 2,048,618
Total Costs	$ 14,761,294	$ 1,654,886	$ 1,704,106	$ 1,753,325	$ 1,802,543	$ 1,891,760	$ 1,900,976	$ 1,950,191	$ 1,999,405	$ 2,048,618

80 year whole-of-life cost	$ 363,691,351		40 year NPV	$ 209,929,041	2060 yield	7,179	ML/a
80 year NPV	$ 232,319,205	3%		$ 196,325,548	NPV/ML yield	$ 27,347	
	$ 204,345,989	5%		$ 187,002,848			
	$ 190,031,915	7%					

Life cycle cost analysis - 20 GL Dunoon Dam

Estimated costs (2020 $)	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50
Initial acquistion costs (non-recurring)												
Capital costs												
Construction costs (asset renewal life)		$ -										
RCC Dam (incl. destratifier)	PWA	$ 80,473,250										
Pumping station	PWA	$ 16,091,790										
Rising main	PWA	$ 18,901,740										
Roads	PWA	$ 17,345,900										
assume same as 50 GL — Indirect costs	RCC (includes pre-construction etc)	$ 55,384,835										
Total initial capital costs		$ 188,197,515	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)	PWA	$ 9,285,900						221,000				
Pumping station	PWA	$ 25,875,200	2,216,500					343,200				
Rising main	PWA	$ 10,093,200										
Roads	PWA	$ 8,405,800	1,835,600									
Total renewal costs		$ 53,660,100	$ 4,052,100	$ -	$ -	$ -	$ -	$ 564,200	$ -	$ -	$ -	$ -
Total acquisition costs		$ 241,857,615	$ 4,052,100	$ -	$ -	$ -	$ -	$ 564,200	$ -	$ -	$ -	$ -
Ongoing operating and maintenance (recurring)												
Maintenance costs												
RCC Dam (incl. destratifier)	PWA	$ 2,744,234	41,759	46,269	46,269	46,269	46,269	45,479	45,874	45,874	45,874	45,874
Pumping station	PWA	$ 5,004,621	37,706	70,070	70,070	70,070	70,070	70,070	67,622	68,846	68,846	68,846
Rising main	PWA	$ 1,893,540	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620
Roads	PWA	$ 1,937,892	25,739	29,046	29,046	29,046	29,046	29,046	29,046	29,046	29,046	29,046
Total maintenance costs		$ 11,750,275	$ 142,824	$ 183,005	$ 183,005	$ 183,005	$ 183,005	$ 182,215	$ 180,162	$ 181,386	$ 181,386	$ 181,386
Operating costs												
DAM		$ -										
Annual Operation/ Inspection	PWA	$ 4,560,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	PWA	$ 8,360,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	PWA	$ 600,000	40,000					40,000				
20-yearly Dam safety review	PWA	$ 600,000	200,000									
PUMPING STATION		$ -										
Water pumping cost	PWA	$ 94,311,936	1,766,444	1,758,495	1,750,581	1,742,704	1,734,862	1,727,055	1,719,283	1,711,546	1,703,844	1,696,177
Total operating costs		$ 110,083,461	$ 2,176,444	$ 1,928,495	$ 1,920,581	$ 1,912,704	$ 1,904,862	$ 1,937,055	$ 1,889,283	$ 1,881,546	$ 1,873,844	$ 1,866,177
Total operating and maintenance costs		$ 121,833,736	$ 2,319,268	$ 2,111,500	$ 2,103,586	$ 2,095,709	$ 2,087,867	$ 2,119,270	$ 2,069,445	$ 2,062,932	$ 2,055,230	$ 2,047,563
Total Costs		$ 363,691,351	$ 6,371,368	$ 2,111,500	$ 2,103,586	$ 2,095,709	$ 2,087,867	$ 2,683,470	$ 2,069,445	$ 2,062,932	$ 2,055,230	$ 2,047,563

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)	2,934,100									
Pumping station	988,000									
Rising main	10,093,200									
Total renewal costs	$ 14,015,300	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total acquisition costs	$ 14,015,300	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maintenance — RCC Dam (incl. destratifier)	33,153	40,125	40,125	40,125	40,125	40,125	40,520	40,520	40,520	40,520
Pumping station	66,566	98,466	98,466	98,466	98,466	98,466	98,466	99,690	99,690	99,690
Rising main	-	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540
Roads	29,046	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458
Total maintenance costs	$ 128,765	$ 181,589	$ 181,589	$ 181,589	$ 181,589	$ 181,589	$ 181,984	$ 183,208	$ 183,208	$ 183,208
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
Water pumping cost	1,688,544	1,680,946	1,673,381	1,665,851	1,658,355	1,650,892	1,643,463	1,636,068	1,628,705	1,621,376
Total operating costs	$ 1,898,544	$ 1,850,946	$ 1,843,381	$ 1,835,851	$ 1,828,355	$ 1,860,892	$ 1,813,463	$ 1,806,068	$ 1,798,705	$ 1,791,376
Total operating and maintenance costs	$ 2,027,309	$ 2,032,535	$ 2,024,970	$ 2,017,440	$ 2,009,944	$ 2,042,481	$ 1,995,447	$ 1,989,276	$ 1,981,913	$ 1,974,584
Total Costs	$ 16,042,609	$ 2,032,535	$ 2,024,970	$ 2,017,440	$ 2,009,944	$ 2,042,481	$ 1,995,447	$ 1,989,276	$ 1,981,913	$ 1,974,584

Estimated costs (2020 $)	61	62	63	64	65	66	67	68	69	70
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)	3,513,900									
Pumping station	9,384,700									
Roads	3,285,100									
Total renewal costs	$ 16,183,700	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total acquisition costs	$ 16,183,700	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maintenance — RCC Dam (incl. destratifier)	25,095	34,292	34,292	34,292	34,292	34,292	34,292	34,292	34,292	34,292
Pumping station	13,237	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761
Rising main	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	25,404	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931
Total maintenance costs	$ 76,276	$ 133,064	$ 133,064	$ 133,064	$ 133,064	$ 133,064	$ 133,064	$ 133,064	$ 133,064	$ 133,064
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
20-yearly Dam safety review	200,000									
Water pumping cost	1,614,080	1,606,817	1,599,586	1,592,388	1,585,222	1,578,089	1,570,987	1,563,918	1,556,880	1,549,874
Total operating costs	$ 2,024,080	$ 1,776,817	$ 1,769,586	$ 1,762,388	$ 1,755,222	$ 1,788,089	$ 1,740,987	$ 1,733,918	$ 1,726,880	$ 1,719,874
Total operating and maintenance costs	$ 2,100,356	$ 1,909,881	$ 1,902,650	$ 1,895,452	$ 1,888,286	$ 1,921,153	$ 1,874,051	$ 1,866,982	$ 1,859,944	$ 1,852,938
Total Costs	$ 18,284,056	$ 1,909,881	$ 1,902,650	$ 1,895,452	$ 1,888,286	$ 1,921,153	$ 1,874,051	$ 1,866,982	$ 1,859,944	$ 1,852,938

Estimated costs (2020 $)	71	72	73	74	75	76	77	78	79	80
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals — RCC Dam (incl. destratifier)						221,000				
Pumping station	2,871,700					343,200				
Total renewal costs	$ 2,871,700	$ -	$ -	$ -	$ -	$ 564,200	$ -	$ -	$ -	$ -
Total acquisition costs	$ 2,871,700	$ -	$ -	$ -	$ -	$ 564,200	$ -	$ -	$ -	$ -
Maintenance — RCC Dam (incl. destratifier)	34,292	41,582	41,582	41,582	41,582	40,792	41,187	41,187	41,187	41,187
Pumping station	39,134	73,707	73,707	73,707	73,707	71,259	72,483	72,483	72,483	72,483
Rising main	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
Roads	27,931	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238
Total maintenance costs	$ 126,437	$ 171,607	$ 171,607	$ 171,607	$ 171,607	$ 168,369	$ 169,988	$ 169,988	$ 169,988	$ 169,988
Annual Operation/ Inspection	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Destratifier operation	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
5-yearly Dam movement survey	40,000					40,000				
Water pumping cost	1,542,900	1,535,957	1,529,045	1,522,164	1,515,314	1,508,496	1,501,707	1,494,950	1,488,222	1,481,525
Total operating costs	$ 1,752,900	$ 1,705,957	$ 1,699,045	$ 1,692,164	$ 1,685,314	$ 1,718,496	$ 1,671,707	$ 1,664,950	$ 1,658,222	$ 1,651,525
Total operating and maintenance costs	$ 1,879,337	$ 1,877,564	$ 1,870,652	$ 1,863,771	$ 1,856,921	$ 1,886,865	$ 1,841,695	$ 1,834,938	$ 1,828,210	$ 1,821,513
Total Costs	$ 4,751,037	$ 1,877,564	$ 1,870,652	$ 1,863,771	$ 1,856,921	$ 2,451,065	$ 1,841,695	$ 1,834,938	$ 1,828,210	$ 1,821,513

80 year whole-of-life cost	$ 363,691,351		40 year NPV
80 year NPV	$ 232,319,205	3%	
	$ 204,345,989	5%	
	$ 190,031,915	7%	

Life cycle cost analysis - Marom Creek WTP

Estimated costs (2020 $)	Source	Total 80 years	1	2	3	4	5	6	7	8	9	10
Initial acquistion costs (non-recurring)												
Capital costs												
Engineering (20%)	CWT 2018	$ 1,831,750	915,875	915,875		-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -	-	-		-	-	-	-	-	-	-
Marom Creek WTP upgrade		$ 7,327,000	-	-	3,663,500	3,663,500	-	-	-	-	-	-
Total initial capital costs		**$ 9,158,750**	$ 915,875	$ 915,875	$ 3,663,500	$ 3,663,500	$ -	$ -	$ -	$ -	$ -	$ -
Renewals												
Estimate (2% p.a.)		$ 5,641,791	-	-	1	-	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs		**$ 5,641,791**	$ -	$ -	$ 1	$ -	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs		**$ 14,800,541**	$ 915,875	$ 915,875	$ 3,663,501	$ 3,663,500	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced		$ -	-	-	1	-	-	-	-	-	-	-
Net acquisition costs		**$ 14,800,542**	$ 915,875	$ 915,875	$ 3,663,502	$ 3,663,500	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Ongoing operating and maintenance (recurring)												
Maintenance costs												
Maintenance	CWT 2018	$ 49,365,702	-	-	1	-	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs		**$ 49,365,702**	$ -	$ -	$ 1	$ -	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Operating costs												
Marom Creek WTP – Chemicals	CWT 2018	$ 19,402,383					$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs		**$ 19,402,383**	$ -	$ -	$ -	$ -	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs		**$ 68,768,085**	$ -	$ -	$ 1	$ -	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Cost Over 80 years		**$ 83,568,627**										
Total Annualised costs over 80 years		**$ 1,031,711**										
Total Costs		**$ 83,568,626**	**$ 915,875**	**$ 915,875**	**$ 3,663,502**	**$ 3,663,500**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
Engineering (20%)	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Marom Creek WTP upgrade	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Estimate (2% p.a.)	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Maintenance	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Marom Creek WTP – Chemicals	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Costs	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

Estimated costs (2020 $)	21	22	23	24	25	26	27	28	29	30
Engineering (20%)					-	-	-	-	-	-
Construction costs (asset renewal life)					-	-	-	-	-	-
Marom Creek WTP upgrade	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Estimate (2% p.a.)	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Maintenance	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Marom Creek WTP – Chemicals	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Costs	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

Estimated costs (2020 $)	31	32	33	34	35	36	37	38	39	40
Engineering (20%)	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Marom Creek WTP upgrade	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Estimate (2% p.a.)	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Maintenance	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Marom Creek WTP – Chemicals	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Costs	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

80 year whole-of-life cost	**$ 83,568,626**						
80 year NPV	**$ 34,971,489**	3%	40 year NPV	**$ 27,918,427**	2060 yield	198	ML/a
	$ 24,561,843	5%		**$ 22,088,688**	NPV/ML yield	$ 111,559	
	$ 19,165,441	7%		**$ 18,244,868**			

Life cycle cost analysis - Marom Creek WTP

Estimated costs (2020 $)	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50
Initial acquistion costs (non-recurring)												
Capital costs												
Engineering (20%)	CWT 2018	$ 1,831,750	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -	-	-	-	-	-	-	-	-	-	-
Marom Creek WTP upgrade		$ 7,327,000	-	-	-	-	-	-	-	-	-	-
Total initial capital costs		**$ 9,158,750**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals												
Estimate (2% p.a.)		$ 5,641,791	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs		**$ 5,641,791**	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs		**$ 14,800,541**	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced		$ -	-	-	-	-	-	-	-	-	-	-
Net acquisition costs		**$ 14,800,542**	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Ongoing operating and maintenance (recurring)												
Maintenance costs												
Maintenance	CWT 2018	$ 49,365,702	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs		**$ 49,365,702**	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Operating costs												
Marom Creek WTP – Chemicals	CWT 2018	$ 19,402,383	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs		**$ 19,402,383**	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs		**$ 68,768,085**	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Cost Over 80 years		**$ 83,568,627**										
Total Annualised costs over 80 years		**$ 1,031,711**										
Total Costs		**$ 83,568,626**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
Engineering (20%)	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Marom Creek WTP upgrade	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Estimate (2% p.a.)	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Maintenance	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Marom Creek WTP – Chemicals	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Costs	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

Estimated costs (2020 $)	61	62	63	64	65	66	67	68	69	70
Engineering (20%)	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Marom Creek WTP upgrade	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Estimate (2% p.a.)	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Maintenance	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Marom Creek WTP – Chemicals	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Costs	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

Estimated costs (2020 $)	71	72	73	74	75	76	77	78	79	80	81
Engineering (20%)	-	-	-	-	-	-	-				
Construction costs (asset renewal life)	-	-	-	-	-	-	-				
Marom Creek WTP upgrade	-	-	-	-	-	-	-				
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Estimate (2% p.a.)	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270
Total renewal costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Total acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
less Trade-in of item being replaced	-	-	-	-	-	-	-				
Net acquisition costs	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270
Maintenance	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113
Total maintenance costs	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113
Marom Creek WTP – Chemicals	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating costs	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979
Total operating and maintenance costs	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092
Total Costs	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**	**$ 966,362**

80 year whole-of-life cost	**$ 83,568,626**		
80 year NPV	**$ 34,971,489**	3%	40 year NPV
	$ 24,561,843	5%	
	$ 19,165,441	7%	

Life cycle cost analysis - Woodburn Option (based on costing for Alstonville)

Estimated costs (2020 $)	Source	Total 80 years	1	2	3	4	5	6	7	8	9	10
Initial acquistion costs (non-recurring)												
Capital costs												
Scheme investigation costs	Jacobs 2020	$ 492,000	492,000	-	-	-	-	-	-	-	-	-
Design and documentation costs	Jacobs 2020	$ 1,720,000	-	1,720,000	-	-	-	-	-	-	-	-
Environmental approval costs	Jacobs 2020	$ 985,000	-	-	985,000	-	-	-	-	-	-	-
Project management costs	Jacobs 2020	$ 615,000	-	-	615,000	-	-	-	-	-	-	-
land acquistion costs	existing site	$ -	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -	-	-	-		-	-	-	-	-	-
Bores (50 years)	Jacobs 2020 cost for 2 bores x3/2	$ 1,485,000				1,485,000						
Mechanical (25 years)	Jacobs 2020	$ 6,740,000				6,740,000						
Electrical (25 years)	Jacobs 2020	$ 5,120,000				5,120,000						
Civil including Pipelines (85 years)	Jacobs 2020	$ 16,250,000				16,250,000						
Instrumentation Control Communications (15 yrs)	Jacobs 2020	$ 2,090,000				2,090,000						
Integration costs												
Existing supply network modifications		$ 985,000	-	-	985,000	-	-	-	-	-	-	-
Existing facility modifications		$ -	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
Total initial capital costs		**$ 36,482,000**	$ 492,000	$ 1,720,000	$ 2,585,000	$ 31,685,000	$ -	$ -	$ -	$ -	$ -	$ -
Renewals												
Repairs/unscheduled maintenance	Jacobs 2020	$ 15,823,077	-	-	-	-	140,000	141,400	142,814	144,242	145,685	147,141
Upgrades and refurbishments	Jacobs 2020	$ 600,000	-	-	-	-	-	-	-	-	-	50,000
Spare parts and accessories	Jacobs 2020	$ 3,990,000	-	-	-	-	15,000	16,000	17,000	18,000	19,000	20,000
Bores Renewals (50 years)	Jacobs 2020	$ 1,485,000										
Mechanical Renewals (25 years)	Jacobs 2020	$ 20,220,000										
Electrical Renewals (25 years)	Jacobs 2020	$ 15,360,000										
Civil including Pipelines Renewals (85 years)		$ -										
Instrumentation Control Communications (15 yrs)	Jacobs 2020	$ 10,450,000										
Other repair costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
Major filter renewals		$ -	-	-	-	-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-
Total renewal costs		**$ 67,928,077**	$ -	$ -	$ -	$ -	$ 155,000	$ 157,400	$ 159,814	$ 162,242	$ 164,685	$ 217,141
Total acquisition costs		**$ 104,410,077**	$ 492,000	$ 1,720,000	$ 2,585,000	$ 31,685,000	$ 155,000	$ 157,400	$ 159,814	$ 162,242	$ 164,685	$ 217,141
Ongoing operating and maintenance (recurring)												
Maintenance costs												
Scheduled/preventative maintenance	Jacobs 2020	$ 12,040,300	-	-	-	-	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	Jacobs 2020	$ 1,064,000	-	-	-	-	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-
Total maintenance costs		**$ 13,104,300**	$ -	$ -	$ -	$ -	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs												
Staffing costs - Borefield and Transfer	Jacobs 2020	$ 4,560,000	-	-	-	-	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	Jacobs 2020	$ 9,880,000					130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	Jacobs 2020	$ 9,120,000	-	-	-	-	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	Jacobs 2020	$ 10,944,000					144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	Jacobs 2020	$ 12,160,000	-	-	-	-	160,000	160,000	160,000	160,000	160,000	160,000
Training	Jacobs 2020	$ 114,000	-	-	-	-	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring		$ -	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs 2020	$ 1,900,000	-	-	-	-	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
Support Costs	Jacobs 2020	$ 3,610,000	-	-	-	-	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs		**$ 52,288,000**	$ -	$ -	$ -	$ -	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs		**$ 65,392,300**	$ -	$ -	$ -	$ -	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years		**$ 169,802,377**										
Total Annualised costs over 80 years		**$ 2,122,529.71**										
Total Costs		**$ 169,802,377**	**$ 492,000**	**$ 1,720,000**	**$ 2,585,000**	**$ 31,685,000**	**$ 1,015,425**	**$ 1,017,825**	**$ 1,020,239**	**$ 1,022,667**	**$ 1,025,110**	**$ 1,077,566**

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
Initial acquistion costs (non-recurring)										
Capital costs										
Scheme investigation costs	-	-	-	-	-	-	-	-	-	
Design and documentation costs	-	-	-	-	-	-	-	-	-	
Environmental approval costs	-	-	-	-	-	-	-	-	-	
Project management costs	-	-	-	-	-	-	-	-	-	
land acquistion costs	-	-	-	-	-	-	-	-	-	
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	
Bores (50 years)										
Mechanical (25 years)										
Electrical (25 years)										
Civil including Pipelines (85 years)										
Instrumentation Control Communications (15 yrs)										
Integration costs										
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals										
Repairs/unscheduled maintenance	148,613	150,099	151,600	153,116	154,647	156,194	157,756	159,333	160,926	162,536
Upgrades and refurbishments	-	-	-	-	-	50,000	-	-	-	-
Spare parts and accessories	21,000	22,000	23,000	24,000	25,000	26,000	27,000	28,000	29,000	30,000
Bores Renewals (50 years)										
Mechanical Renewals (25 years)										
Electrical Renewals (25 years)										
Civil including Pipelines Renewals (85 years)										
Instrumentation Control Communications (15 yrs)									2,090,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals	-		-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 169,613	$ 172,099	$ 174,600	$ 177,116	$ 179,647	$ 232,194	$ 184,756	$ 187,333	$ 2,279,926	$ 192,536
Total acquisition costs	$ 169,613	$ 172,099	$ 174,600	$ 177,116	$ 179,647	$ 232,194	$ 184,756	$ 187,333	$ 2,279,926	$ 192,536
Ongoing operating and maintenance (recurring)										
Maintenance costs										
Scheduled/preventative maintenance	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs										
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years										
Total Annualised costs over 80 years										
Total Costs	**$ 1,030,038**	**$ 1,032,524**	**$ 1,035,025**	**$ 1,037,541**	**$ 1,040,072**	**$ 1,092,619**	**$ 1,045,181**	**$ 1,047,758**	**$ 3,140,351**	**$ 1,052,961**

Estimated costs (2020 $)	21	22	23	24	25	26	27	28	29	30
Initial acquistion costs (non-recurring)										
Capital costs										
Scheme investigation costs				-	-	-	-	-	-	-
Design and documentation costs				-	-	-	-	-	-	-
Environmental approval costs				-	-	-	-	-	-	-
Project management costs				-	-	-	-	-	-	-
land acquistion costs				-	-	-	-	-	-	-
Construction costs (asset renewal life)				-	-	-	-	-	-	-
Bores (50 years)										
Mechanical (25 years)										
Electrical (25 years)										
Civil including Pipelines (85 years)										
Instrumentation Control Communications (15 yrs)										
Integration costs										
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals										
Repairs/unscheduled maintenance	164,161	165,803	167,461	169,135	170,827	172,535	174,260	176,003	177,763	179,540
Upgrades and refurbishments	-	50,000	-	-	-	-	-	50,000	-	-
Spare parts and accessories	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000
Bores Renewals (50 years)										
Mechanical Renewals (25 years)									6,740,000	
Electrical Renewals (25 years)									5,120,000	
Civil including Pipelines Renewals (85 years)										
Instrumentation Control Communications (15 yrs)										
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals	-	-	-		-					
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 195,161	$ 247,803	$ 200,461	$ 203,135	$ 205,827	$ 208,535	$ 211,260	$ 264,003	$ 12,076,763	$ 219,540
Total acquisition costs	$ 195,161	$ 247,803	$ 200,461	$ 203,135	$ 205,827	$ 208,535	$ 211,260	$ 264,003	$ 12,076,763	$ 219,540
Ongoing operating and maintenance (recurring)										
Maintenance costs										
Scheduled/preventative maintenance	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs										
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years										
Total Annualised costs over 80 years										
Total Costs	**$ 1,055,586**	**$ 1,108,228**	**$ 1,060,886**	**$ 1,063,560**	**$ 1,066,252**	**$ 1,068,960**	**$ 1,071,685**	**$ 1,124,428**	**$ 12,937,188**	**$ 1,079,965**

Estimated costs (2020 $)	31	32	33	34	35	36	37	38	39	40
Initial acquistion costs (non-recurring)										
Capital costs										
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	-	-	-	-	-	-	-	-	-	-
Project management costs	-	-	-	-	-	-	-	-	-	-
land acquistion costs	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Bores (50 years)										
Mechanical (25 years)										
Electrical (25 years)										
Civil including Pipelines (85 years)										
Instrumentation Control Communications (15 yrs)										
Integration costs										
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals										
Repairs/unscheduled maintenance	181,336	183,149	184,981	186,831	188,699	190,586	192,492	194,417	196,361	198,324
Upgrades and refurbishments	-	-	-	50,000	-	-	-	-	-	50,000
Spare parts and accessories	41,000	42,000	43,000	44,000	45,000	46,000	47,000	48,000	49,000	50,000
Bores Renewals (50 years)										
Mechanical Renewals (25 years)										
Electrical Renewals (25 years)										
Civil including Pipelines Renewals (85 years)										
Instrumentation Control Communications (15 yrs)				2,090,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals										
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 222,336	$ 225,149	$ 227,981	$ 2,370,831	$ 233,699	$ 236,586	$ 239,492	$ 242,417	$ 245,361	$ 298,324
Total acquisition costs	$ 222,336	$ 225,149	$ 227,981	$ 2,370,831	$ 233,699	$ 236,586	$ 239,492	$ 242,417	$ 245,361	$ 298,324
Ongoing operating and maintenance (recurring)										
Maintenance costs										
Scheduled/preventative maintenance	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs										
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years										
Total Annualised costs over 80 years										
Total Costs	**$ 1,082,761**	**$ 1,085,574**	**$ 1,088,406**	**$ 3,231,256**	**$ 1,094,124**	**$ 1,097,011**	**$ 1,099,917**	**$ 1,102,842**	**$ 1,105,786**	**$ 1,158,749**

80 year whole-of-life cost	$ 169,802,377		40 year NPV	$ 61,969,913	2060 yield 698
80 year NPV	$ 75,515,541	3%		$ 51,230,292	NPV/ML yield $ 73,396
	$ 55,817,346	5%		$ 44,018,800	
	$ 45,670,973	7%			

Life cycle cost analysis - Woodburn Option (based on costing for Alstonville)

Estimated costs (2020 $)	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50
Initial acquistion costs (non-recurring)												
Capital costs												
Scheme investigation costs	Jacobs 2020	$ 492,000	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	Jacobs 2020	$ 1,720,000	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	Jacobs 2020	$ 985,000	-	-	-	-	-	-	-	-	-	-
Project management costs	Jacobs 2020	$ 615,000	-	-	-	-	-	-	-	-	-	-
land acquistion costs	existing site	$ -	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -	-	-	-	-	-	-	-	-	-	-
Bores (50 years)	Jacobs 2020 cost for 2 bores x3/2	$ 1,485,000										
Mechanical (25 years)	Jacobs 2020	$ 6,740,000										
Electrical (25 years)	Jacobs 2020	$ 5,120,000										
Civil including Pipelines (85 years)	Jacobs 2020	$ 16,250,000										
Instrumentation Control Communications (15 yrs)	Jacobs 2020	$ 2,090,000										
Integration costs												
Existing supply network modifications		$ 985,000	-	-	-	-	-	-	-	-	-	-
Existing facility modifications		$ -	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
Total initial capital costs		**$ 36,482,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals												
Repairs/unscheduled maintenance	Jacobs 2020	$ 15,823,077	200,308	202,311	204,334	206,377	208,441	210,525	212,631	214,757	216,904	219,074
Upgrades and refurbishments	Jacobs 2020	$ 600,000	-	-	-	-	-	50,000	-	-	-	-
Spare parts and accessories	Jacobs 2020	$ 3,990,000	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000
Bores Renewals (50 years)	Jacobs 2020	$ 1,485,000										
Mechanical Renewals (25 years)	Jacobs 2020	$ 20,220,000										
Electrical Renewals (25 years)	Jacobs 2020	$ 15,360,000										
Civil including Pipelines Renewals (85 years)		$ -										
Instrumentation Control Communications (15 yrs)	Jacobs 2020	$ 10,450,000									2,090,000	
Other repair costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
Major filter renewals		$ -										
		$ -	-	-	-	-	-	-	-	-	-	-
Total renewal costs		**$ 67,928,077**	$ 251,308	$ 254,311	$ 257,334	$ 260,377	$ 263,441	$ 316,525	$ 269,631	$ 272,757	$ 2,365,904	$ 279,074
Total acquisition costs		**$ 104,410,077**	$ 251,308	$ 254,311	$ 257,334	$ 260,377	$ 263,441	$ 316,525	$ 269,631	$ 272,757	$ 2,365,904	$ 279,074
Ongoing operating and maintenance (recurring)												
Maintenance costs												
Scheduled/preventative maintenance	Jacobs 2020	$ 12,040,300	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	Jacobs 2020	$ 1,064,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-
Total maintenance costs		**$ 13,104,300**	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs												
Staffing costs - Borefield and Transfer	Jacobs 2020	$ 4,560,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	Jacobs 2020	$ 9,880,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	Jacobs 2020	$ 9,120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	Jacobs 2020	$ 10,944,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	Jacobs 2020	$ 12,160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	Jacobs 2020	$ 114,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring		$ -	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs 2020	$ 1,900,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
Support Costs	Jacobs 2020	$ 3,610,000	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs		**$ 52,288,000**	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs		**$ 65,392,300**	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years		**$ 169,802,377**										
Total Annualised costs over 80 years		**$ 2,122,529.71**										
Total Costs		**$ 169,802,377**	**$ 1,111,733**	**$ 1,114,736**	**$ 1,117,759**	**$ 1,120,802**	**$ 1,123,866**	**$ 1,176,950**	**$ 1,130,056**	**$ 1,133,182**	**$ 3,226,329**	**$ 1,139,499**

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
Initial acquistion costs (non-recurring)										
Capital costs										
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	-	-	-	-	-	-	-	-	-	-
Project management costs	-	-	-	-	-	-	-	-	-	-
land acquistion costs	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Bores (50 years)										
Mechanical (25 years)										
Electrical (25 years)										
Civil including Pipelines (85 years)										
Instrumentation Control Communications (15 yrs)										
Integration costs										
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals										
Repairs/unscheduled maintenance	221,264	223,477	225,712	227,969	230,248	232,551	234,876	237,225	239,597	241,993
Upgrades and refurbishments	-	50,000	-	-	-	-	-	50,000	-	-
Spare parts and accessories	61,000	62,000	63,000	64,000	65,000	66,000	67,000	68,000	69,000	70,000
Bores Renewals (50 years)				1,485,000						
Mechanical Renewals (25 years)				6,740,000						
Electrical Renewals (25 years)				5,120,000						
Civil including Pipelines Renewals (85 years)										
Instrumentation Control Communications (15 yrs)										
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals										
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 282,264	$ 335,477	$ 288,712	$ 13,636,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993
Total acquisition costs	$ 282,264	$ 335,477	$ 288,712	$ 13,636,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993
Ongoing operating and maintenance (recurring)										
Maintenance costs										
Scheduled/preventative maintenance	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs										
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years										
Total Annualised costs over 80 years										
Total Costs	**$ 1,142,689**	**$ 1,195,902**	**$ 1,149,137**	**$ 14,497,394**	**$ 1,155,673**	**$ 1,158,976**	**$ 1,162,301**	**$ 1,215,650**	**$ 1,169,022**	**$ 1,172,418**

Estimated costs (2020 $)	61	62	63	64	65	66	67	68	69	70
Initial acquistion costs (non-recurring)										
Capital costs										
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	-	-	-	-	-	-	-	-	-	-
Project management costs	-	-	-	-	-	-	-	-	-	-
land acquistion costs	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Bores (50 years)										
Mechanical (25 years)										
Electrical (25 years)										
Civil including Pipelines (85 years)										
Instrumentation Control Communications (15 yrs)										
Integration costs										
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals										
Repairs/unscheduled maintenance	244,413	246,858	249,326	251,819	254,338	256,881	259,450	262,044	264,665	267,311
Upgrades and refurbishments	-	-	-	50,000	-	-	-	-	-	50,000
Spare parts and accessories	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000
Bores Renewals (50 years)										
Mechanical Renewals (25 years)										
Electrical Renewals (25 years)										
Civil including Pipelines Renewals (85 years)										
Instrumentation Control Communications (15 yrs)				2,090,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals										
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 315,413	$ 318,858	$ 322,326	$ 2,465,819	$ 329,338	$ 332,881	$ 336,450	$ 340,044	$ 343,665	$ 397,311
Total acquisition costs	$ 315,413	$ 318,858	$ 322,326	$ 2,465,819	$ 329,338	$ 332,881	$ 336,450	$ 340,044	$ 343,665	$ 397,311
Ongoing operating and maintenance (recurring)										
Maintenance costs										
Scheduled/preventative maintenance	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs										
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years										
Total Annualised costs over 80 years										
Total Costs	**$ 1,175,838**	**$ 1,179,283**	**$ 1,182,751**	**$ 3,326,244**	**$ 1,189,763**	**$ 1,193,306**	**$ 1,196,875**	**$ 1,200,469**	**$ 1,204,090**	**$ 1,257,736**

Estimated costs (2020 $)	71	72	73	74	75	76	77	78	79	80
Initial acquistion costs (non-recurring)										
Capital costs										
Scheme investigation costs	-	-	-	-	-	-				
Design and documentation costs	-	-	-	-	-	-				
Environmental approval costs	-	-	-	-	-	-				
Project management costs	-	-	-	-	-	-				
land acquistion costs	-	-	-	-	-	-				
Construction costs (asset renewal life)	-	-	-	-	-	-				
Bores (50 years)										
Mechanical (25 years)										
Electrical (25 years)										
Civil including Pipelines (85 years)										
Instrumentation Control Communications (15 yrs)										
Integration costs										
Existing supply network modifications	-	-	-	-	-	-				
Existing facility modifications	-	-	-	-	-	-				
Other capital costs (specify)	-	-	-	-	-	-				
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -				
Renewals										
Repairs/unscheduled maintenance	269,984	272,684	275,411	278,165	280,947	283,756	286,594	289,460	292,354	295,278
Upgrades and refurbishments	-	-	-	-	-	50,000				
Spare parts and accessories	81,000	82,000	83,000	84,000	85,000	86,000	87,000	88,000	89,000	90,000
Bores Renewals (50 years)										
Mechanical Renewals (25 years)									6,740,000	
Electrical Renewals (25 years)									5,120,000	
Civil including Pipelines Renewals (85 years)										
Instrumentation Control Communications (15 yrs)									2,090,000	
Other repair costs (specify)	-	-	-	-	-	-				
Major filter renewals										
	-	-	-	-	-	-				
Total renewal costs	$ 350,984	$ 354,684	$ 358,411	$ 362,165	$ 365,947	$ 419,756	$ 373,594	$ 377,460	$ 14,331,354	$ 385,278
Total acquisition costs	$ 350,984	$ 354,684	$ 358,411	$ 362,165	$ 365,947	$ 419,756	$ 373,594	$ 377,460	$ 14,331,354	$ 385,278
Ongoing operating and maintenance (recurring)										
Maintenance costs										
Scheduled/preventative maintenance	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-				
	-	-	-	-	-	-				
Total maintenance costs	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425
Operating costs										
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Utilities - GWTP	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000
Chemical Supplies and consumables	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-				
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-				
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000
Total operating and maintenance costs	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years										
Total Annualised costs over 80 years										
Total Costs	**$ 1,211,409**	**$ 1,215,109**	**$ 1,218,836**	**$ 1,222,590**	**$ 1,226,372**	**$ 1,280,181**	**$ 1,234,019**	**$ 1,237,885**	**$ 15,191,779**	**$ 1,245,703**

80 year whole-of-life cost	$ 169,802,377	
80 year NPV	$ 75,515,541	3%
	$ 55,817,346	5%
	$ 45,670,973	7%

Life cycle cost analysis - Alstonville Option

Estimated costs ($'s)		Source		Total all years	1	2	3	4
Initial acquistion costs (non-recurring)								
Capital costs								
	Scheme investigation costs	Jacobs 2020	$	492,000	492,000	-	-	-
	Design and documentation costs	Jacobs 2020	$	1,720,000	-	1,720,000	-	-
	Environmental approval costs	Jacobs 2020	$	985,000	-	985,000	-	-
	Project management costs	Jacobs 2020	$	615,000	-	615,000	-	-
	land acquistion costs	Jacobs 2020	$	3,800,000	-	3,800,000	-	-
	Construction costs (asset renewal life)		$	-	-	-		-
	Bores (50 years)	Jacobs 2020	$	990,000			495,000	495,000
	Mechanical (25 years)	Jacobs 2020	$	6,740,000			3,370,000	3,370,000
	Electrical (25 years)	Jacobs 2020	$	5,120,000			2,560,000	2,560,000
	Civil including Pipelines (85 years)	Jacobs 2020	$	16,250,000			8,125,000	8,125,000
	Instrumentation Control Communications (15 yrs)	Jacobs 2020	$	2,090,000			1,045,000	1,045,000
Integration costs								
	Existing supply network modifications		$	985,000	-	-	492,500	492,500
	Existing facility modifications		$	-	-	-	-	-
	Other capital costs (specify)		$	-	-	-	-	-
								-
Marom creek WTP	land acquistion savings	Jacobs 2020	-$	2,531,000			(1,265,500)	(1,265,500)
	conventional water treatment plant savings	Jacobs 2020	-$	6,650,000			(3,325,000)	(3,325,000)
	Ozone/bac Process after conventional water treatı	Jacobs 2020	-$	6,995,000			(3,497,500)	(3,497,500)
	clear water storage	Jacobs 2020	-$	2,750,000			(1,375,000)	(1,375,000)
	disinfection	Jacobs 2020	-$	1,520,000			(760,000)	(760,000)
	Treated water pipeline	Jacobs 2020	$	6,600,000			3,300,000	3,300,000
					-	-	-	-
	Total initial capital costs		**$**	**25,941,000**	$ 492,000	$ 7,120,000	$ 9,164,500	$ 9,164,500
Renewals								
	Repairs/unscheduled maintenance	Jacobs 2020	$	15,823,077	-	-	-	-
	Upgrades and refurbishments	Jacobs 2020	$	600,000	-	-	-	-
	Spare parts and accessories	Jacobs 2020	$	3,990,000	-	-	-	-
	Bores Renewals (50 years)	Jacobs 2020	$	990,000				
	Mechanical Renewals (25 years)	Jacobs 2020	$	20,220,000				
	Electrical Renewals (25 years)	Jacobs 2020	$	15,360,000				
	Civil including Pipelines Renewals (85 years)		$	-				
	Instrumentation Control Communications (15 yrs)	Jacobs 2020	$	10,450,000				
	Other repair costs (specify)		$	-	-	-	-	-
	Major filter renewals		$	-	-	-	-	-
			$	-	-	-	-	-
	Total renewal costs		**$**	**67,433,077**	$ -	$ -	$ -	$ -
Total acquisition costs			**$**	**93,374,077**	$ 492,000	$ 7,120,000	$ 9,164,500	$ 9,164,500
Ongoing operating and maintenance (recurring)								
Maintenance costs								
	Scheduled/preventative maintenance	Jacobs 2020	$	3,482,510	-	-	-	-
	Waste disposal	Jacobs 2020	$	1,064,000	-	-	-	-
	Other maintenance costs (specify)		$	-	-	-	-	-
	Total maintenance costs		**$**	**4,546,510**	$ -	$ -	$ -	$ -
Operating costs								
	Staffing costs - Borefield and Transfer	Jacobs 2020	$	4,560,000	-	-	-	-
	Staffing costs - GWTP	Jacobs 2020	$	9,880,000				
	Utilities - Borefield and Transfer	Jacobs 2020	$	7,296,000	-	-	-	-
	Utilities - GWTP	Jacobs 2020	$	8,755,200				
	Chemical Supplies and consumables	Jacobs 2020	$	9,728,000	-	-	-	-
	Training	Jacobs 2020	$	114,000	-	-	-	-
	WQ monitoring		$	-	-	-	-	-
	Licences	Jacobs 2020	$	1,900,000	-	-	-	-
	Other operating costs (specify)		$	-	-	-	-	-
	Support Costs	Jacobs 2020	$	3,610,000	-	-	-	-
	Total operating costs		**$**	**45,843,200**	$ -	$ -	$ -	$ -
Total operating and maintenance costs			**$**	**50,389,710**	$ -	$ -	$ -	$ -
Total disposal costs			**$**	-	$ -	$ -	$ -	$ -
Total Cost Over 80 years			**$**	**143,763,787**				
Total Annualised costs over 80 years			**$**	**1,797,047.33**				
Total Costs			**$**	**143,763,787**	**$ 492,000**	**$ 7,120,000**	**$ 9,164,500**	**$ 9,164,500**

Item	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
land acquistion costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	140,000	141,400	142,814	144,242	145,685	147,141	148,613	150,099	151,600	153,116	154,647	156,194	157,756	159,333	160,926	162,536	164,161	165,803
Upgrades and refurbishments	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000
Spare parts and accessories	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	26,000	27,000	28,000	29,000	30,000	31,000	32,000
Instrumentation Control Communications (15 yrs)															2,090,000			
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major filter renewals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total renewal costs	155,000	$ 157,400	$ 159,814	$ 162,242	$ 164,685	$ 217,141	$ 169,613	$ 172,099	$ 174,600	$ 177,116	$ 179,647	$ 232,194	$ 184,756	$ 187,333	$ 2,279,926	$ 192,536	$ 195,161	$ 247,803
Total acquisition costs	155,000	$ 157,400	$ 159,814	$ 162,242	$ 164,685	$ 217,141	$ 169,613	$ 172,099	$ 174,600	$ 177,116	$ 179,647	$ 232,194	$ 184,756	$ 187,333	$ 2,279,926	$ 192,536	$ 195,161	$ 247,803
Scheduled/preventative maintenance	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Utilities - GWTP	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200
Chemical Supplies and consumables	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200
Total operating and maintenance costs	663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023
Total disposal costs	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	818,023	$ 820,423	$ 822,837	$ 825,265	$ 827,707	$ 880,164	$ 832,635	$ 835,121	$ 837,622	$ 840,138	$ 842,670	$ 895,216	$ 847,778	$ 850,356	$ 2,942,949	$ 855,558	$ 858,184	$ 910,825

Item	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
land acquistion costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	167,461	169,135	170,827	172,535	174,260	176,003	177,763	179,540	181,336	183,149	184,981	186,831	188,699	190,586	192,492	194,417	196,361	198,324
Upgrades and refurbishments	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000
Spare parts and accessories	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000	41,000	42,000	43,000	44,000	45,000	46,000	47,000	48,000	49,000	50,000
Mechanical Renewals (25 years)							6,740,000											
Electrical Renewals (25 years)							5,120,000											
Instrumentation Control Communications (15 yrs)												2,090,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major filter renewals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 200,461	$ 203,135	$ 205,827	$ 208,535	$ 211,260	$ 264,003	$ 12,076,763	$ 219,540	$ 222,336	$ 225,149	$ 227,981	$ 2,370,831	$ 233,699	$ 236,586	$ 239,492	$ 242,417	$ 245,361	$ 298,324
Total acquisition costs	$ 200,461	$ 203,135	$ 205,827	$ 208,535	$ 211,260	$ 264,003	$ 12,076,763	$ 219,540	$ 222,336	$ 225,149	$ 227,981	$ 2,370,831	$ 233,699	$ 236,586	$ 239,492	$ 242,417	$ 245,361	$ 298,324
Scheduled/preventative maintenance	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Utilities - GWTP	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200
Chemical Supplies and consumables	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200
Total operating and maintenance costs	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	$ 863,483	$ 866,158	$ 868,849	$ 871,557	$ 874,283	$ 927,025	$ 12,739,785	$ 882,563	$ 885,358	$ 888,172	$ 891,003	$ 3,033,853	$ 896,721	$ 899,608	$ 902,514	$ 905,439	$ 908,383	$ 961,347

80 year whole-of-life cost	$	143,763,787				
80 year NPV	$	60,862,511	3%	40 year NPV	$ 48,860,970	2060 yield 916 ML/a
	$	44,109,829	5%		$ 40,065,265	NPV/ML yield $ 43,739
	$	35,778,806	7%		$ 34,328,399	

Life cycle cost analysis - Alstonville Option

Estimated costs ($'s)		Source		Total all years
Initial acquistion costs (non-recurring)				
Capital costs				
	Scheme investigation costs	Jacobs 2020	$	492,000
	Design and documentation costs	Jacobs 2020	$	1,720,000
	Environmental approval costs	Jacobs 2020	$	985,000
	Project management costs	Jacobs 2020	$	615,000
	land acquistion costs	Jacobs 2020	$	3,800,000
	Construction costs (asset renewal life)		$	-
	Bores (50 years)	Jacobs 2020	$	990,000
	Mechanical (25 years)	Jacobs 2020	$	6,740,000
	Electrical (25 years)	Jacobs 2020	$	5,120,000
	Civil including Pipelines (85 years)	Jacobs 2020	$	16,250,000
	Instrumentation Control Communications (15 yrs)	Jacobs 2020	$	2,090,000
Integration costs				
	Existing supply network modifications		$	985,000
	Existing facility modifications		$	-
	Other capital costs (specify)		$	-
Marom creek WTP	land acquistion savings	Jacobs 2020	-$	2,531,000
	conventional water treatment plant savings	Jacobs 2020	-$	6,650,000
	Ozone/bac Process after conventional water treatı	Jacobs 2020	-$	6,995,000
	clear water storage	Jacobs 2020	-$	2,750,000
	disinfection	Jacobs 2020	-$	1,520,000
	Treated water pipeline	Jacobs 2020	$	6,600,000
	Total initial capital costs		**$**	**25,941,000**
Renewals				
	Repairs/unscheduled maintenance	Jacobs 2020	$	15,823,077
	Upgrades and refurbishments	Jacobs 2020	$	600,000
	Spare parts and accessories	Jacobs 2020	$	3,990,000
	Bores Renewals (50 years)	Jacobs 2020	$	990,000
	Mechanical Renewals (25 years)	Jacobs 2020	$	20,220,000
	Electrical Renewals (25 years)	Jacobs 2020	$	15,360,000
	Civil including Pipelines Renewals (85 years)		$	-
	Instrumentation Control Communications (15 yrs)	Jacobs 2020	$	10,450,000
	Other repair costs (specify)		$	-
	Major filter renewals		$	-
			$	-
	Total renewal costs		**$**	**67,433,077**
Total acquisition costs			**$**	**93,374,077**
Ongoing operating and maintenance (recurring)				
Maintenance costs				
	Scheduled/preventative maintenance	Jacobs 2020	$	3,482,510
	Waste disposal	Jacobs 2020	$	1,064,000
	Other maintenance costs (specify)		$	-
	Total maintenance costs		**$**	**4,546,510**
Operating costs				
	Staffing costs - Borefield and Transfer	Jacobs 2020	$	4,560,000
	Staffing costs - GWTP	Jacobs 2020	$	9,880,000
	Utilities - Borefield and Transfer	Jacobs 2020	$	7,296,000
	Utilities - GWTP	Jacobs 2020	$	8,755,200
	Chemical Supplies and consumables	Jacobs 2020	$	9,728,000
	Training	Jacobs 2020	$	114,000
	WQ monitoring		$	-
	Licences	Jacobs 2020	$	1,900,000
	Other operating costs (specify)		$	-
	Support Costs	Jacobs 2020	$	3,610,000
	Total operating costs		**$**	**45,843,200**
Total operating and maintenance costs			**$**	**50,389,710**
Total disposal costs			**$**	-
Total Cost Over 80 years			**$**	**143,763,787**
Total Annualised costs over 80 years			**$**	**1,797,047.33**
Total Costs			**$**	**143,763,787**

Item	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
land acquistion costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	200,308	202,311	204,334	206,377	208,441	210,525	212,631	214,757	216,904	219,074	221,264	223,477	225,712	227,969	230,248	232,551	234,876	237,225	239,597	241,993
Upgrades and refurbishments	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-
Spare parts and accessories	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000	61,000	62,000	63,000	64,000	65,000	66,000	67,000	68,000	69,000	70,000
Bores Renewals (50 years)														990,000						
Mechanical Renewals (25 years)														6,740,000						
Electrical Renewals (25 years)														5,120,000						
Instrumentation Control Communications (15 yrs)									2,090,000											
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 251,308	$ 254,311	$ 257,334	$ 260,377	$ 263,441	$ 316,525	$ 269,631	$ 272,757	$ 2,365,904	$ 279,074	$ 282,264	$ 335,477	$ 288,712	$ 13,141,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993
Total acquisition costs	$ 251,308	$ 254,311	$ 257,334	$ 260,377	$ 263,441	$ 316,525	$ 269,631	$ 272,757	$ 2,365,904	$ 279,074	$ 282,264	$ 335,477	$ 288,712	$ 13,141,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993
Scheduled/preventative maintenance	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Utilities - GWTP	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200
Chemical Supplies and consumables	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200
Total operating and maintenance costs	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	$ 914,330	$ 917,333	$ 920,356	$ 923,400	$ 926,463	$ 979,548	$ 932,653	$ 935,779	$ 3,028,927	$ 942,096	$ 945,287	$ 998,499	$ 951,734	$ 13,804,991	$ 958,271	$ 961,573	$ 964,899	$ 1,018,248	$ 971,620	$ 975,016

Item	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Scheme investigation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Design and documentation costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Environmental approval costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Project management costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
land acquistion costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Repairs/unscheduled maintenance	244,413	246,858	249,326	251,819	254,338	256,881	259,450	262,044	264,665	267,311	269,984	272,684	275,411	278,165	280,947	283,756	286,594	289,460	292,354	295,278
Upgrades and refurbishments	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000				
Spare parts and accessories	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000	81,000	82,000	83,000	84,000	85,000	86,000	87,000	88,000	89,000	90,000
Mechanical Renewals (25 years)																			6,740,000	
Electrical Renewals (25 years)																			5,120,000	
Instrumentation Control Communications (15 yrs)				2,090,000															2,090,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total renewal costs	$ 315,413	$ 318,858	$ 322,326	$ 2,465,819	$ 329,338	$ 332,881	$ 336,450	$ 340,044	$ 343,665	$ 397,311	$ 350,984	$ 354,684	$ 358,411	$ 362,165	$ 365,947	$ 419,756	$ 373,594	$ 377,460	$ 14,331,354	$ 385,278
Total acquisition costs	$ 315,413	$ 318,858	$ 322,326	$ 2,465,819	$ 329,338	$ 332,881	$ 336,450	$ 340,044	$ 343,665	$ 397,311	$ 350,984	$ 354,684	$ 358,411	$ 362,165	$ 365,947	$ 419,756	$ 373,594	$ 377,460	$ 14,331,354	$ 385,278
Scheduled/preventative maintenance	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total maintenance costs	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823
Staffing costs - Borefield and Transfer	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Utilities - GWTP	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200
Chemical Supplies and consumables	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Support Costs	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500	47,500
Total operating costs	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200
Total operating and maintenance costs	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	$ 978,436	$ 981,880	$ 985,349	$ 3,128,842	$ 992,360	$ 995,903	$ 999,472	$ 1,003,067	$ 1,006,687	$ 1,060,334	$ 1,014,007	$ 1,017,707	$ 1,021,434	$ 1,025,188	$ 1,028,969	$ 1,082,779	$ 1,036,616	$ 1,040,482	$ 14,994,377	$ 1,048,300

80 year whole-of-life cost	$	143,763,787		
80 year NPV	$	60,862,511	3%	40 year NPV
	$	44,109,829	5%	
	$	35,778,806	7%	

Life cycle cost analysis - Tyagarah Scheme 1 Option, 6.4 ML/d

Estimated costs (2020 $)	Source	Total 80 years	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Initial acquisition costs (non-recurring)																																										
Capital costs																																										
Scheme investigation costs (2%)	Jacobs, 2020	$ 600,000	590,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs (7%)	Jacobs, 2020	$ 2,087,000	-	2,055,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs (4%)	Jacobs, 2020	$ 1,193,000	-	-	1,175,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs (2.5%)	Jacobs, 2020	$ 746,000	-	-	735,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land acquisition costs	Jacobs, 2020	$ 7,020,000	-	-	6,800,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -																																								
Bores (50 years)	Jacobs, 2020	$ 1,015,000				845,000																		170,000																		
Mechanical (25 years)	Jacobs, 2020	$ 9,940,000				9,720,000																		220,000																		
Electrical (25 years)	Jacobs, 2020	$ 7,045,000				6,925,000																		120,000																		
Civil including Pipelines (85 years)	Jacobs, 2020	$ 17,000,000				16,770,000																		230,000																		
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 3,013,000				2,990,000																		23,000																		
Integration costs Integration costs (4%)	Jacobs, 2020	$ 1,193,000	-	-	1,175,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Total initial capital costs		$ 50,852,000	$ 590,000	$ 2,055,000	$ 9,885,000	$ 37,250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,000	$ 32,000	$ 267,000	$ 763,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		$ -																																								
Renewals																																										
Repairs/unscheduled maintenance	Jacobs, 2020	$ 22,604,395	-	-	-	-	200,000	202,000	204,020	206,060	208,121	210,202	212,304	214,427	216,571	218,737	220,924	223,134	225,365	227,619	229,895	232,194	234,516	236,861	239,229	241,622	244,038	246,478	248,943	251,433	253,947	256,486	259,051	261,642	264,258	266,901	269,570	272,265	274,988	277,738	280,515	283,321
Upgrades and refurbishments	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000
Spare parts and accessories	Jacobs, 2020	$ 4,370,000	-	-	-	-	20,000	21,000	22,000	23,000	24,000	25,000	26,000	27,000	28,000	29,000	30,000	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000	41,000	42,000	43,000	44,000	45,000	46,000	47,000	48,000	49,000	50,000	51,000	52,000	53,000	54,000	55,000
Bores Renewals (50 years)	Jacobs, 2020	$ 1,015,000																																								
Mechanical Renewals (25 years)	Jacobs, 2020	$ 29,600,000																													9,720,000											
Electrical Renewals (25 years)	Jacobs, 2020	$ 21,015,000																													6,925,000											
Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ 69,000																																					23,000			
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 14,950,000																			2,990,000															2,990,000						
Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-		-	-	-	-	-	-	-	-	-	300,000	-	-	-	-	-	-	-	-	-	300,000	-	-	-	-	-	-	-	-	-	300,000	-	-	-	-	-	-	-
		$ -																																								
Total renewal costs		$ 96,773,395	$ -	$ -	$ -	$ -	$ 220,000	$ 223,000	$ 226,020	$ 229,060	$ 232,121	$ 285,202	$ 238,304	$ 241,427	$ 544,571	$ 247,737	$ 250,924	$ 304,134	$ 257,365	$ 260,619	$ 3,253,895	$ 267,194	$ 270,516	$ 323,861	$ 577,229	$ 280,622	$ 284,038	$ 287,478	$ 290,943	$ 394,433	$ 16,942,947	$ 301,486	$ 305,051	$ 308,642	$ 612,258	$ 3,405,901	$ 319,570	$ 323,265	$ 349,988	$ 330,738	$ 334,515	$ 438,321
		$ -																																								
Total acquisition costs		$ 147,625,395	$ 590,000	$ 2,055,000	$ 9,885,000	$ 37,250,000	$ 220,000	$ 223,000	$ 226,020	$ 229,060	$ 232,121	$ 285,202	$ 238,304	$ 241,427	$ 544,571	$ 247,737	$ 250,924	$ 304,134	$ 257,365	$ 260,619	$ 3,263,895	$ 299,194	$ 537,516	$ 1,086,861	$ 577,229	$ 280,622	$ 284,038	$ 287,478	$ 290,943	$ 394,433	$ 16,942,947	$ 301,486	$ 305,051	$ 308,642	$ 612,258	$ 3,405,901	$ 319,570	$ 323,265	$ 349,988	$ 330,738	$ 334,515	$ 438,321
		$ -																																								
less Trade-in of item being replaced	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Net acquisition costs		$ 147,625,395	$ 590,000	$ 2,055,000	$ 9,885,000	$ 37,250,000	$ 220,000	$ 223,000	$ 226,020	$ 229,060	$ 232,121	$ 285,202	$ 238,304	$ 241,427	$ 544,571	$ 247,737	$ 250,924	$ 304,134	$ 257,365	$ 260,619	$ 3,263,895	$ 299,194	$ 537,516	$ 1,086,861	$ 577,229	$ 280,622	$ 284,038	$ 287,478	$ 290,943	$ 394,433	$ 16,942,947	$ 301,486	$ 305,051	$ 308,642	$ 612,258	$ 3,405,901	$ 319,570	$ 323,265	$ 349,988	$ 330,738	$ 334,515	$ 438,321
		$ -																																								
Leasing costs		$ -																																								
Lease payments	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residual lease payments	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Total leasing costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		$ -																																								
Ongoing operating and maintenance (recurring)		$ -																																								
Maintenance costs		$ -																																								
Scheduled/preventative maintenance	Jacobs, 2020	$ 6,786,510	-	-	-	-	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	190,065	190,065	190,065	190,065	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Waste disposal	Jacobs, 2020	$ 2,456,000	-	-	-	-	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Total maintenance costs		$ 9,242,510	$ -	$ -	$ -	$ -	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 204,065	$ 228,065	$ 228,065	$ 228,065	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
		$ -																																								
Operating costs		$ -																																								
Staffing costs - Borefield and Transfer	Jacobs, 2020	$ 9,120,000	-	-	-	-	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Staffing costs - GWTP	Jacobs, 2020	$ 9,880,000	-	-	-	-	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	Jacobs, 2020	$ 13,204,800					153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	Jacobs, 2020	$ 15,845,760					184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000
Chemical Supplies and consumables GWTP	Jacobs, 2020	$ 17,606,400	-	-	-	-	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Training	Jacobs, 2020	$ 114,000	-	-	-	-	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs, 2020	$ 1,900,000	-	-	-	-	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	Jacobs, 2020	$ 4,750,000	-	-	-	-	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
		$ -																																								
		$ -																																								
Total operating costs		$ 72,420,960	$ -	$ -	$ -	$ -	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000
Total operating and maintenance costs		**$ 81,663,470**	$ -	$ -	$ -	$ -	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,081,970	$ 1,085,785	$ 1,203,065	$ 1,203,065	$ 1,203,065	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000
Disposal costs																																										
End-of-life disposal costs of the equipment	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years		$ 229,288,865																																								
Total Costs		$ 229,288,865	$ 590,000	$ 2,055,000	$ 9,885,000	$ 37,250,000	$ 1,301,970	$ 1,304,970	$ 1,307,990	$ 1,311,030	$ 1,314,091	$ 1,367,172	$ 1,320,274	$ 1,323,397	$ 1,626,541	$ 1,329,707	$ 1,332,894	$ 1,386,104	$ 1,339,335	$ 1,342,589	$ 4,345,865	$ 1,381,164	$ 1,619,486	$ 2,172,646	$ 1,780,294	$ 1,483,687	$ 1,487,103	$ 1,352,478	$ 1,355,943	$ 1,459,433	$ 18,007,947	$ 1,366,486	$ 1,370,051	$ 1,373,642	$ 1,677,258	$ 4,470,901	$ 1,384,570	$ 1,388,265	$ 1,414,988	$ 1,395,738	$ 1,399,515	$ 1,503,321

80 year whole-of-life cost	$ 229,288,865		40 year NPV	$ 84,459,844	2060 yield	1,789	ML/a
80 year NPV	$ 102,557,614	3%		$ 69,888,062	NPV/ML yield	$ 39,065	
	$ 76,008,100	5%		$ 60,122,402			
	$ 62,323,819	7%					

Life cycle cost analysis - Tyagarah Scheme 1 Option, 6.4 ML/d

Estimated costs (2020 $)	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Initial acquisition costs (non-recurring)																																										
Capital costs																																										
Scheme investigation costs (2%)	Jacobs, 2020	$ 600,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs (7%)	Jacobs, 2020	$ 2,087,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs (4%)	Jacobs, 2020	$ 1,193,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs (2.5%)	Jacobs, 2020	$ 746,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land acquisition costs	Jacobs, 2020	$ 7,020,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -																																								
Bores (50 years)	Jacobs, 2020	$ 1,015,000																																								
Mechanical (25 years)	Jacobs, 2020	$ 9,940,000																																								
Electrical (25 years)	Jacobs, 2020	$ 7,045,000																																								
Civil including Pipelines (85 years)	Jacobs, 2020	$ 17,000,000																																								
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 3,013,000																																								
Integration costs Integration costs (4%)	Jacobs, 2020	$ 1,193,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Total initial capital costs		$ 50,852,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		$ -																																								
Renewals																																										
Repairs/unscheduled maintenance	Jacobs, 2020	$ 22,604,395	286,154	289,015	291,905	294,825	297,773	300,750	303,758	306,796	309,864	312,962	316,092	319,253	322,445	325,670	328,926	332,216	335,538	338,893	342,282	345,705	349,162	352,654	356,180	359,742	363,339	366,973	370,642	374,349	378,092	381,873	385,692	389,549	393,444	397,379	401,353	405,366	409,420	413,514	417,649	421,826
Upgrades and refurbishments	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-
Spare parts and accessories	Jacobs, 2020	$ 4,370,000	56,000	57,000	58,000	59,000	60,000	61,000	62,000	63,000	64,000	65,000	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000	81,000	82,000	83,000	84,000	85,000	86,000	87,000	88,000	89,000	90,000	91,000	92,000	93,000	94,000	95,000
Bores Renewals (50 years)	Jacobs, 2020	$ 1,015,000														845,000																		170,000								
Mechanical Renewals (25 years)	Jacobs, 2020	$ 29,600,000							220,000							9,720,000																		220,000						9,720,000		
Electrical Renewals (25 years)	Jacobs, 2020	$ 21,015,000							120,000							6,925,000																		120,000						6,925,000		
Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ 69,000												23,000															23,000													
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 14,950,000									2,990,000															2,990,000															2,990,000	
Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Major filter renewals	Jacobs, 2020	$ 2,100,000		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-	-	-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	
		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
		$ -																																								
Total renewal costs		$ 96,773,395	$ 342,154	$ 346,015	$ 649,905	$ 353,825	$ 357,773	$ 461,750	$ 705,758	$ 369,796	$ 3,363,864	$ 377,962	$ 382,092	$ 509,253	$ 690,445	$ 17,884,670	$ 398,926	$ 403,216	$ 407,538	$ 511,893	$ 416,282	$ 420,705	$ 425,162	$ 429,654	$ 734,180	$ 3,528,742	$ 443,339	$ 447,973	$ 475,642	$ 457,349	$ 462,092	$ 566,873	$ 471,692	$ 986,549	$ 781,444	$ 486,379	$ 491,353	$ 596,366	$ 501,420	$ 17,151,514	$ 3,501,649	$ 516,826
		$ -																																								
Total acquisition costs		$ 147,625,395	$ 342,154	$ 346,015	$ 649,905	$ 353,825	$ 357,773	$ 461,750	$ 705,758	$ 369,796	$ 3,363,864	$ 377,962	$ 382,092	$ 509,253	$ 690,445	$ 17,884,670	$ 398,926	$ 403,216	$ 407,538	$ 511,893	$ 416,282	$ 420,705	$ 425,162	$ 429,654	$ 734,180	$ 3,528,742	$ 443,339	$ 447,973	$ 475,642	$ 457,349	$ 462,092	$ 566,873	$ 471,692	$ 986,549	$ 781,444	$ 486,379	$ 491,353	$ 596,366	$ 501,420	$ 17,151,514	$ 3,501,649	$ 516,826
		$ -																																								
less Trade-in of item being replaced	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
		$ -																																								
Net acquisition costs		$ 147,625,395	$ 342,154	$ 346,015	$ 649,905	$ 353,825	$ 357,773	$ 461,750	$ 705,758	$ 369,796	$ 3,363,864	$ 377,962	$ 382,092	$ 509,253	$ 690,445	$ 17,884,670	$ 398,926	$ 403,216	$ 407,538	$ 511,893	$ 416,282	$ 420,705	$ 425,162	$ 429,654	$ 734,180	$ 3,528,742	$ 443,339	$ 447,973	$ 475,642	$ 457,349	$ 462,092	$ 566,873	$ 471,692	$ 986,549	$ 781,444	$ 486,379	$ 491,353	$ 596,366	$ 501,420	$ 17,151,514	$ 3,501,649	$ 516,826
		$ -																																								
Leasing costs		$ -																																								
Lease payments	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residual lease payments	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Total leasing costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		$ -																																								
Ongoing operating and maintenance (recurring)		$ -																																								
Maintenance costs		$ -																																								
Scheduled/preventative maintenance	Jacobs, 2020	$ 6,786,510	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Waste disposal	Jacobs, 2020	$ 2,456,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																																								
Total maintenance costs		$ 9,242,510	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
		$ -																																								
Operating costs		$ -																																								
Staffing costs - Borefield and Transfer	Jacobs, 2020	$ 9,120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
Staffing costs - GWTP	Jacobs, 2020	$ 9,880,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
Utilities - Borefield and Transfer	Jacobs, 2020	$ 13,204,800	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	Jacobs, 2020	$ 15,845,760	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000
Chemical Supplies and consumables GWTP	Jacobs, 2020	$ 17,606,400	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Training	Jacobs, 2020	$ 114,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs, 2020	$ 1,900,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	Jacobs, 2020	$ 4,750,000	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
		$ -																																								
		$ -																																								
Total operating costs		$ 72,420,960	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000
Total operating and maintenance costs		**$ 81,663,470**	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000	$ 1,065,000
Disposal costs																																										
End-of-life disposal costs of the equipment	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Over 80 years		$ 229,288,865																																								
Total Costs		$ 229,288,865	$ 1,407,154	$ 1,411,015	$ 1,714,905	$ 1,418,825	$ 1,422,773	$ 1,526,750	$ 1,770,758	$ 1,434,796	$ 4,428,864	$ 1,442,962	$ 1,447,092	$ 1,574,253	$ 1,755,445	$ 18,949,670	$ 1,463,926	$ 1,468,216	$ 1,472,538	$ 1,576,893	$ 1,481,282	$ 1,485,705	$ 1,490,162	$ 1,494,654	$ 1,799,180	$ 4,593,742	$ 1,508,339	$ 1,512,973	$ 1,540,642	$ 1,522,349	$ 1,527,092	$ 1,631,873	$ 1,536,692	$ 2,051,549	$ 1,846,444	$ 1,551,379	$ 1,556,353	$ 1,661,366	$ 1,566,420	$ 18,216,514	$ 4,566,649	$ 1,581,826

80 year whole-of-life cost	$ 229,288,865	
80 year NPV	$ 102,557,614	3%
	$ 76,008,100	5%
	$ 62,323,819	7%

Life cycle cost analysis - Tyagarah Scheme 2 Option, expansion to 12.5 ML/d

Estimated costs (2020 $) — years 1–20

Item	Source	Total 80 years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial acquisition costs (non-recurring)																						
Capital costs																						
Scheme investigation costs (2%)	Jacobs, 2020	$ 331,000	315,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16,000	
Design and documentation costs (7%)	Jacobs, 2020	$ 1,171,000	-	1,115,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56,000
Environmental approval costs (4%)	Jacobs, 2020	$ 667,000	-	-	635,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Project management costs (2.5%)	Jacobs, 2020	$ 420,000	-	-	400,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Land acquisition costs	Jacobs, 2020	$ 690,000	-	-	465,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Construction costs (asset renewal life)</u>		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bores (50 years)	Jacobs, 2020	$ 760,000	-	-	-	425,000																
Mechanical (25 years)	Jacobs, 2020	$ 6,877,500	-	-	-	6,437,500																
Electrical (25 years)	Jacobs, 2020	$ 4,402,500	-	-	-	4,162,500																
Civil including Pipelines (85 years)	Jacobs, 2020	$ 12,412,500	-	-	-	12,162,500																
Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 2,063,750	-	-	-	2,018,750																
Integration costs Integration costs (4%)	Jacobs, 2020	$ 667,000	-	-	635,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Existing supply network modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Existing facility modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																				
Total initial capital costs		$ 30,462,250	$ 315,000	$ 1,115,000	$ 2,135,000	$ 25,206,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,000	$ 56,000
Renewals		$ -																				
Repairs/unscheduled maintenance	Jacobs, 2020	$ 28,255,494	-	-	-	-	250,000	252,500	255,025	257,575	260,151	262,753	265,380	268,034	270,714	273,421	276,156	278,917	281,706	284,523	287,369	290,242
Upgrades and refurbishments	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-
Spare parts and accessories	Jacobs, 2020	$ 5,130,000	-	-	-	-	30,000	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000	41,000	42,000	43,000	44,000	45,000
Bores Renewals (50 years)	Jacobs, 2020	$ 1,520,000																				
Mechanical Renewals (25 years)	Jacobs, 2020	$ 45,490,000																				
Electrical Renewals (25 years)	Jacobs, 2020	$ 20,990,000																				
Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ -																				
Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 23,160,000																			4,605,000	
Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-	-	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																				
Total renewal costs		$ 127,695,494	$ -	$ -	$ -	$ -	$ 280,000	$ 283,500	$ 287,025	$ 290,575	$ 294,151	$ 347,753	$ 301,380	$ 305,034	$ 608,714	$ 312,421	$ 316,156	$ 369,917	$ 323,706	$ 327,523	$ 4,936,369	$ 335,242
		$ -																				
Total acquisition costs		$ 158,157,744	$ 315,000	$ 1,115,000	$ 2,135,000	$ 25,206,250	$ 280,000	$ 283,500	$ 287,025	$ 290,575	$ 294,151	$ 347,753	$ 301,380	$ 305,034	$ 608,714	$ 312,421	$ 316,156	$ 369,917	$ 323,706	$ 327,523	$ 4,952,369	$ 391,242
		$ -																				
Ongoing operating and maintenance (recurring)		$ -																				
Maintenance costs		$ -																				
Scheduled/preventative maintenance	Jacobs, 2020	$ 9,958,275	-	-	-	-	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031	126,031
Waste disposal	Jacobs, 2020	$ 1,064,000	-	-	-	-	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																				
Total maintenance costs		$ 11,022,275	$ -	$ -	$ -	$ -	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031	$ 140,031
		$ -																				
Operating costs		$ -																				
Staffing costs - Borefield and Transfer	Jacobs, 2020	$ 11,400,000	-	-	-	-	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Staffing costs - GWTP	Jacobs, 2020	$ 11,400,000	-	-	-	-	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Utilities - Borefield and Transfer	Jacobs, 2020	$ 22,065,600					259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200	259,200
Utilities - GWTP	Jacobs, 2020	$ 26,478,720					311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040	311,040
Chemical Supplies and consumables GWTP	Jacobs, 2020	$ 29,420,800	-	-	-	-	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600	345,600
Training	Jacobs, 2020	$ 114,000	-	-	-	-	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs, 2020	$ 1,900,000	-	-	-	-	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	Jacobs, 2020	$ 5,700,000	-	-	-	-	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total operating costs		$ 108,479,120	$ -	$ -	$ -	$ -	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340	$ 1,317,340
Total operating and maintenance costs		$ 119,501,395	$ -	$ -	$ -	$ -	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371	$ 1,457,371
Total Costs		$ 277,659,139	$ 315,000	$ 1,115,000	$ 2,135,000	$ 25,206,250	$ 1,737,371	$ 1,740,871	$ 1,744,396	$ 1,747,947	$ 1,751,522	$ 1,805,124	$ 1,758,751	$ 1,762,405	$ 2,066,085	$ 1,769,793	$ 1,773,527	$ 1,827,288	$ 1,781,078	$ 1,784,895	$ 6,409,740	$ 1,848,613

Years 21–40

Item	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Scheme investigation costs (2%)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs (7%)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs (4%)	32,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs (2.5%)	20,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land acquisition costs	225,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Construction costs (asset renewal life)</u>					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bores (50 years)		335,000																		
Mechanical (25 years)		440,000																		
Electrical (25 years)		240,000																		
Civil including Pipelines (85 years)		250,000																		
Instrumentation Control Communications (15 yrs)		45,000																		
Integration costs (4%)	32,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(Jacobs, 2020)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ 309,000	$ 1,310,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	293,145	296,076	299,037	302,027	305,048	308,098	311,179	314,291	317,434	320,608	323,814	327,052	330,323	333,626	336,962	340,332	343,735	347,173	350,644	354,151
Upgrades and refurbishments	-	50,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000
Spare parts and accessories	46,000	47,000	48,000	49,000	50,000	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000	61,000	62,000	63,000	64,000	65,000
Bores Renewals (50 years)																				
Mechanical Renewals (25 years)									14,870,000											
Electrical Renewals (25 years)									10,255,000											
Civil including Pipelines Renewals (85 years)																				
Instrumentation Control Communications (15 yrs)														4,605,000			45,000			
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major filter renewals		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 339,145	$ 393,076	$ 647,037	$ 351,027	$ 355,048	$ 359,098	$ 363,179	$ 467,291	$ 25,496,434	$ 375,608	$ 379,814	$ 384,052	$ 688,323	$ 5,097,626	$ 396,962	$ 401,332	$ 450,735	$ 410,173	$ 414,644	$ 519,151
Total acquisition costs	$ 648,145	$ 1,703,076	$ 647,037	$ 351,027	$ 355,048	$ 359,098	$ 363,179	$ 467,291	$ 25,496,434	$ 375,608	$ 379,814	$ 384,052	$ 688,323	$ 5,097,626	$ 396,962	$ 401,332	$ 450,735	$ 410,173	$ 414,644	$ 519,151
Scheduled/preventative maintenance	126,031	126,031	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(Jacobs, 2020)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 140,031	$ 140,031	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581
Staffing costs - Borefield and Transfer	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Staffing costs - GWTP	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Utilities - Borefield and Transfer	259,200	259,200	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Utilities - GWTP	311,040	311,040	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Chemical Supplies and consumables GWTP	345,600	345,600	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total operating costs	$ 1,317,340	$ 1,317,340	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500
Total operating and maintenance costs	$ 1,457,371	$ 1,457,371	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081
Total Costs	$ 2,105,516	$ 3,160,447	$ 2,255,118	$ 1,959,108	$ 1,963,129	$ 1,967,179	$ 1,971,260	$ 2,075,372	$ 27,104,515	$ 1,983,689	$ 1,987,895	$ 1,992,133	$ 2,296,404	$ 6,705,707	$ 2,005,043	$ 2,009,413	$ 2,058,816	$ 2,018,254	$ 2,022,725	$ 2,127,232

80 year whole-of-life cost	$ 277,659,139		40 year NPV	$ 80,437,715	2060 yield	3,448 ML/a
80 year NPV	$ 105,760,458	3%		$ 61,558,652	NPV/ML yield	$ 38,123
	$ 70,231,337	5%		$ 49,463,064		
	$ 52,611,472	7%				

Life cycle cost analysis - Tyagarah Scheme 2 Option, expansion to 12.5 ML/d

Estimated costs (2020 $) — years 41–60

Item	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Initial acquisition costs (non-recurring)																						
Capital costs																						
Scheme investigation costs (2%)	Jacobs, 2020	$ 331,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Design and documentation costs (7%)	Jacobs, 2020	$ 1,171,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental approval costs (4%)	Jacobs, 2020	$ 667,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Project management costs (2.5%)	Jacobs, 2020	$ 420,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land acquisition costs	Jacobs, 2020	$ 690,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Construction costs (asset renewal life)</u>		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bores (50 years)	Jacobs, 2020	$ 760,000																				
Mechanical (25 years)	Jacobs, 2020	$ 6,877,500																				
Electrical (25 years)	Jacobs, 2020	$ 4,402,500																				
Civil including Pipelines (85 years)	Jacobs, 2020	$ 12,412,500																				
Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 2,063,750																				
Integration costs Integration costs (4%)	Jacobs, 2020	$ 667,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																				
Total initial capital costs		$ 30,462,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals		$ -																				
Repairs/unscheduled maintenance	Jacobs, 2020	$ 28,255,494	357,692	361,269	364,882	368,531	372,216	375,938	379,697	383,494	387,329	391,203	395,115	399,066	403,057	407,087	411,158	415,270	419,422	423,616	427,853	432,131
Upgrades and refurbishments	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-
Spare parts and accessories	Jacobs, 2020	$ 5,130,000	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000	81,000	82,000	83,000	84,000	85,000
Bores Renewals (50 years)	Jacobs, 2020	$ 1,520,000														1,185,000						
Mechanical Renewals (25 years)	Jacobs, 2020	$ 45,490,000							440,000							14,870,000						
Electrical Renewals (25 years)	Jacobs, 2020	$ 20,990,000							240,000							10,255,000						
Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ -																				
Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 23,160,000									4,605,000			45,000								
Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Major filter renewals	Jacobs, 2020	$ 2,100,000		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																				
Total renewal costs		$ 127,695,494	$ 423,692	$ 428,269	$ 732,882	$ 437,531	$ 442,216	$ 546,938	$ 1,131,697	$ 456,494	$ 5,066,329	$ 466,203	$ 471,115	$ 621,066	$ 781,057	$ 26,796,087	$ 491,158	$ 496,270	$ 501,422	$ 606,616	$ 511,853	$ 517,131
		$ -																				
Total acquisition costs		$ 158,157,744	$ 423,692	$ 428,269	$ 732,882	$ 437,531	$ 442,216	$ 546,938	$ 1,131,697	$ 456,494	$ 5,066,329	$ 466,203	$ 471,115	$ 621,066	$ 781,057	$ 26,796,087	$ 491,158	$ 496,270	$ 501,422	$ 606,616	$ 511,853	$ 517,131
		$ -																				
Ongoing operating and maintenance (recurring)		$ -																				
Maintenance costs		$ -																				
Scheduled/preventative maintenance	Jacobs, 2020	$ 9,958,275	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581
Waste disposal	Jacobs, 2020	$ 1,064,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		$ -																				
Total maintenance costs		$ 11,022,275	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581
		$ -																				
Operating costs		$ -																				
Staffing costs - Borefield and Transfer	Jacobs, 2020	$ 11,400,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Staffing costs - GWTP	Jacobs, 2020	$ 11,400,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Utilities - Borefield and Transfer	Jacobs, 2020	$ 22,065,600	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Utilities - GWTP	Jacobs, 2020	$ 26,478,720	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Chemical Supplies and consumables GWTP	Jacobs, 2020	$ 29,420,800	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
Training	Jacobs, 2020	$ 114,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs, 2020	$ 1,900,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	Jacobs, 2020	$ 5,700,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total operating costs		$ 108,479,120	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500
Total operating and maintenance costs		$ 119,501,395	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081
Total Costs		$ 277,659,139	$ 2,031,773	$ 2,036,350	$ 2,340,963	$ 2,045,612	$ 2,050,297	$ 2,155,019	$ 2,739,779	$ 2,064,576	$ 6,674,411	$ 2,074,284	$ 2,079,196	$ 2,229,147	$ 2,389,138	$ 28,404,168	$ 2,099,239	$ 2,104,351	$ 2,109,503	$ 2,214,698	$ 2,119,934	$ 2,125,212

Years 61–80

Item	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Scheme investigation costs (2%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Design and documentation costs (7%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Environmental approval costs (4%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Project management costs (2.5%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Land acquisition costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
<u>Construction costs (asset renewal life)</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
(Jacobs, 2020)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Repairs/unscheduled maintenance	436,452	440,817	445,225	449,677	454,174	458,716	463,303	467,936	472,615	477,342	482,115	486,936	491,806	496,724	501,691	506,708	511,775	516,893	522,062	527,282
Upgrades and refurbishments	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-
Spare parts and accessories	86,000	87,000	88,000	89,000	90,000	91,000	92,000	93,000	94,000	95,000	96,000	97,000	98,000	99,000	100,000	101,000	102,000	103,000	104,000	105,000
Bores Renewals (50 years)												335,000								
Mechanical Renewals (25 years)												440,000							14,870,000	
Electrical Renewals (25 years)												240,000								
Civil including Pipelines Renewals (85 years)																				
Instrumentation Control Communications (15 yrs)				4,605,000			45,000												4,605,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Major filter renewals		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total renewal costs	$ 522,452	$ 527,817	$ 833,225	$ 5,243,677	$ 544,174	$ 549,716	$ 600,303	$ 560,936	$ 566,615	$ 672,342	$ 578,115	$ 1,598,936	$ 889,806	$ 595,724	$ 601,691	$ 707,708	$ 613,775	$ 619,893	$ 20,101,062	$ 632,282
Total acquisition costs	$ 522,452	$ 527,817	$ 833,225	$ 5,243,677	$ 544,174	$ 549,716	$ 600,303	$ 560,936	$ 566,615	$ 672,342	$ 578,115	$ 1,598,936	$ 889,806	$ 595,724	$ 601,691	$ 707,708	$ 613,775	$ 619,893	$ 20,101,062	$ 632,282
Scheduled/preventative maintenance	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581	132,581
Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
(Jacobs, 2020)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Total maintenance costs	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581	$ 146,581
Staffing costs - Borefield and Transfer	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Staffing costs - GWTP	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Utilities - Borefield and Transfer	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Utilities - GWTP	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Chemical Supplies and consumables GWTP	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000
Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Support Costs	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total operating costs	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500	$ 1,461,500
Total operating and maintenance costs	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081	$ 1,608,081
Total Costs	$ 2,130,534	$ 2,135,898	$ 2,441,306	$ 6,851,759	$ 2,152,255	$ 2,157,797	$ 2,208,384	$ 2,169,017	$ 2,174,697	$ 2,280,423	$ 2,186,196	$ 3,207,017	$ 2,497,887	$ 2,203,805	$ 2,209,772	$ 2,315,789	$ 2,221,856	$ 2,227,974	$ 21,709,143	$ 2,240,363

80 year whole-of-life cost	$ 277,659,139		40 year NPV
80 year NPV	$ 105,760,458	3%	
	$ 70,231,337	5%	
	$ 52,611,472	7%	

Life cycle cost analysis - Newrybar Option

Estimated costs (2020 $)		Source	Total 80 years	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial acquistion costs (non-recurring)																							
Capital costs																							
	Scheme investigation costs (2%)	Jacobs (2020)	$ 730,000	730,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Design and documentation costs (7%)	Jacobs (2020)	$ 2,560,000	-	2,560,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Environmental approval costs (4%)	Jacobs (2020)	$ 1,460,000	-	-	1,460,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Project management costs (2.5%)	Jacobs (2020)	$ 915,000	-	-	915,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Land acquistion costs	Jacobs (2020)	$ 8,870,000	-	-	8,870,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Construction costs (asset renewal life)	Jacobs (2020)	$ -	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Bores (50 years)	Jacobs (2020)	$ 1,320,000				1,320,000																
	Mechanical (25 years)	Jacobs (2020)	$ 9,250,000				9,250,000																
	Electrical (25 years)	Jacobs (2020)	$ 5,910,000				5,910,000																
	Civil including Pipelines (85 years)	Jacobs (2020)	$ 28,120,000				28,120,000																
	Instrumentation Control Communications (15 yrs)	Jacobs (2020)	$ 2,560,000				2,560,000																
Integration costs	Integration costs (4%)	Jacobs (2020)	$ 1,460,000	-	-	1,460,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	Existing supply network modifications	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total initial capital costs		**$ 63,155,000**	$ 730,000	$ 2,560,000	$ 12,705,000	$ 47,160,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals																							
	Repairs/unscheduled maintenance	Jacobs (2020)	$ 22,604,395	-	-	-	-	200,000	202,000	204,020	206,060	208,121	210,202	212,304	214,427	216,571	218,737	220,924	223,134	225,365	227,619	229,895	232,194
	Upgrades and refurbishments	Jacobs (2020)	$ 1,200,000	-	-	-	-	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-
	Spare parts and accessories	Jacobs (2020)	$ 4,750,000	-	-	-	-	25,000	26,000	27,000	28,000	29,000	30,000	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000
	Bores Renewals (50 years)	Jacobs (2020)	$ 1,320,000																				
	Mechanical Renewals (25 years)	Jacobs (2020)	$ 18,500,000																				
	Electrical Renewals (25 years)	Jacobs (2020)	$ 11,820,000																				
	Civil including Pipelines Renewals (85 years)	Jacobs (2020)	$ -																				
	Instrumentation Control Communications (15 yrs)	Jacobs (2020)	$ 10,240,000																			2,560,000	
	Other repair costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RO membranes (10 years)	Jacobs (2020)	$ 7,000,000	-	-	-	-	-	-	-	-	-	-	-		-	-	1,000,000	-	-	-	-	
	Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-		-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-
	Total renewal costs		**$ 79,534,395**	$ -	$ -	$ -	$ -	$ 225,000	$ 228,000	$ 231,020	$ 234,060	$ 237,121	$ 340,202	$ 243,304	$ 246,427	$ 549,571	$ 252,737	$ 1,255,924	$ 359,134	$ 262,365	$ 265,619	$ 2,828,895	$ 272,194
Total acquisition costs			**$ 142,689,395**	$ 730,000	$ 2,560,000	$ 12,705,000	$ 47,160,000	$ 225,000	$ 228,000	$ 231,020	$ 234,060	$ 237,121	$ 340,202	$ 243,304	$ 246,427	$ 549,571	$ 252,737	$ 1,255,924	$ 359,134	$ 262,365	$ 265,619	$ 2,828,895	$ 272,194
Total leasing costs			**$ -**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing Operating and Maintenance (recurring)																							
Maintenance costs																							
	Scheduled/preventative maintenance	Jacobs (2020)	$ 17,920,800	-	-	-	-	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800
	Waste disposal	Jacobs (2020)	$ 1,064,000	-	-	-	-	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
	Other maintenance costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total maintenance costs		**$ 18,984,800**	$ -	$ -	$ -	$ -	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800
Operating costs																							
	Staffing costs - Borefield and Transfer	Jacobs (2020)	$ 9,120,000	-	-	-	-	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
	Staffing costs - GWTP	Jacobs (2020)	$ 9,880,000					130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
	Utilities - Borefield and Transfer	Jacobs (2020)	$ 13,132,800	-	-	-	-	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800
	Utilities - GWTP	Jacobs (2020)	$ 52,531,200					691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200
	Chemical Supplies and consumables	Jacobs (2020)	$ 21,888,000	-	-	-	-	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000
	Training	Jacobs (2020)	$ 114,000	-	-	-	-	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
	WQ monitoring	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Licences	Jacobs (2020)	$ 1,900,000	-	-	-	-	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
	Other operating costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Support Costs	Jacobs (2020)	$ 4,750,000	-	-	-	-	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
	Total operating costs		**$ 113,316,000**	$ -	$ -	$ -	$ -	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000
Total operating and maintenance costs			**$ 132,300,800**	$ -	$ -	$ -	$ -	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800
Total Costs			**$ 274,990,195**	**$ 730,000**	**$ 2,560,000**	**$ 12,705,000**	**$ 47,160,000**	**$ 1,965,800**	**$ 1,968,800**	**$ 1,971,820**	**$ 1,974,860**	**$ 1,977,921**	**$ 2,081,002**	**$ 1,984,104**	**$ 1,987,227**	**$ 2,290,371**	**$ 1,993,537**	**$ 2,996,724**	**$ 2,099,934**	**$ 2,003,165**	**$ 2,006,419**	**$ 4,569,695**	**$ 2,012,994**

Estimated costs (2020 $)		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Initial acquistion costs (non-recurring)																					
Capital costs																					
	Scheme investigation costs (2%)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Design and documentation costs (7%)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Environmental approval costs (4%)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Project management costs (2.5%)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Land acquistion costs				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Construction costs (asset renewal life)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bores (50 years)																				
	Mechanical (25 years)																				
	Electrical (25 years)																				
	Civil including Pipelines (85 years)																				
	Instrumentation Control Communications (15 yrs)																				
Integration costs	Integration costs (4%)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals																					
	Repairs/unscheduled maintenance	234,516	236,861	239,229	241,622	244,038	246,478	248,943	251,433	253,947	256,486	259,051	261,642	264,258	266,901	269,570	272,265	274,988	277,738	280,515	283,321
	Upgrades and refurbishments	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000
	Spare parts and accessories	41,000	42,000	43,000	44,000	45,000	46,000	47,000	48,000	49,000	50,000	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000
	Bores Renewals (50 years)																				
	Mechanical Renewals (25 years)									9,250,000											
	Electrical Renewals (25 years)									5,910,000											
	Civil including Pipelines Renewals (85 years)																				
	Instrumentation Control Communications (15 yrs)														2,560,000						
	Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RO membranes (10 years)	-	-	-		1,000,000										1,000,000					
	Major filter renewals		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-
	Total renewal costs	$ 275,516	$ 378,861	$ 582,229	$ 285,622	$ 1,289,038	$ 292,478	$ 295,943	$ 399,433	$ 15,462,947	$ 306,486	$ 310,051	$ 313,642	$ 617,258	$ 2,980,901	$ 1,324,570	$ 328,265	$ 331,988	$ 335,738	$ 339,515	$ 443,321
Total acquisition costs		$ 275,516	$ 378,861	$ 582,229	$ 285,622	$ 1,289,038	$ 292,478	$ 295,943	$ 399,433	$ 15,462,947	$ 306,486	$ 310,051	$ 313,642	$ 617,258	$ 2,980,901	$ 1,324,570	$ 328,265	$ 331,988	$ 335,738	$ 339,515	$ 443,321
Total leasing costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing Operating and Maintenance (recurring)																					
Maintenance costs																					
	Scheduled/preventative maintenance	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800
	Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
	Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total maintenance costs	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800
Operating costs																					
	Staffing costs - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
	Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
	Utilities - Borefield and Transfer	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800
	Utilities - GWTP	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200
	Chemical Supplies and consumables	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000
	Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
	WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
	Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Support Costs	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
	Total operating costs	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000
Total operating and maintenance costs		$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800
Total Costs		**$ 2,016,316**	**$ 2,119,661**	**$ 2,323,029**	**$ 2,026,422**	**$ 3,029,838**	**$ 2,033,278**	**$ 2,036,743**	**$ 2,140,233**	**$ 17,203,747**	**$ 2,047,286**	**$ 2,050,851**	**$ 2,054,442**	**$ 2,358,058**	**$ 4,721,701**	**$ 3,065,370**	**$ 2,069,065**	**$ 2,072,788**	**$ 2,076,538**	**$ 2,080,315**	**$ 2,184,121**

80 year whole-of-life cost	$ 274,990,195		40 year NPV	############	2060 yield	1,833	ML/a
80 year NPV	$ 131,213,859	3%		$ 91,091,988	NPV/ML yield	$ 49,696	
	$ 98,566,607	5%		$ 78,382,136			
	$ 81,151,532	7%					

Life cycle cost analysis - Newrybar Option

Estimated costs (2020 $)		Source	Total 80 years	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Initial acquistion costs (non-recurring)																							
Capital costs																							
	Scheme investigation costs (2%)	Jacobs (2020)	$ 730,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Design and documentation costs (7%)	Jacobs (2020)	$ 2,560,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Environmental approval costs (4%)	Jacobs (2020)	$ 1,460,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Project management costs (2.5%)	Jacobs (2020)	$ 915,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Land acquistion costs	Jacobs (2020)	$ 8,870,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Construction costs (asset renewal life)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bores (50 years)	Jacobs (2020)	$ 1,320,000																				
	Mechanical (25 years)	Jacobs (2020)	$ 9,250,000																				
	Electrical (25 years)	Jacobs (2020)	$ 5,910,000																				
	Civil including Pipelines (85 years)	Jacobs (2020)	$ 28,120,000																				
	Instrumentation Control Communications (15 yrs)	Jacobs (2020)	$ 2,560,000																				
Integration costs	Integration costs (4%)	Jacobs (2020)	$ 1,460,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Existing supply network modifications	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total initial capital costs		**$ 63,155,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals																							
	Repairs/unscheduled maintenance	Jacobs (2020)	$ 22,604,395	286,154	289,015	291,905	294,825	297,773	300,750	303,758	306,796	309,864	312,962	316,092	319,253	322,445	325,670	328,926	332,216	335,538	338,893	342,282	345,705
	Upgrades and refurbishments	Jacobs (2020)	$ 1,200,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-
	Spare parts and accessories	Jacobs (2020)	$ 4,750,000	61,000	62,000	63,000	64,000	65,000	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000
	Bores Renewals (50 years)	Jacobs (2020)	$ 1,320,000														1,320,000						
	Mechanical Renewals (25 years)	Jacobs (2020)	$ 18,500,000														9,250,000						
	Electrical Renewals (25 years)	Jacobs (2020)	$ 11,820,000														5,910,000						
	Civil including Pipelines Renewals (85 years)	Jacobs (2020)	$ -																				
	Instrumentation Control Communications (15 yrs)	Jacobs (2020)	$ 10,240,000									2,560,000											
	Other repair costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RO membranes (10 years)	Jacobs (2020)	$ 7,000,000					1,000,000										1,000,000					
	Major filter renewals	Jacobs, 2020	$ 2,100,000		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-
	Total renewal costs		**$ 79,534,395**	$ 347,154	$ 351,015	$ 654,905	$ 358,825	$ 1,362,773	$ 466,750	$ 370,758	$ 374,796	$ 2,938,864	$ 382,962	$ 387,092	$ 491,253	$ 695,445	$ 16,879,670	$ 1,403,926	$ 408,216	$ 412,538	$ 516,893	$ 421,282	$ 425,705
Total acquisition costs			**$ 142,689,395**	$ 347,154	$ 351,015	$ 654,905	$ 358,825	$ 1,362,773	$ 466,750	$ 370,758	$ 374,796	$ 2,938,864	$ 382,962	$ 387,092	$ 491,253	$ 695,445	$ 16,879,670	$ 1,403,926	$ 408,216	$ 412,538	$ 516,893	$ 421,282	$ 425,705
Total leasing costs			**$ -**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ongoing Operating and Maintenance (recurring)																							
Maintenance costs																							
	Scheduled/preventative maintenance	Jacobs (2020)	$ 17,920,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800
	Waste disposal	Jacobs (2020)	$ 1,064,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
	Other maintenance costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total maintenance costs		**$ 18,984,800**	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800
Operating costs																							
	Staffing costs - Borefield and Transfer	Jacobs (2020)	$ 9,120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
	Staffing costs - GWTP	Jacobs (2020)	$ 9,880,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
	Utilities - Borefield and Transfer	Jacobs (2020)	$ 13,132,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800
	Utilities - GWTP	Jacobs (2020)	$ 52,531,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200
	Chemical Supplies and consumables	Jacobs (2020)	$ 21,888,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000
	Training	Jacobs (2020)	$ 114,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
	WQ monitoring	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Licences	Jacobs (2020)	$ 1,900,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
	Other operating costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Support Costs	Jacobs (2020)	$ 4,750,000	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
	Total operating costs		**$ 113,316,000**	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000
Total operating and maintenance costs			**$ 132,300,800**	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800
Total Costs			**$ 274,990,195**	**$ 2,087,954**	**$ 2,091,815**	**$ 2,395,705**	**$ 2,099,625**	**$ 3,103,573**	**$ 2,207,550**	**$ 2,111,558**	**$ 2,115,596**	**$ 4,679,664**	**$ 2,123,762**	**$ 2,127,892**	**$ 2,232,053**	**$ 2,436,245**	**$ 18,620,470**	**$ 3,144,726**	**$ 2,149,016**	**$ 2,153,338**	**$ 2,257,693**	**$ 2,162,082**	**$ 2,166,505**

Estimated costs (2020 $)		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Initial acquistion costs (non-recurring)																					
Capital costs																					
	Scheme investigation costs (2%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Design and documentation costs (7%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Environmental approval costs (4%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Project management costs (2.5%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Land acquistion costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Bores (50 years)																				
	Mechanical (25 years)																				
	Electrical (25 years)																				
	Civil including Pipelines (85 years)																				
	Instrumentation Control Communications (15 yrs)																				
Integration costs	Integration costs (4%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Existing supply network modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Existing facility modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Renewals																					
	Repairs/unscheduled maintenance	349,162	352,654	356,180	359,742	363,339	366,973	370,642	374,349	378,092	381,873	385,692	389,549	393,444	397,379	401,353	405,366	409,420	413,514	417,649	421,826
	Upgrades and refurbishments	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-
	Spare parts and accessories	81,000	82,000	83,000	84,000	85,000	86,000	87,000	88,000	89,000	90,000	91,000	92,000	93,000	94,000	95,000	96,000	97,000	98,000	99,000	100,000
	Bores Renewals (50 years)																				
	Mechanical Renewals (25 years)																				
	Electrical Renewals (25 years)																				
	Civil including Pipelines Renewals (85 years)																				
	Instrumentation Control Communications (15 yrs)				2,560,000																
	Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	RO membranes (10 years)					1,000,000										1,000,000					
	Major filter renewals		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	
	Total renewal costs	$ 430,162	$ 434,654	$ 739,180	$ 3,103,742	$ 1,448,339	$ 452,973	$ 457,642	$ 462,349	$ 467,092	$ 571,873	$ 476,692	$ 481,549	$ 786,444	$ 491,379	$ 1,496,353	$ 601,366	$ 506,420	$ 511,514	$ 516,649	$ 521,826
Total acquisition costs		$ 430,162	$ 434,654	$ 739,180	$ 3,103,742	$ 1,448,339	$ 452,973	$ 457,642	$ 462,349	$ 467,092	$ 571,873	$ 476,692	$ 481,549	$ 786,444	$ 491,379	$ 1,496,353	$ 601,366	$ 506,420	$ 511,514	$ 516,649	$ 521,826
Total leasing costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Ongoing Operating and Maintenance (recurring)																					
Maintenance costs																					
	Scheduled/preventative maintenance	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800	235,800
	Waste disposal	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
	Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Total maintenance costs	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800	$ 249,800
Operating costs																					
	Staffing costs - Borefield and Transfer	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
	Staffing costs - GWTP	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000	130,000
	Utilities - Borefield and Transfer	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800	172,800
	Utilities - GWTP	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200	691,200
	Chemical Supplies and consumables	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000	288,000
	Training	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
	WQ monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Licences	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
	Other operating costs (specify)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Support Costs	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
	Total operating costs	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000	$ 1,491,000
Total operating and maintenance costs		$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800	$ 1,740,800
Total Costs		**$ 2,170,962**	**$ 2,175,454**	**$ 2,479,980**	**$ 4,844,542**	**$ 3,189,139**	**$ 2,193,773**	**$ 2,198,442**	**$ 2,203,149**	**$ 2,207,892**	**$ 2,312,673**	**$ 2,217,492**	**$ 2,222,349**	**$ 2,527,244**	**$ 2,232,179**	**$ 3,237,153**	**$ 2,342,166**	**$ 2,247,220**	**$ 2,252,314**	**$ 2,257,449**	**$ 2,262,626**

80 year whole-of-life cost	$ 274,990,195		40 year NPV
80 year NPV	$ 131,213,859	3%	
	$ 98,566,607	5%	
	$ 81,151,532	7%	

Life cycle cost analysis - Byron Desalination

Estimated costs (2020 $)	Source	Total 80 years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial acquistion costs (non-recurring)																						
Capital costs																						
Capital cost - SeaPak 2500	GANDEN, 2020	$ 54,000,000	47,000,000														7,000,000					
Integration costs		$ -																				
Existing supply network modifications		$ -																				
Existing facility modifications		$ -																				
Other capital costs (specify)		$ -																				
Total initial capital costs		**$ 54,000,000**	$ 47,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,000,000	$ -	$ -	$ -	$ -	$ -
Renewals																						
Replacement UF Modules (6 years)	GANDEN, 2020	$ 23,760,000							990,000						990,000						1,980,000	
Replacement RO modules (5 years)	GANDEN, 2020	$ 13,034,547						465,520					465,520					931,039				
Total renewal costs		**$ 36,794,547**	$ -	$ -	$ -	$ -	$ -	$ 465,520	$ 990,000	$ -	$ -	$ -	$ 465,520	$ -	$ 990,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Total acquisition costs		**$ 90,794,547**	$ 47,000,000	$ -	$ -	$ -	$ -	$ 465,520	$ 990,000	$ -	$ -	$ -	$ 465,520	$ -	$ 990,000	$ -	$ 7,000,000	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Ongoing operating and maintenance (recurring)																						
Maintenance costs																						
Membrane replacement	Noted in renewal costs	$ -																				
Labour (maintenance & management)	GANDEN, 2020	$ 15,405,000		195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	GANDEN, 2020	$ 1,015,000		100,000	75,000	50,000	25,000	25,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	GANDEN, 2020	$ 2,765,000		35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	GANDEN, 2020	$ 1,580,000		20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs		**$ 20,765,000**	$ -	$ 350,000	$ 325,000	$ 300,000	$ 275,000	$ 275,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Operating costs																						
Electricity	GANDEN, 2020	$ 84,096,000		584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	584,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000
Chemical consumption	GANDEN, 2020	$ 68,640		480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	960	960	960	960
Consumables	GANDEN, 2020	$ 14,300		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	200	200	200	200
Labour (operation)	GANDEN, 2020	$ 18,960,000		240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs		**$ 103,138,940**	$ -	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 1,408,580	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160
Total operating and maintenance costs		**$ 123,903,940**	$ -	$ 1,174,580	$ 1,149,580	$ 1,124,580	$ 1,099,580	$ 1,099,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,084,580	$ 1,668,580	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160
Total Costs		**$ 214,698,487**	**$ 47,000,000**	**$ 1,174,580**	**$ 1,149,580**	**$ 1,124,580**	**$ 1,099,580**	**$ 1,565,100**	**$ 2,074,580**	**$ 1,084,580**	**$ 1,084,580**	**$ 1,084,580**	**$ 1,550,100**	**$ 1,084,580**	**$ 2,074,580**	**$ 1,084,580**	**$ 8,084,580**	**$ 2,599,619**	**$ 1,669,160**	**$ 1,669,160**	**$ 3,649,160**	**$ 1,669,160**

Estimated costs (2020 $)	Source	Total 80 years	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Total initial capital costs		**$ 54,000,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)	GANDEN, 2020	$ 23,760,000					1,980,000						1,980,000						1,980,000			
Replacement RO modules (5 years)	GANDEN, 2020	$ 13,034,547	931,039					931,039					931,039					931,039				
Total renewal costs		**$ 36,794,547**	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -
Total acquisition costs		**$ 90,794,547**	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -
Labour (maintenance & management)	GANDEN, 2020	$ 15,405,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	GANDEN, 2020	$ 1,015,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	GANDEN, 2020	$ 2,765,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	GANDEN, 2020	$ 1,580,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs		**$ 20,765,000**	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	GANDEN, 2020	$ 84,096,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000
Chemical consumption	GANDEN, 2020	$ 68,640	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
Consumables	GANDEN, 2020	$ 14,300	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Labour (operation)	GANDEN, 2020	$ 18,960,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs		**$ 103,138,940**	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160
Total operating and maintenance costs		**$ 123,903,940**	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160
Total Costs		**$ 214,698,487**	**$ 2,600,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 3,649,160**	**$ 2,600,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 4,580,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 2,600,199**	**$ 3,649,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**

80 year whole-of-life cost	$ 214,698,487							
80 year NPV	$ 107,611,954	3%	40 year NPV	$ 91,485,683	2060 yield	1,550	ML/a
	$ 84,662,855	5%		$ 78,991,236	NPV/ML yield	$ 50,962	
	$ 73,093,725	7%		$ 70,975,548			

Life cycle cost analysis - Byron Desalination

Estimated costs (2020 $)	Source	Total 80 years	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Initial acquistion costs (non-recurring)																						
Capital costs																						
Capital cost - SeaPak 2500	GANDEN, 2020	$ 54,000,000																				
Integration costs		$ -																				
Existing supply network modifications		$ -																				
Existing facility modifications		$ -																				
Other capital costs (specify)		$ -																				
Total initial capital costs		**$ 54,000,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Renewals																						
Replacement UF Modules (6 years)	GANDEN, 2020	$ 23,760,000			1,980,000						1,980,000						1,980,000					
Replacement RO modules (5 years)	GANDEN, 2020	$ 13,034,547	931,039					931,039					931,039					931,039				
Total renewal costs		**$ 36,794,547**	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -
Total acquisition costs		**$ 90,794,547**	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -
Ongoing operating and maintenance (recurring)																						
Maintenance costs																						
Membrane replacement	Noted in renewal costs	$ -																				
Labour (maintenance & management)	GANDEN, 2020	$ 15,405,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	GANDEN, 2020	$ 1,015,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	GANDEN, 2020	$ 2,765,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	GANDEN, 2020	$ 1,580,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs		**$ 20,765,000**	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Operating costs																						
Electricity	GANDEN, 2020	$ 84,096,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000
Chemical consumption	GANDEN, 2020	$ 68,640	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
Consumables	GANDEN, 2020	$ 14,300	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Labour (operation)	GANDEN, 2020	$ 18,960,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs		**$ 103,138,940**	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160
Total operating and maintenance costs		**$ 123,903,940**	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160
Total Costs		**$ 214,698,487**	**$ 2,600,199**	**$ 1,669,160**	**$ 3,649,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 2,600,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 3,649,160**	**$ 1,669,160**	**$ 2,600,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 3,649,160**	**$ 2,600,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**

Estimated costs (2020 $)	Source	Total 80 years	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Total initial capital costs		**$ 54,000,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)	GANDEN, 2020	$ 23,760,000	1,980,000						1,980,000						1,980,000						1,980,000	
Replacement RO modules (5 years)	GANDEN, 2020	$ 13,034,547	931,039					931,039					931,039					931,039				
Total renewal costs		**$ 36,794,547**	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Total acquisition costs		**$ 90,794,547**	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Labour (maintenance & management)	GANDEN, 2020	$ 15,405,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	GANDEN, 2020	$ 1,015,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	GANDEN, 2020	$ 2,765,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	GANDEN, 2020	$ 1,580,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs		**$ 20,765,000**	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	GANDEN, 2020	$ 84,096,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000	1,168,000
Chemical consumption	GANDEN, 2020	$ 68,640	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
Consumables	GANDEN, 2020	$ 14,300	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Labour (operation)	GANDEN, 2020	$ 18,960,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs		**$ 103,138,940**	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160	$ 1,409,160
Total operating and maintenance costs		**$ 123,903,940**	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160	$ 1,669,160
Total Costs		**$ 214,698,487**	**$ 4,580,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 2,600,199**	**$ 3,649,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 2,600,199**	**$ 1,669,160**	**$ 3,649,160**	**$ 1,669,160**	**$ 1,669,160**	**$ 2,600,199**	**$ 1,669,160**	**$ 1,669,160**	**$ 3,649,160**	**$ 1,669,160**

80 year whole-of-life cost	$ 214,698,487		
80 year NPV	$ 107,611,954	3%	40 year NPV
	$ 84,662,855	5%	
	$ 73,093,725	7%	

NPV Analysis

Scenario 1: Groundwater

		Year available	ML/a Ultimate Proc	kWh/kL				
Stage 1	Marom Creek WTP	2025	1,570	0.91	CWT (2018)	177 kW	22 hrs/d	4300 kL/d
Stage 1	Alstonville groundwater	2025	1,280	0.52				
Stage 2	Woodburn groundwater	2029	1,600	1.21	groundwater + WTP as in Marom Creek			
Stage 3	Tyagarah groundwater Scheme 1	2032	2,048	1.61	Scheme 1, Stage 1 groundwater + WTP as in Marom Creek			
Stage 4	Tyagarah groundwater Scheme 2	2045	4,000	1.61	Same as Stage 1			
Stage 5	Newrybar groundwater	2058	2,304	2.21	groundwater + WTP as in Marom Creek			

	Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	Lifecycle expenditure	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Stage 1	Marom Creek WTP		915,875	915,875	3,663,502	3,663,500	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater		492,000	7,120,000	9,164,500	9,164,500	818,023	820,423	822,837	825,265	827,707	880,164	832,635	835,121	837,622	840,138	842,670	895,216	847,778	850,356	2,942,949	855,558
Stage 2	Woodburn groundwater							492,000	1,720,000	2,585,000	31,685,000	1,015,425	1,017,825	1,020,239	1,022,667	1,025,110	1,077,566	1,030,038	1,032,524	1,035,025	1,037,541	1,040,072
Stage 3	Tyagarah groundwater Scheme 1									590,000	2,055,000	9,885,000	37,250,000	1,301,970	1,304,970	1,307,990	1,311,030	1,314,091	1,367,172	1,320,274	1,323,397	1,626,541
Stage 4	Tyagarah groundwater Scheme 2																					
Stage 5	Newrybar groundwater																					
	Total Scheme		**1,407,875**	**8,035,875**	**12,828,002**	**12,828,000**	**1,784,385**	**2,278,785**	**3,509,199**	**4,966,627**	**35,534,069**	**12,746,951**	**40,066,822**	**4,123,692**	**4,131,622**	**4,139,600**	**4,197,628**	**4,205,707**	**4,213,836**	**4,172,017**	**6,270,249**	**4,488,534**

	Year	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	Lifecycle expenditure	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	858,184	910,825	863,483	866,158	868,849	871,557	874,283	927,025	12,739,785	882,563	885,358	888,172	891,003	3,033,853	896,721	899,608	902,514	905,439	908,383	961,347
Stage 2	Woodburn groundwater	1,092,619	1,045,181	1,047,758	3,140,351	1,052,961	1,055,586	1,108,228	1,060,886	1,063,560	1,066,252	1,068,960	1,071,685	1,124,428	12,937,188	1,079,965	1,082,761	1,085,574	1,088,406	3,231,256	1,094,124
Stage 3	Tyagarah groundwater Scheme 1	1,329,707	1,332,894	1,386,104	1,339,335																
Stage 4	Tyagarah groundwater Scheme 2	315,000	1,115,000	2,135,000	25,206,250	1,898,415	1,901,915	1,905,440	1,908,990	1,912,566	1,966,168	1,919,795	1,923,449	2,227,129	1,930,836	1,934,571	1,988,332	1,942,121	1,945,938	6,570,784	2,009,657
Stage 5	Newrybar groundwater														730,000	2,560,000	12,705,000	47,160,000	1,965,800	1,968,800	1,971,820
	Total Scheme	**4,561,871**	**5,370,262**	**6,398,707**	**31,518,456**	**4,786,587**	**4,795,420**	**4,854,312**	**4,863,263**	**16,682,274**	**4,881,344**	**4,840,475**	**4,849,668**	**5,208,922**	**18,868,239**	**7,437,619**	**17,642,063**	**52,056,572**	**6,871,945**	**13,645,584**	**7,003,310**

80 year whole-of-life cost	**836,397,007**									
80 year NPV	306,176,008	3%		40 year NPV	228,911,776		Yield benefit	4,170	ML	2020-2060
	195,922,792	5%			**169,299,256**		NPV/ML yield	40,597	$/ML	
	141,351,422	7%			131,624,542					

			2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Energy use	Marom Creek WTP	kWh/kL					0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		kL					1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	kWh/kL					0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		kL					1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	kWh/kL										1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		kL										1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	kWh/kL												1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL												2,048	2,048	2,048	2,048	2,048	2,048	2,048	2,048	2,048
	Tyagarah groundwater Scheme 2	kWh/kL																				
		kL																				
	Newrybar groundwater	kWh/kL																				
		kL																				
	Total Scheme						**2,087**	**2,087**	**2,087**	**2,087**	**2,087**	**4,016**	**4,016**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**

			2041	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**
Energy use	Marom Creek WTP	kWh/kL	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		kL	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	kWh/kL	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		kL	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	kWh/kL	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		kL	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	kWh/kL	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL	2,048	2,048	2,048	2,048																
	Tyagarah groundwater Scheme 2	kWh/kL					1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL					4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater	kWh/kL																			2.21	2.21
		kL																			2,304	2,304
	Total Scheme		**7,304**	**7,304**	**7,304**	**7,304**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**15,533**	**15,533**

80 year NPV	279,388	3%
	154,104	5%
	96,281	7%

NPV Analysis

Scenario 1: Groundwater

		Year available
Stage 1	Marom Creek WTP	2025
Stage 1	Alstonville groundwater	2025
Stage 2	Woodburn groundwater	2029
Stage 3	Tyagarah groundwater Scheme 1	2032
Stage 4	Tyagarah groundwater Scheme 2	2045
Stage 5	Newrybar groundwater	2058

	Year	**0**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	Lifecycle expenditure	**2020**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**
Stage 1	Marom Creek WTP		966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater		914,330	917,333	920,356	923,400	926,463	979,548	932,653	935,779	3,028,927	942,096	945,287	998,499	951,734	13,804,991	958,271	961,573	964,899	1,018,248	971,620	975,016
Stage 2	Woodburn groundwater		1,097,011	1,099,917	1,102,842	1,105,786	1,158,749	1,111,733	1,114,736	1,117,759	1,120,802	1,123,866	1,176,950	1,130,056	1,133,182	3,226,329	1,139,499	1,142,689	1,195,902	1,149,137	14,497,394	1,155,673
Stage 3	Tyagarah groundwater Scheme 1																					
Stage 4	Tyagarah groundwater Scheme 2		2,266,560	3,321,491	2,416,162	2,120,152	2,124,173	2,128,223	2,132,304	2,236,416	27,265,559	2,144,733	2,148,939	2,153,177	2,457,448	6,866,751	2,166,087	2,170,457	2,219,860	2,179,298	2,183,769	2,288,276
Stage 5	Newrybar groundwater		1,974,860	1,977,921	2,081,002	1,984,104	1,987,227	2,290,371	1,993,537	2,996,724	2,099,934	2,003,165	2,006,419	4,569,695	2,012,994	2,016,316	2,119,661	2,323,029	2,026,422	3,029,838	2,033,278	2,036,743
	Total Scheme		**7,219,123**	**8,283,024**	**7,486,724**	**7,099,804**	**7,162,974**	**7,476,237**	**7,139,592**	**8,253,040**	**34,481,583**	**7,180,222**	**7,243,957**	**9,817,789**	**7,521,720**	**26,880,749**	**7,349,880**	**7,564,111**	**7,373,445**	**8,342,882**	**20,652,423**	**7,422,070**

	Year	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	Lifecycle expenditure	**2081**	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**	**2088**	**2089**	**2090**	**2091**	**2092**	**2093**	**2094**	**2095**	**2096**	**2097**	**2098**	**2099**	**2100**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	978,436	981,880	985,349	3,128,842	992,360	995,903	999,472	1,003,067	1,006,687	1,060,334	1,014,007	1,017,707	1,021,434	1,025,188	1,028,969	1,082,779	1,036,616	1,040,482	14,994,377	1,048,300
Stage 2	Woodburn groundwater	1,158,976	1,162,301	1,215,650	1,169,022	1,172,418	1,175,838	1,179,283	1,182,751	3,326,244	1,189,763	1,193,306	1,196,875	1,200,469	1,204,090	1,257,736	1,211,409	1,215,109	1,218,836	1,222,590	1,226,372
Stage 3	Tyagarah groundwater Scheme 1																				
Stage 4	Tyagarah groundwater Scheme 2	2,192,817	2,197,394	2,502,007	2,206,656	2,211,341	2,316,063	2,900,822	2,225,619	6,835,454	2,235,328	2,240,240	2,390,191	2,550,182	28,565,212	2,260,283	2,265,395	2,270,547	2,375,741	2,280,978	2,286,256
Stage 5	Newrybar groundwater	2,140,233	17,203,747	2,047,286	2,050,851	2,054,442	2,358,058	4,721,701	3,065,370	2,069,065	2,072,788	2,076,538	2,080,315	2,184,121	2,087,954	2,091,815	2,395,705	2,099,625	3,103,573	2,207,550	2,111,558
	Total Scheme	**7,436,824**	**22,511,685**	**7,716,654**	**9,521,733**	**7,396,923**	**7,812,225**	**10,767,640**	**8,443,169**	**14,203,813**	**7,524,574**	**7,490,453**	**7,651,450**	**7,922,567**	**33,848,805**	**7,605,166**	**7,921,650**	**7,588,259**	**8,704,995**	**21,671,857**	**7,638,848**

80 year whole-of-life cost	**836,397,007**	
80 year NPV	306,176,008	3%
	195,922,792	5%
	141,351,422	7%

			2061	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**
Energy use	Marom Creek WTP	kWh/kL	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		kL	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	kWh/kL	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		kL	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	kWh/kL	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		kL	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	kWh/kL	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL																				
	Tyagarah groundwater Scheme 2	kWh/kL	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater	kWh/kL	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
		kL	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304
	Total Scheme		**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**

			2081	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**	**2088**	**2089**	**2090**	**2091**	**2092**	**2093**	**2094**	**2095**	**2096**	**2097**	**2098**	**2099**	**2100**
Energy use	Marom Creek WTP	kWh/kL	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		kL	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	kWh/kL	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		kL	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	kWh/kL	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		kL	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	kWh/kL	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL																				
	Tyagarah groundwater Scheme 2	kWh/kL	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		kL	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater	kWh/kL	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
		kL	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304	2,304
	Total Scheme		**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**	**15,533**

80 year NPV	279,388	3%
	154,104	5%
	96,281	7%

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
NPV Analysis																						
Scenario 2a: Dunoon Dam (20GL)			ML/a																			
		Year available	Production	kWh/kL	Energy use kWh p.a.																	
Stage 1	Marom Creek WTP	2025	1,570	0.91	1,421						inflation 2014-2019		1.09									
Stage 1	Alstonville groundwater	2025	1,280	0.52	666						inflation 2019-2020		1.015									
Stage 2a	20 GL Dunoon Dam	2029		1.60									1.106									
	Nightcap WTP upgrade	2034		1.60		Assume increase in energy usage as for Marom Creek WTP, increase production as for DD																
	Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	Lifecycle expenditure	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Stage 1	Marom Creek WTP		915,875	915,875	3,663,502	3,663,500	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater		492,000	7,120,000	9,164,500	9,164,500	818,023	820,423	822,837	825,265	827,707	880,164	832,635	835,121	837,622	840,138	842,670	895,216	847,778	850,356	2,942,949	855,558
Stage 2a	20 GL Dunoon Dam							55,384,835	66,406,340	66,406,340	291,448	291,448	331,448	340,697	389,945	439,191	488,436	577,680	662,394	711,636	760,876	810,116
2034 capital+1.5%p.a. recurrent	Nightcap WTP upgrade													9,691,073	9,691,073	290,732	290,732	290,732	290,732	290,732	290,732	290,732
	Total Scheme		**1,407,875**	**8,035,875**	**12,828,002**	**12,828,000**	**1,784,385**	**57,171,620**	**68,195,539**	**68,197,967**	**2,085,518**	**2,137,974**	**2,130,446**	**11,833,253**	**11,885,002**	**2,536,424**	**2,588,200**	**2,729,990**	**2,767,266**	**2,819,085**	**4,960,919**	**2,922,768**
80 year whole-of-life cost	**619,141,183**																					
80 year NPV	315,021,565	3%		40 year NPV	272,573,181		Yield benefit	5,370	ML	2020-2060												
	242,778,718	5%			**228,151,363**		NPV/ML yield	42,484	$/ML													
	201,127,184	7%			195,786,082																	
Energy use	Marom Creek WTP	kWh/kL					0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		kL					1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	kWh/kL					0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		kL					1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	20 GL Dunoon Dam	kWh/kL									1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	(from RCC supply data)	kL									278	278	278	278	278	575	873	1,171	1,468	1,766	2,063	2,361
	Nightcap WTP upgrade	kWh/kL														1.6	1.6	1.6	1.6	1.6	1.6	1.6
		kL														575	575	575	575	575	575	575
	Total Scheme						**666**	**666**	**666**	**666**	**1,110**	**1,110**	**1,110**	**1,110**	**1,110**	**2,507**	**2,983**	**3,459**	**3,936**	**4,412**	**4,888**	**5,364**
80 year NPV	256,243	3%																				
	127,091	5%																				
	70,647	7%																				

		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	Year	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	Lifecycle expenditure	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	858,184	910,825	863,483	866,158	868,849	871,557	874,283	927,025	12,739,785	882,563	885,358	888,172	891,003	3,033,853	896,721	899,608	902,514	905,439	908,383	961,347
Stage 2a	20 GL Dunoon Dam	1,460,316	906,972	956,209	1,005,444	1,054,678	2,994,966	1,186,835	1,236,066	1,285,295	1,334,524	1,423,751	1,434,597	1,483,822	1,533,046	1,582,269	14,761,294	1,654,886	1,704,106	1,753,325	1,802,543
2034 capital+1.5%p.a. recurrent	Nightcap WTP upgrade	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732
	Total Scheme	**3,575,594**	**3,074,892**	**3,076,786**	**3,128,696**	**3,180,621**	**5,123,618**	**3,318,212**	**3,420,185**	**15,282,175**	**3,474,181**	**3,566,204**	**3,579,863**	**3,631,919**	**5,823,993**	**3,736,085**	**16,917,996**	**3,814,494**	**3,866,639**	**3,918,802**	**4,020,984**
Energy use	Marom Creek WTP	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	20 GL Dunoon Dam	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	(from RCC supply data)	2,659	2,956	3,254	3,551	3,849	4,146	4,444	4,741	5,039	5,336	5,634	5,931	6,229	6,526	6,824	7,121	7,419	7,716	8,014	8,311
	Nightcap WTP upgrade	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
		575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575
	Total Scheme	**5,840**	**6,316**	**6,792**	**7,268**	**7,744**	**8,220**	**8,696**	**9,172**	**9,648**	**10,124**	**10,600**	**11,076**	**11,552**	**12,028**	**12,504**	**12,980**	**13,456**	**13,932**	**14,408**	**14,884**

			41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
NPV Analysis																						
Scenario 2a: Dunoon Dam (20GL)																						
		Year available																				
Stage 1	Marom Creek WTP	2025																				
Stage 1	Alstonville groundwater	2025																				
Stage 2a	20 GL Dunoon Dam	2029																				
	Nightcap WTP upgrade	2034																				
	Year	**0**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	Lifecycle expenditure	**2020**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**
Stage 1	Marom Creek WTP		966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater		914,330	917,333	920,356	923,400	926,463	979,548	932,653	935,779	3,028,927	942,096	945,287	998,499	951,734	13,804,991	958,271	961,573	964,899	1,018,248	971,620	975,016
Stage 2a	20 GL Dunoon Dam		1,891,760	1,900,976	1,950,191	1,999,405	2,048,618	6,371,368	2,111,500	2,103,586	2,095,709	2,087,867	2,683,470	2,069,445	2,062,932	2,055,230	2,047,563	16,042,609	2,032,535	2,024,970	2,017,440	2,009,944
2034 capital+1.5%p.a. recurrent	Nightcap WTP upgrade		290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732
	Total Scheme		**4,063,184**	**4,075,403**	**4,127,641**	**4,179,898**	**4,232,175**	**8,608,010**	**4,301,247**	**4,296,460**	**6,381,730**	**4,287,057**	**4,885,851**	**4,325,039**	**4,271,761**	**17,117,316**	**4,262,928**	**18,261,277**	**4,254,528**	**4,300,312**	**4,246,154**	**4,242,054**
80 year whole-of-life cost	**619,141,183**																					
80 year NPV	315,021,565	3%																				
	242,778,718	5%																				
	201,127,184	7%																				
Energy use	Marom Creek WTP	kWh/kL	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		kL	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	kWh/kL	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		kL	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	20 GL Dunoon Dam	kWh/kL	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	(from RCC supply data)	kL	8,608	8,906	9,203	9,501	9,798	10,095	10,393	10,675	10,627	10,579	10,531	10,484	10,437	10,390	10,343	10,296	10,250	10,204	10,158	10,112
	Nightcap WTP upgrade	kWh/kL	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
		kL	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575
	Total Scheme		**15,360**	**15,836**	**16,312**	**16,787**	**17,263**	**17,739**	**18,215**	**18,666**	**18,589**	**18,512**	**18,436**	**18,360**	**18,285**	**18,210**	**18,135**	**18,061**	**17,986**	**17,913**	**17,839**	**17,766**
80 year NPV	256,243	3%																				
	127,091	5%																				
	70,647	7%																				

		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
	Year	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	Lifecycle expenditure	**2081**	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**	**2088**	**2089**	**2090**	**2091**	**2092**	**2093**	**2094**	**2095**	**2096**	**2097**	**2098**	**2099**	**2100**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	978,436	981,880	985,349	3,128,842	992,360	995,903	999,472	1,003,067	1,006,687	1,060,334	1,014,007	1,017,707	1,021,434	1,025,188	1,028,969	1,082,779	1,036,616	1,040,482	14,994,377	1,048,300
Stage 2a	20 GL Dunoon Dam	2,042,481	1,995,447	1,989,276	1,981,913	1,974,584	18,284,056	1,909,881	1,902,650	1,895,452	1,888,286	1,921,153	1,874,051	1,866,982	1,859,944	1,852,938	4,751,037	1,877,564	1,870,652	1,863,771	1,856,921
2034 capital+1.5%p.a. recurrent	Nightcap WTP upgrade	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732	290,732
	Total Scheme	**4,278,011**	**4,234,421**	**4,231,718**	**6,367,849**	**4,224,038**	**20,537,054**	**4,166,447**	**4,162,811**	**4,159,233**	**4,205,714**	**4,192,254**	**4,148,852**	**4,145,510**	**4,142,226**	**4,139,002**	**7,090,910**	**4,171,274**	**4,168,228**	**18,115,242**	**4,162,316**
Energy use	Marom Creek WTP	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
		1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570	1,570
	Alstonville groundwater	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	20 GL Dunoon Dam	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	(from RCC supply data)	10,067	10,021	9,976	9,931	9,887	9,842	9,798	9,754	9,710	9,666	9,623	9,580	9,536	9,494	9,451	9,408	9,366	9,324	9,282	9,240
	Nightcap WTP upgrade	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
		575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575	575
	Total Scheme	**17,693**	**17,621**	**17,549**	**17,477**	**17,405**	**17,334**	**17,263**	**17,193**	**17,122**	**17,052**	**16,983**	**16,914**	**16,845**	**16,776**	**16,708**	**16,640**	**16,572**	**16,504**	**16,437**	**16,370**

NPV Analysis

Scenario 2b: Dunoon Dam (50 GL)

		Year available	ML/a Production	kWh/kL	Energy use kWh p.a.
Stage 1	Marom Creek WTP	2025	1,570	incl in Alstonville	
Stage 1	Alstonville groundwater	2025	1,280	0.52	666
Stage 3	50 GL Dunoon Dam	2029			

	Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Lifecycle expenditure	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Stage 1	Marom Creek WTP		915,875	915,875	3,663,502	3,663,500	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater		492,000	7,120,000	9,164,500	9,164,500	818,023	820,423	822,837	825,265	827,707	880,164
Stage 3	50 GL Dunoon Dam							55,384,835	82,600,757	82,600,757	293,174	293,174
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade											
	Total Scheme		**1,407,875**	**8,035,875**	**12,828,002**	**12,828,000**	**1,784,385**	**57,171,620**	**84,389,955**	**84,392,384**	**2,087,244**	**2,139,700**

	Year	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	Lifecycle expenditure	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	832,635	835,121	837,622	840,138	842,670	895,216	847,778	850,356	2,942,949	855,558
Stage 3	50 GL Dunoon Dam	333,174	342,423	391,671	440,917	490,162	579,406	665,846	715,088	764,328	813,568
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade		9,691,073	9,691,073	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**2,132,172**	**11,834,979**	**11,886,728**	**2,635,060**	**2,686,837**	**2,828,627**	**2,867,629**	**2,919,448**	**5,061,282**	**3,023,131**

	Year	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
	Lifecycle expenditure	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	858,184	910,825	863,483	866,158	868,849	871,557	874,283	927,025	12,739,785	882,563
Stage 3	50 GL Dunoon Dam	1,463,768	910,424	959,661	1,008,896	1,058,130	2,998,418	1,191,037	1,240,268	1,289,497	1,338,726
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**3,675,957**	**3,175,254**	**3,177,149**	**3,229,058**	**3,280,984**	**5,223,981**	**3,419,325**	**3,521,298**	**15,383,288**	**3,575,294**

	Year	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	Lifecycle expenditure	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	885,358	888,172	891,003	3,033,853	896,721	899,608	902,514	905,439	908,383	961,347
Stage 3	50 GL Dunoon Dam	1,427,953	1,438,799	1,488,024	1,537,248	1,586,471	14,958,246	1,658,564	1,707,784	1,757,003	1,806,221
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**3,667,317**	**3,680,975**	**3,733,032**	**5,925,106**	**3,837,198**	**17,211,859**	**3,915,083**	**3,967,228**	**4,019,391**	**4,121,573**

80 year whole-of-life cost	**658,907,966**							
80 year NPV	343,939,167	3%	40 year NPV	300,668,234	Yield benefit	13,249	ML	2020-2060
	267,518,613	5%		**252,602,785**	NPV/ML yield	19,066	$/ML	
	222,665,849	7%		217,217,821				
Energy use	same as 2a							

NPV Analysis

Scenario 2b: Dunoon Dam (50 GL)

Stage 1	Marom Creek WTP
Stage 1	Alstonville groundwater
Stage 3	50 GL Dunoon Dam

	Year	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
	Lifecycle expenditure	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	914,330	917,333	920,356	923,400	926,463	979,548	932,653	935,779	3,028,927	942,096
Stage 3	50 GL Dunoon Dam	1,895,438	1,904,654	1,953,869	2,003,083	2,052,296	6,375,046	2,115,928	2,108,014	2,100,137	2,092,295
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**4,163,773**	**4,175,992**	**4,228,230**	**4,280,487**	**4,332,764**	**8,708,598**	**4,402,586**	**4,397,799**	**6,483,069**	**4,388,396**

	Year	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	Lifecycle expenditure	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	945,287	998,499	951,734	13,804,991	958,271	961,573	964,899	1,018,248	971,620	975,016
Stage 3	50 GL Dunoon Dam	2,687,898	2,073,873	2,067,360	2,059,658	2,051,991	16,510,066	2,036,999	2,029,434	2,021,904	2,014,408
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**4,987,189**	**4,426,377**	**4,373,099**	**17,218,654**	**4,364,267**	**18,825,645**	**4,355,903**	**4,401,687**	**4,347,529**	**4,343,429**

	Year	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
	Lifecycle expenditure	**2081**	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**	**2088**	**2089**	**2090**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	978,436	981,880	985,349	3,128,842	992,360	995,903	999,472	1,003,067	1,006,687	1,060,334
Stage 3	50 GL Dunoon Dam	2,046,945	1,999,911	1,993,740	1,986,377	1,979,048	18,247,810	1,913,562	1,906,331	1,899,133	1,891,967
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**4,379,386**	**4,335,796**	**4,333,093**	**6,469,224**	**4,325,413**	**20,597,718**	**4,267,039**	**4,263,403**	**4,259,825**	**4,306,306**

	Year	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	Lifecycle expenditure	**2091**	**2092**	**2093**	**2094**	**2095**	**2096**	**2097**	**2098**	**2099**	**2100**
Stage 1	Marom Creek WTP	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362	966,362
Stage 1	Alstonville groundwater	1,014,007	1,017,707	1,021,434	1,025,188	1,028,969	1,082,779	1,036,616	1,040,482	14,994,377	1,048,300
Stage 3	50 GL Dunoon Dam	1,924,834	1,877,732	1,870,663	1,863,625	1,856,619	4,754,718	1,881,815	1,874,903	1,868,022	1,861,172
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643	387,643
	Total Scheme	**4,292,845**	**4,249,444**	**4,246,101**	**4,242,818**	**4,239,593**	**7,191,502**	**4,272,436**	**4,269,390**	**18,216,404**	**4,263,478**

80 year whole-of-life cost	**658,907,966**
80 year NPV	343,939,167
	267,518,613
	222,665,849
Energy use	same as 2a

Appendix 2. MULTI-CRITERIA ANALYSIS

Criteria	Environmental Criteria			Environmental Score	Environmental Weighting	Social Criteria			Social Score	Social Weighting	Net present value ($ million)	Total Score per $NPV
	Aquatic	Terrestrial	Energy consumption			Typical residential bill	Water users	Heritage				
Description	Impact on groundwater and surface water quality and aquatic ecology and measures to offset those impacts.	Impact on terrestrial ecology and measures to offset those impacts.	80 year energy consumption (MWh)	Weighted criteria score	Weighting compared to social criteria	Impact on the typical residential bills for each Council from the revised notional cost.	Impact on other water users and measures to offset those impacts.	Impact on cultural heritage and measures to offset those impacts.	Weighted criteria score	Weighting compared to environmental criteria	NPV of capital and operating costs (80 years) at 5% discount rate	10^{3x}(Environmental Score + Social Score)/NPV
Criteria weighting	33%	33%	33%	100%	50%	33%	33%	33%	100%	50%		
Scenario 1: Groundwater												
Result	Some potential impacts on GDEs. Impacts can be minimised through site selection and monitoring	Impacts can be minimised through site selection	154,000	**3.00**		1.21	Impacts can be minimised through site selection and monitoring	Impacts can be minimised through site selection	**3.35**		196	**16.2**
Score	3	4.0	2.0			2.55	3.5	4.0				
Scenario 2A: Dunoon Dam (20 GL)												
Result	Significant impacts are partially offset by environmental flow regime	Significant impacts are partially offset by compensatory measures	127,000	**2.67**		1.30	Significant impacts are partially offset by environmental flow regime and extraction rules	Significant impacts are unlikely to be mitigated	**2.16**		243	**9.9**
Score	2.5	2.5	3.0			2.48	2.5	1.5				
Scenario 2B: Dunoon Dam (50 GL)												
Result	Significant impacts are partially offset by environmental flow regime	Significant impacts are partially offset by compensatory measures	127,000	**2.33**		1.30	Significant impacts are partially offset by environmental flow regime and extraction rules	Significant impacts are unlikely to be mitigated	**1.83**		268	**7.8**
Score	2.0	2.0	3.0			2.48	2.0	1.0				
Score out of 5	5 - highest											