Public Document Pack

ROUS COUNTY COUNCIL

Extraordinary Council meeting business paper

Wednesday, 21 July 2021

commencing 1.00 pm

Rous Administration Centre (L4), 218-232 Molesworth Street, Lismore

Note: This meeting will be recorded and those in attendance should refrain from making any defamatory comments. There are to be no other recordings of this meeting without the prior authorisation of Council.

Philip Rudd
General Manager

AGENDA

1. Opening of meeting

2. Acknowledgement of Country

3. Apologies and Leave of Absence

4. General Manager Reports

5. Close of business

Rous Regional Water Supply – revised draft Integrated Water Cycle Management Strategy adoption (Future Water Project 2060)

(D20/751)

Business activity priority	Strategy and planning
Goal 2	Align strategic direction to core functions and sustainability

RECOMMENDATION that Council:

1. Receive and note the public exhibition review document attached to this report entitled *'Future Water Plan 2060 Public Exhibition of revised Integrated Water Cycle Management Strategy outcomes June 2021'* prepared by Vaxa Group, in relation to the revised draft Integrated Water Cycle Management (IWCM) Strategy placed on public exhibition for 8 weeks from 1 April 2021 to 28 May 2021.

2. Note that copies of submissions received during the public exhibition period are available on the Rous County Council website.

3. Thank all persons and organisations that provided a submission to, or engaged in, the public exhibition and consultation process.

4. Adopt the revised draft Integrated IWCM Strategy attached to this report which, having regard to the results of the public exhibition process, has been amended to include the Dunoon dam proposal as a contingency option beyond Stage 2 of the IWCM.

5. (a) Receive and note the letter dated 30 June 2021 from NTSCorp regarding various matters associated with the Reconciliation Action Plan Advisory Group and the Dunoon dam project Aboriginal cultural heritage report.

   (b) Receive a further update from management on the matters outlined in the NTSCorp letter mentioned above at 5(a).

6. Approve the completion of detailed cultural heritage and biodiversity assessments associated with the proposed Dunoon dam in consultation with relevant Traditional Custodians including the Widjabul Wia-bal Native Title Claim Group.

7. Defer implementing the resolution associated with the proposed Dunoon dam, resolved by Council at its meeting of 16 December 2020 (resolution [61/20] Item 2), until after Stage 3 options have been determined.

8. Approve the transfer of $159,000 from the 'bulk water' reserve for the 2021/22 financial year for progress of the actions detailed in the 'Proposed changes to the revised draft Future Water Project (FWP) 2060' section of this report.

Purpose

To provide information and advice to Council to inform its decision on addressing water security risk as the bulk water supplier to the local government areas of Ballina, Byron, Lismore City and Richmond Valley.

Outcome

An IWCM Strategy adopted by Rous County Council's governing body that incorporates changes based on the results of the public exhibition of the revised draft FWP 2060 (Attachment A).

Background

The following snapshot is provided as context for this report.

What is an Integrated Water Cycle Management (IWCM) Strategy?

An IWCM Strategy is a local water utility's (LWU's) resourcing strategy for the provision of appropriate, affordable, cost-effective and sustainable urban water services that meet community needs and protect public health and the environment.

Rous County Council is a LWU.

This means Council is required to demonstrate best practice water supply management by implementing the NSW Government's *Best Practice Management of Water Supply and Sewerage Guidelines*.

One of the six 'best practice criteria' requires Council to have a current, complying IWCM Strategy. An IWCM Strategy is a framework designed to identify water supply management problems and then address those problems by determining appropriate responses that best meet social, environmental and economic objectives.

An IWCM Strategy also provides Council the means to obtain Ministerial approval under section 60 of the *Local Government Act 1993* to undertake certain water supply works.

What does an IWCM Strategy do?

An IWCM Strategy:

1. Sets the objectives, performance standards and associated performance indicators for the water and sewer business (Note: Rous does not provide sewer services. This means the 'sewer' requirements under the IWCM Strategy are not relevant).
2. Identifies the needs and issues based on evidence and sound analysis.
3. 'Right sizes' infrastructure.
4. Determines the investment priority in consultation with the community and stakeholders.
5. Identifies the 'best value 30-year' IWCM scenario on a triple bottom line (TBL) basis.

The key outcomes of an IWCM Strategy are:

1. 30-year total asset management plan.
2. 30-year financial plan.
3. Drought and emergency response contingency plan.

What is the problem the IWCM Strategy is trying to solve?

Regional water security – ensuring that there is enough water to meet the needs of the region.

The challenges:

- By 2024 demand for water is forecast to start exceeding what can be reliably supplied.
- By 2060 a 37% increase in water demand is forecast due to population growth.
- By 2060 the amount of water that the existing system can reliably supply is forecast to decline by almost 22% due to climate change.

The mission of the FWP 2060 is to address these challenges through a combination of ongoing water saving measures and new water sources.

What is the recent history of Rous' IWCM strategies?

Best practice requires that an IWCM Strategy be regularly reviewed to ensure currency with new information and changing conditions.

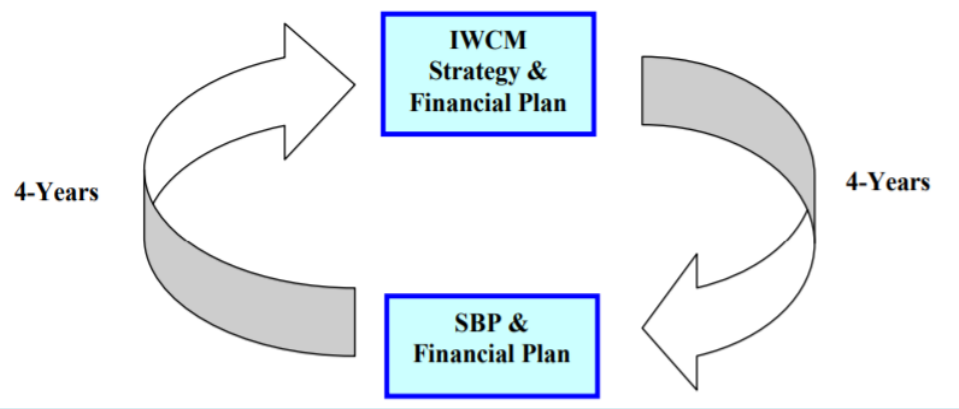
Council adopted an IWCM Strategy in 2014 ('2014 IWCM Strategy'). It was also known as the '*Future Water Strategy*'.

The 2014 IWCM Strategy provided for:

(a) The development of enhanced demand management options; and

(b) Investigations into new water source options.

The IWCM Strategy and Strategic Business Plan need to be prepared every 8 years on a rotation of every 4 years:



A review of the 2014 IWCM Strategy was completed and in 2020 the initial draft *Future Water Project 2060* ('initial draft FWP 2060') was developed.

What were the key points of the initial draft FWP 2060 in terms of new water sources?

There were two key points:

1. Groundwater: to secure the short-to-medium-term water supply
2. Surface water: to secure the long-term water supply (Dunoon dam proposal).

What was the approach to community engagement on the initial draft FWP 2060?

The initial draft FWP 2060 was subject to an extended public exhibition period in the latter half of 2020. The original public exhibition period was 6 weeks, and that period was extended by a further 4 weeks.

In total the public exhibition period was 10 weeks (1 July 2020 to 9 September 2020).

The onset of COVID-19 during 2020 meant that some preferred methods of consultation were unable to be used. This was because of NSW Public Health order requirements including social distancing rules.

The results were reported to Council at its meeting on 16 December 2020 and it was decided not to proceed with further investigations into the Dunoon Dam [61/20]. This resulted in a revised IWCM Strategy being prepared ('revised draft FWP 2060') which excluded the Dunoon dam proposal.

Council, at its extraordinary meeting on 17 March 2021, approved the revised draft FWP 2060 for the purpose of an 8-week public exhibition period (1 April 2021 to 28 May 2021). Council also agreed to receive a report at an extraordinary meeting in July 2021 (including an overview of the feedback received during the public exhibition period and how that feedback has been considered) when it would consider the IWCM Strategy for adoption.

Adopting the revised draft FWP 2060 will allow Council to commence implementing the key works and other actions needed to secure the regional water supply.

It sets out a three-stage approach over the next 40 years:

Stage One 2021–2025 | Stage Two 2026–2029	**Aim:** Ensure the forecast increase in water demand can be met for at least the next 20 years.

What it looks like: Bringing new groundwater sources online as additional primary supplies.

Including:

- Revamping the Alstonville area's existing groundwater supply scheme; and
- Developing a new groundwater scheme in the Tyagarah area.

In addition, new bores will be constructed and connected as part of the Woodburn area's existing groundwater supply. This will provide a greater level of resilience in the event of a drought emergency.

Stage One and **Stage Two** also prioritises the continued implementation of more innovative water conservation measures to better manage demand and, thereby, give Council the time and opportunity to further investigate new, long-term water source options.

Stage One will particularly see investigations commence into how to overcome the barriers to using purified recycled water for drinking purposes – whether via indirect potable reuse or direct potable reuse.

This includes plans to build a pilot treatment plant and direct potable reuse scheme that can supply purified recycled water to the Perradenya Estate near Lismore.

Stage Three 2030–2060	**Aim:** Implement further new water sources to secure Council's regional water supply until 2060 and beyond.
What it looks like: 'Yet to be determined' - depends on the outcomes of **Stages One** and **Two**.	

The IWCM review process ensures Council is continually assessing the potential use of modern, developing water supply options such as purified recycled water, desalination and advanced demand management initiatives for meeting long-term demand.

Key points to inform decision on adoption of the revised draft FWP 2060

Outside of its two formal public exhibition periods in the past year, the FWP 2060 has continued to generate plenty of strong community and other interest.

In particular, a number of submissions were received both just prior to and following Council's meeting of 16 December 2020.

These submissions have been collated as part of the analysis of community feedback in relation to the revised draft FWP 2060.

A. Public exhibition – the results – recommended changes to the revised draft FWP 2060

The revised draft FWP 2060 was publicly exhibited for 8 weeks (1 April 2021 to 28 May 2021).

Aim

To inform the community of the revised draft FWP 2060 and seek initial feedback on Stage 3 options contained within the strategy. The overall engagement was based on an 'inform' and 'consult' approach (based on the IAP2 public participation spectrum) with a greater effort being placed into community events and information sessions (due to the relaxation of COVID19 restrictions, when compared to the previous exhibition period of the initial draft FWP 2060).

Method

- A dedicated project page on Council's website that hosted all project documentation.
- Community summary brochure
- Key documents and summaries (PDF for review and/or download)
- Responses to frequently asked questions categorised as: General, Groundwater, Other questions and the former Dunoon dam proposal.

Council promoted the opportunity to make comment through the public exhibition in various ways:

- **Advertisements within media** - information advertisement campaigns aired on two television stations with a total of 307 x 30 second advertisements being run. Estimated viewer reach was over 150,000.
- **Flyers** - approximately 33,000 information flyers were distributed in RCC constituent council rate notices and via direct mailout.
- **Print media** - three media releases, with associated media coverage.
- **Social media** - four social media posts on RCC's Facebook page, with 'shares' and content re-purposing by third parties.
- **Information events** - 16 community and industry information events were held (direct reach over 400).
- **Radio interviews** - separate interviews on two (2) local radio stations with the Chairperson or Council's General Manager.

Results

A summary of the public exhibition period's outcomes is provided below and were presented to Council at a workshop on 23 June 2021.

A total of 13,781 submissions were received through a variety of means, representing a 10-fold increase from the initial draft FWP 2060 public exhibition period.

The data that has been received during the public exhibition has been collated into three (3) distinct datasets:

- Online survey – with responses to set questions.
- Written submissions.
- Petition signatures.

Format of response	Submissions
RCC online survey	558
Written submissions (largely proforma driven)	1,856[#]
Petitions	11,317
Late (written submissions)	50

[#] *Denotes: Inclusion of 7 online general customer survey forms and the removal of 5 duplicate records.*

Online survey submissions

The online survey results indicated that there was not clear support for the groundwater options associated with the revised draft FWP 2060. However, there was unusually high support for desalination and potable re-use, at least compared to groundwater. This may be due in part to the community alarm surrounding groundwater extraction by the bottled water industry within the broader region.

The dataset indicated two distinct themes, being those that were supportive of potable re-use, were not supportive of the Dunoon dam proposal and to a much lesser extent groundwater. Conversely, those that were less supportive of groundwater and the Stage 3 options, showed a clear preference for the Dunoon dam proposal.

It is unclear whether this result is likely to be caused by 'push' factors (e.g. away from the Dunoon dam proposal), rather than 'pull' factors. The true level of overall community support for the Stage 3 options will not be known until further comprehensive investigations are completed.

Written submissions

Most written submissions were based on two distinctive pro-formas (accounting for approximately 90% of all written submissions), heavily focused on either support for or rejection of the Dunoon dam proposal. Again, there was no clear support for the groundwater options. Of the personalised written submissions received, the following table details the responses of organisations in the region.

Table 1 - Submissions from organisations 'for' and 'against' the revised draft FWP 2060

Responses 'for'	Responses 'against' [1]
1. Ballina Environment Society [2] 2. Byron Environment Centre [2] 3. Friends of the Koala Inc. [2] 4. Institute for Sustainable Futures [2] 5. Lismore City Council [2] 6. Lismore Greens [2] 7. Member for Ballina [2] 8. Tuntable Creek Landcare 9. Water Services Association of Australia	1. Casino Food Co-Op 2. Richmond Valley Council [2] 3. Save Alstonville Aquifer

[1] *denotes: A range of small businesses also submitted against the revised draft FWP 2060.*
[2] *denotes: submissions received from these organisations in the previous public exhibition initial draft FWP 2060*

Of these new submissions there was more support for the revised draft FWP 2060.

Petition signatures

Of the 11,317 signatures received in the petition datasets, 10,208 respondents expressed clear support for the Dunoon dam proposal over all other options. This large petition was primarily focused on Council's decision at its meeting on 16 December 2020, after the first public exhibition of the initial draft FWP 2060. The remaining submitters expressed support for groundwater, provided it in no way impacted agricultural users.

General observations

Based on Council's website, analytical data showed relatively high traffic during the public exhibition phase with access peaks likely coinciding with RCC promotion, media uptake and community activism. There was lower than expected downloads of technical documentation. However, this is not uncommon and there can be two likely scenarios:

- Respondents felt they were informed sufficiently based on the information they had available. (e.g. revised draft FWP 2060 - webpage, flyer, and/or brochure) or;
- Respondents provided their views based on information gathered from other sources that supported their own views on the revised draft FWP 2060. (Regional media outlets, community groups and social media)

Analysis of the submitter's origin indicated that the clear majority (approx. 83%) could be confirmed as being received from the LGA's of Rous' constituent councils. In several instances submitters either chose not to provide those details (e.g. approx.10% of written submissions) or origin data was not able to be determined (e.g. approx. 4.4% of petition signatures), which accounts for approximately 6% of all submissions.

There was differing levels of contribution from the four (4) constituent council areas across the various formats/channels. Overall, submission rates from the Byron Shire LGA were low for all three datasets, despite over 11,000 flyers being delivered to its residents and community drop-in sessions being held locally. The low participation is at odds with what is considered to be a well-informed and locally active community, especially given the revised draft FWP 2060 is proposing both short and long-term actions within this shire. A stronger community response is expected, once Council commences the implementation of those actions.

Attachment B provides the full report on the public exhibition periods outcomes prepared by an external consultant.

Proposed changes to the revised draft FWP 2060 based on feedback from public exhibition

Council received petitions with 10,208 signatures calling for the Dunoon dam proposal to be reconsidered. This along with written and online surveys, represents the highest response to any one project or issue that Council has received. After the public exhibition period, Council received a letter from the NTSCorp limited, who is acting on behalf of the Widjabul Wia-bal Native Title claim group (Attachment C).

The letter requests that no decision in relation to the Dunoon dam proposal, including disposal of the land by Council, should proceed without proper consultation with the group. The group has also requested that RCC commission a qualified archaeologist to prepare an Aboriginal Cultural Heritage assessment for the proposal area and commit to meaningful consultation with the group.

The letter also raised several objections with Council's previous decisions, processes and actions, or lack thereof since the commissioning of the preliminary cultural heritage assessment in 2010. The group reaffirms that the site remains of cultural and spiritual importance, as it contains numerous Aboriginal sites, including burial sites, with the ongoing protection of these sites being of the utmost importance.

It is recommended that Council commit to these works in full consultation with the group and other stakeholders.

Along with cultural heritage, biodiversity impacts of the Dunoon dam proposal are a key consideration for that project. It is recommended that biodiversity investigations should also be undertaken. These investigations would consider the project impacts along with defining vegetation classifications and conditions, for both impacted and non-impacted areas.

These works would be based on the current assessment approaches and methodologies. The assessment will have a dual purpose of assessing future stewardship improvement options for areas that have been identified as high conservation value.

B. Risks

Delaying the adoption of an IWCM Strategy and regional water security risk

Without a current adopted IWCM Strategy, Council lacks a confirmed strategic direction for managing regional water security risk.

The report (D20/7051) to Council's meeting of 16 December 2020 advised that the timely adoption of an updated IWCM Strategy was imperative.

That position has not changed.

This is especially due to the time that has elapsed since the *Future Water Strategy* (2014 IWCM Strategy) was adopted and the forecast increased demand on the regional water supply from changing climate conditions and population growth.

Other risks from delaying the adoption of an updated IWCM Strategy:

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

<u>Revised</u> draft FWP 2060 and Greenhouse Gas Abatement Strategy

At its meeting of 20 June 2018, Council adopted its first Greenhouse Gas Abatement Strategy as part of a commitment to minimise carbon emissions and electricity costs [48/18].

Given the already substantial energy demands of operating the region's existing water supply system, the strategy especially set an ambitious goal for the take-up of renewable energy based on Council's emissions sources at the time.

It is important Council is aware that the adoption of the revised draft FWP 2060 is expected to have significant implications for the Greenhouse Gas Abatement Strategy.

In particular, there are considerable energy demands involved with accessing, transporting and treating groundwater, wastewater and seawater for drinking purposes.

As a result, the addition of groundwater sources – and potentially purified recycled water or desalination – to the regional water supply will substantially increase Council's electrical energy needs.

Should Council adopt the revised draft FWP 2060, a review of the Greenhouse Gas Abatement Strategy's carbon emissions and renewable energy targets will need to be undertaken.

Governance

- **Finance**

Rous' Long Term Financial Plan (LTFP) aims to provide adequate financial resources to implement its strategic plans and subsequently operate its assets in the delivery of services to our regional customer base. For example - bulk water sources, treatment and distribution.

At the April and June 2021 meetings, Council considered and then adopted its Delivery program | Operational plan including the 2021/22 budget allocations.

The April report provided a 'caveat' that the LTFP includes significant assumptions in respect to future capital works which are currently 'proposals' that continue to be actively investigated.

The recommendation in this report seeks a total allocation of $315,000 for the 2021/22 budget to progress items discussed in the *Proposed changes to the revised draft* FWP 2060 section of this report. The adopted budget 2021/22 contains $531,000 related to Dunoon Dam land matters over the next three financial years. It is proposed that the identified 2022/23 budget amount ($159,000) be reallocated into the current financial year ($156,000) should Recommendation 8 be adopted.

- **Legal**

NTSCorp letter dated 30 June 2021 – status of assessment of allegation of breach

NTSCorp, acting for and on behalf of the Widjabul Wia-bul Native Title Claim Group, has alleged that Rous has breached requirements under the *National Parks and Wildlife Act 1974.* An internal review is underway and an update on the matter will be provided in due course.

Conclusion

An updated IWCM Strategy is required to effectively confront several critical water security challenges facing Council's regional water supply.

Following Council's decision at its 16 December 2020 meeting [61/20] not to proceed with further investigations into the Dunoon dam as part of an updated IWCM Strategy, the revised draft FWP 2060 was prepared.

The revised draft FWP 2060 sets out a three-stage IWCM Strategy that focuses on additional groundwater sources being gradually brought online as primary supplies over the next decade.

It also prioritises the implementation of more innovative water conservation measures and investigation of purified recycled water for drinking purposes.

The revised draft FWP 2060 was publicly exhibited for eight weeks from 1 April 2021 to 28 May 2021. Following that process and having regard to the feedback provided, it is recommended that Council adopt the revised draft FWP 2060 attached to this report incorporating changes informed by the public exhibition process, specifically, re-inclusion of the proposed Dunoon dam as a contingency option beyond Stage 2 of the IWCM.

Phillip Rudd
General Manager

Attachments

A. Rous Regional Supply: Future Water Project 2060 – revised draft FWP 2060 IWCM *(pp. 12-161)*

B. Future Water Plan 2060 public exhibition of revised Integrated Water Cycle Management Strategy outcomes June 2021 (VAXA) *(pp. 162-211)*

C. Letter dated 30 June 2021 from NTSCorp to the General Manager *(pp. 212-214)*

Attachment A

Hydrosphere Consulting

FutureWater PROJECT 2060

SECURING WATER SUPPLY FOR OUR REGION

Rous Regional Supply:

Future Water Project 2060

Integrated Water Cycle Management Strategy

Final Draft for public exhibition

March 2021

Disclaimer:

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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.

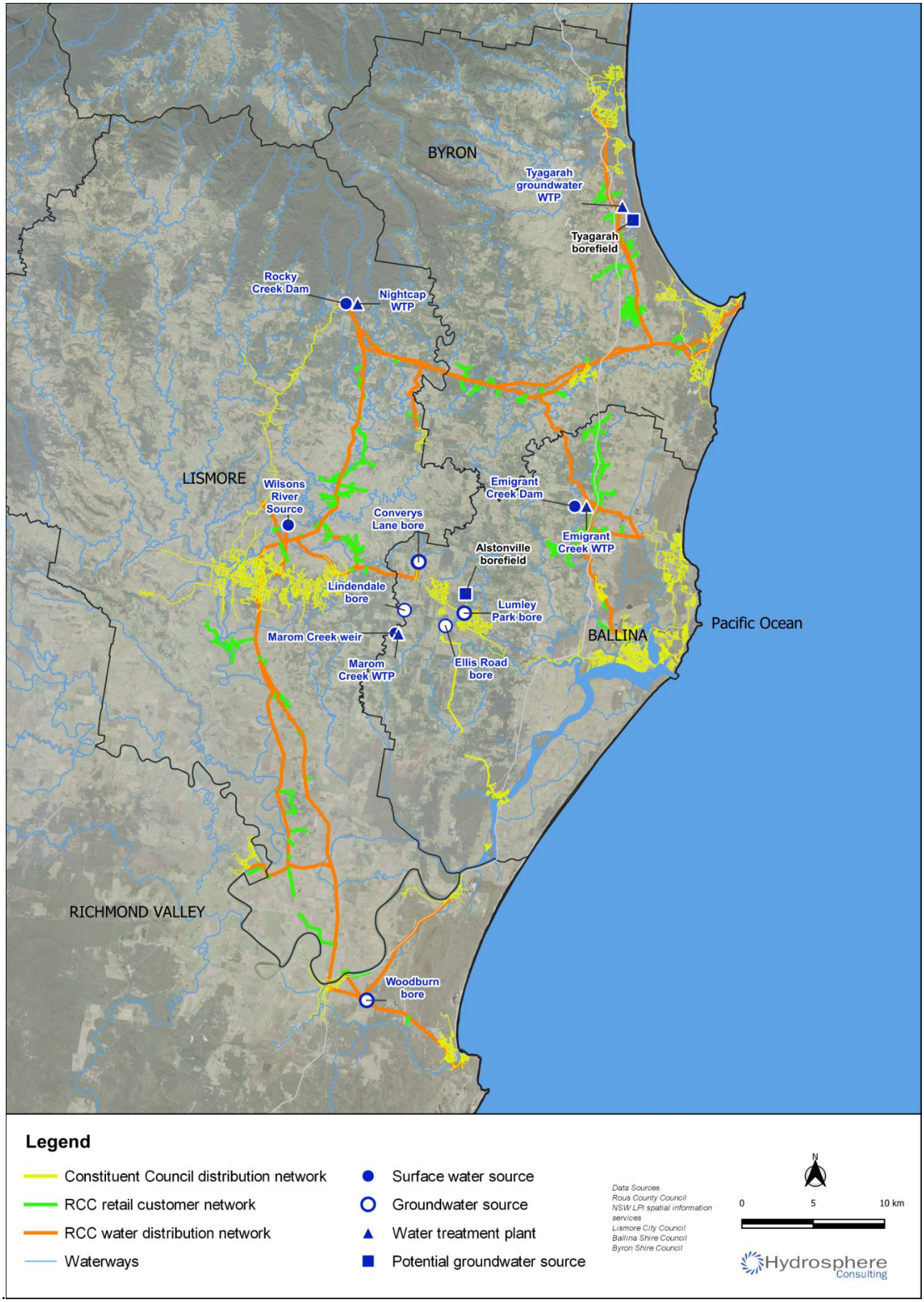

Figure 1: Preferred scenario: Marom Creek, Stage 1 and 2 groundwater

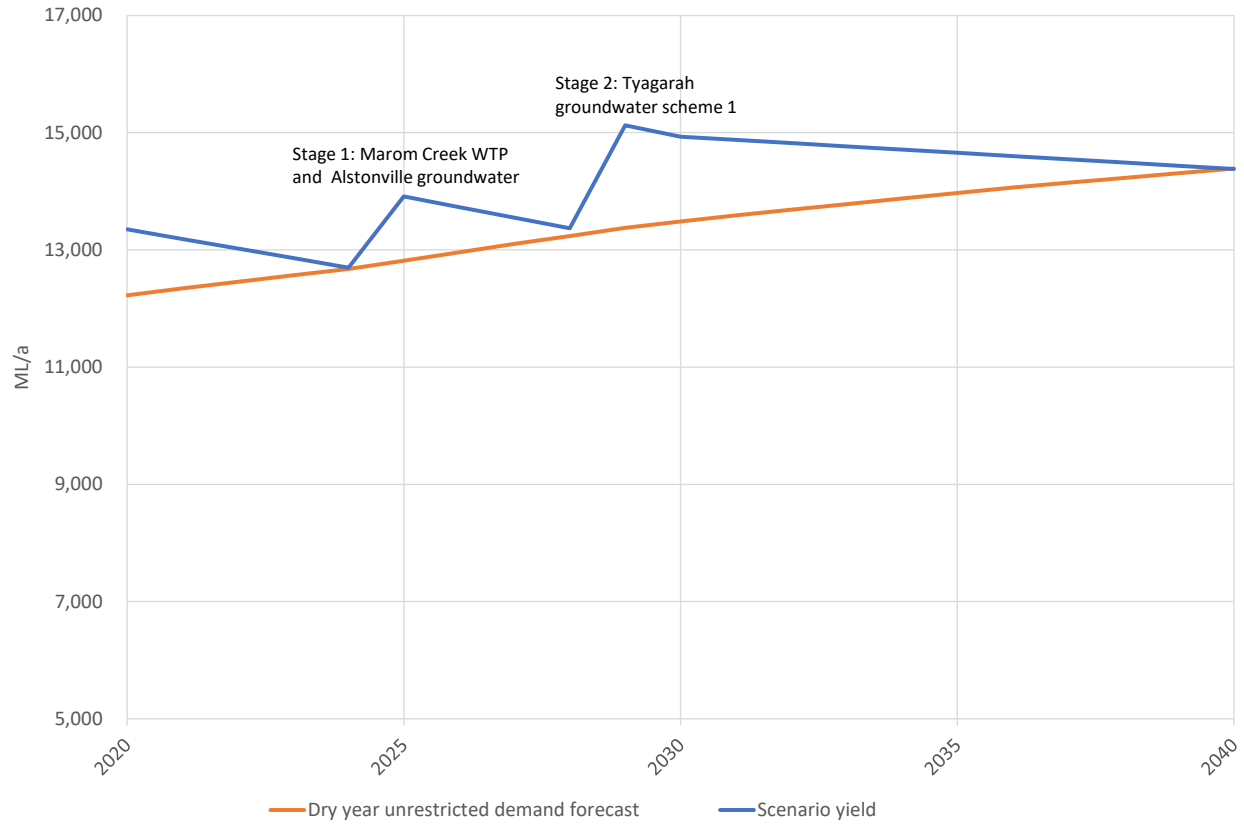

Figure 2: Preferred scenario: staging and secure yield

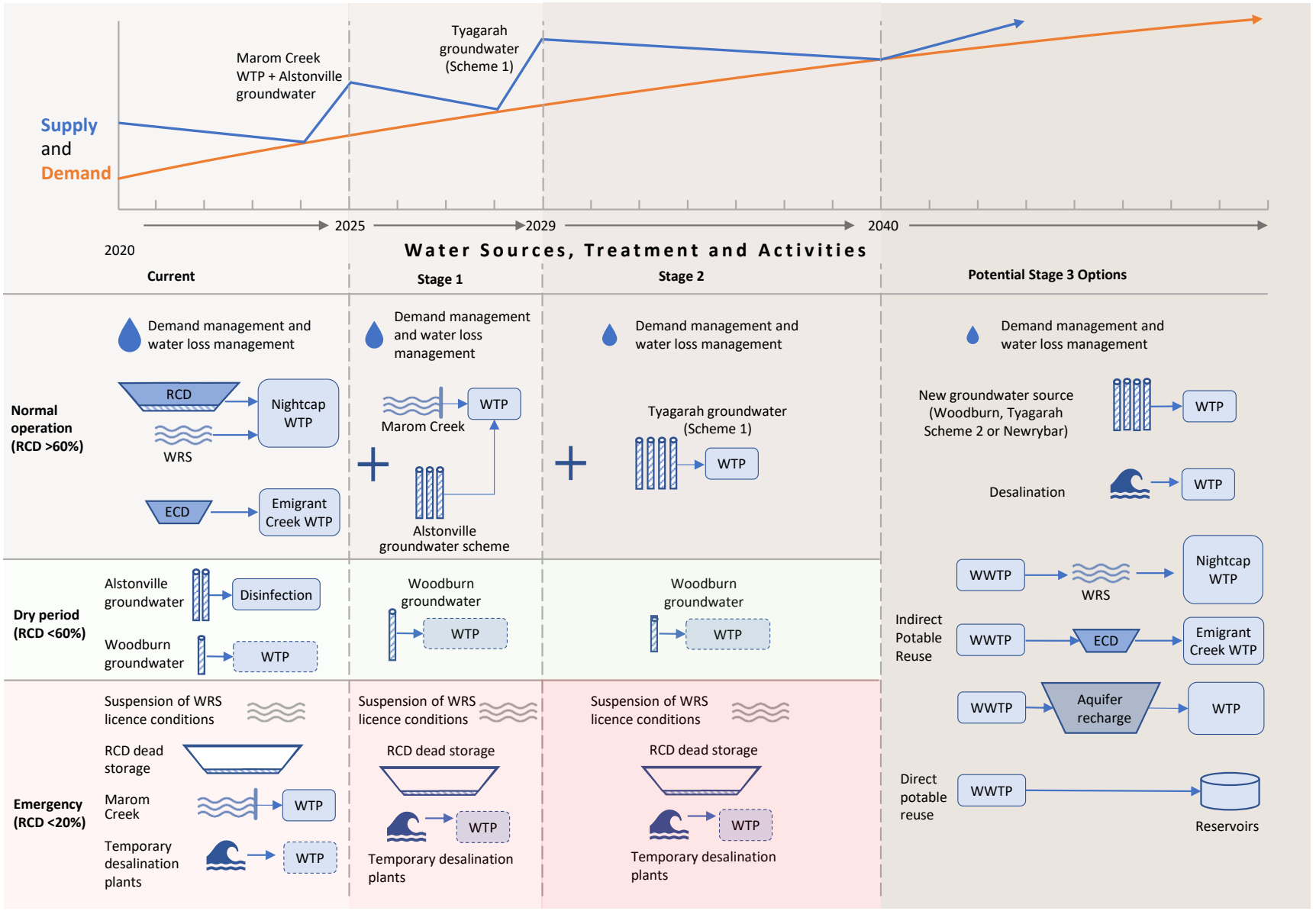

Figure 3: Staging of water source augmentation

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

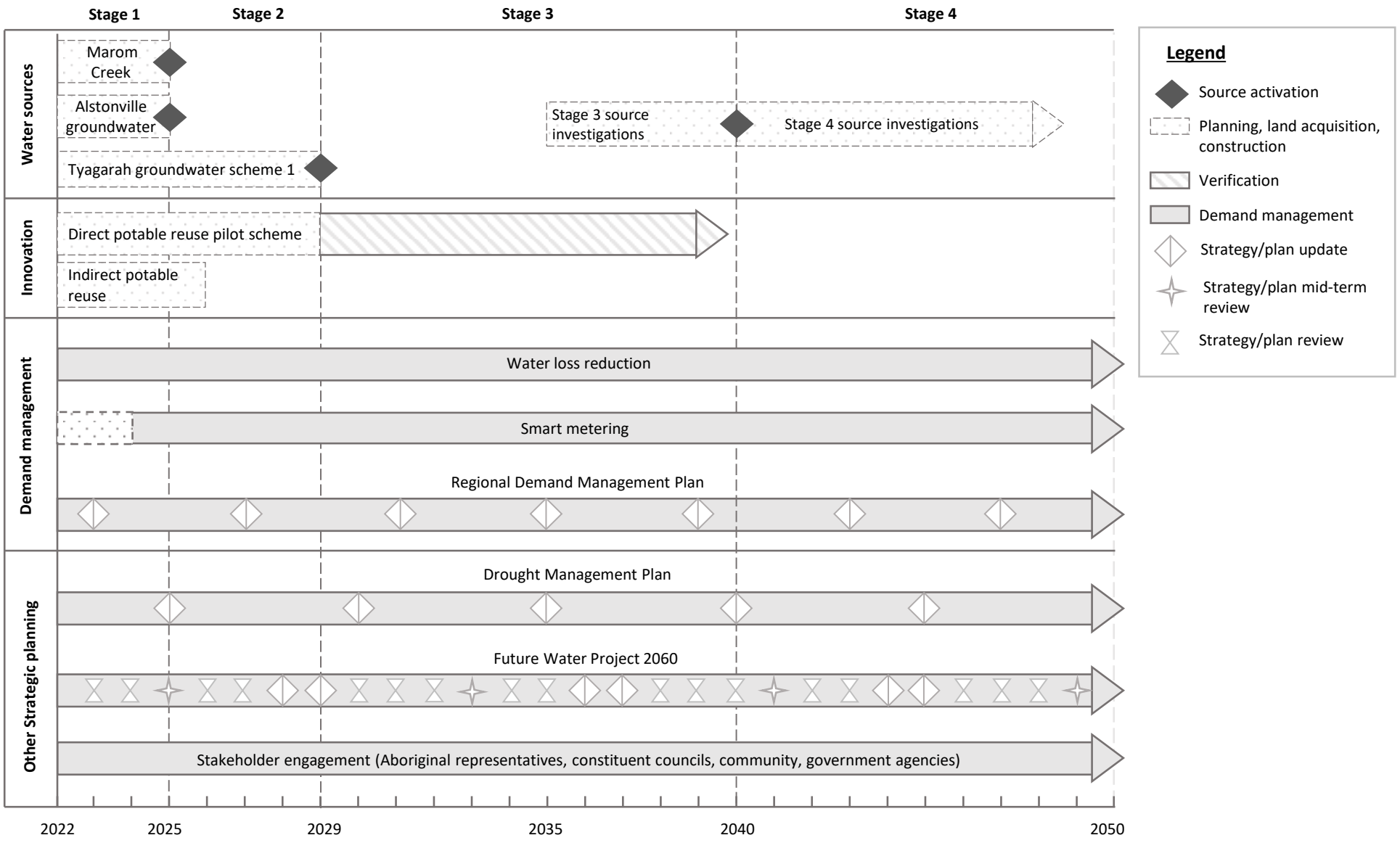

Figure 4: Future Water Project implementation planning

CONTENTS

FIGURES

TABLES

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.

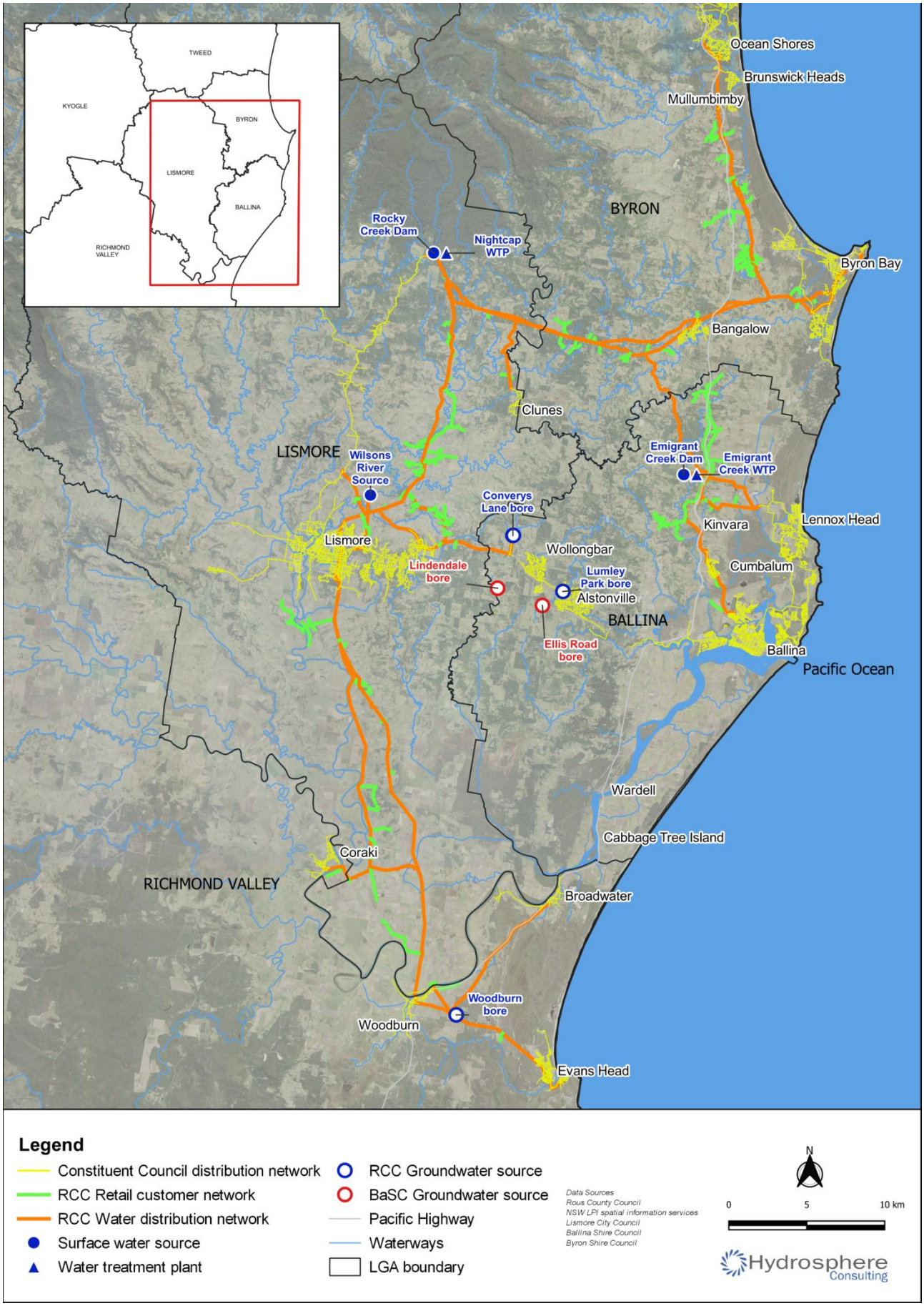

Figure 5: Regional bulk supply network

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%		Start WRS and ECD
60%	Dry period operation	Start Woodburn bore 3, Lumley Park and Converys Lane bores
30%		Start BaSC's plateau bores (Lindendale and Ellis Road)
20%	Emergency operation	Start emergency supply source
15%		
10%		

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.

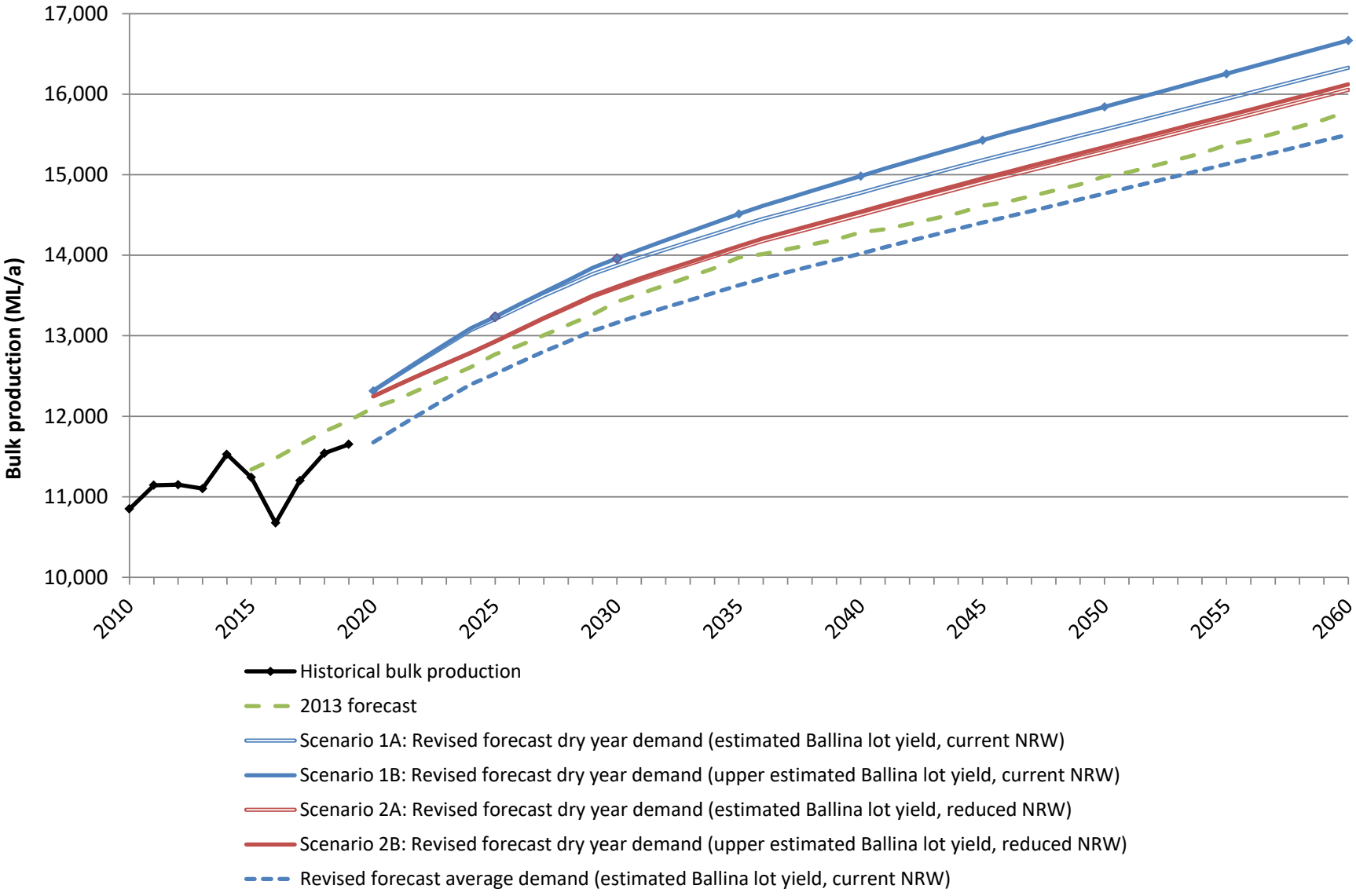

Figure 6: Forecast demand (bulk production) scenarios and comparison with the 2013 forecast – Rous bulk supply area

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.

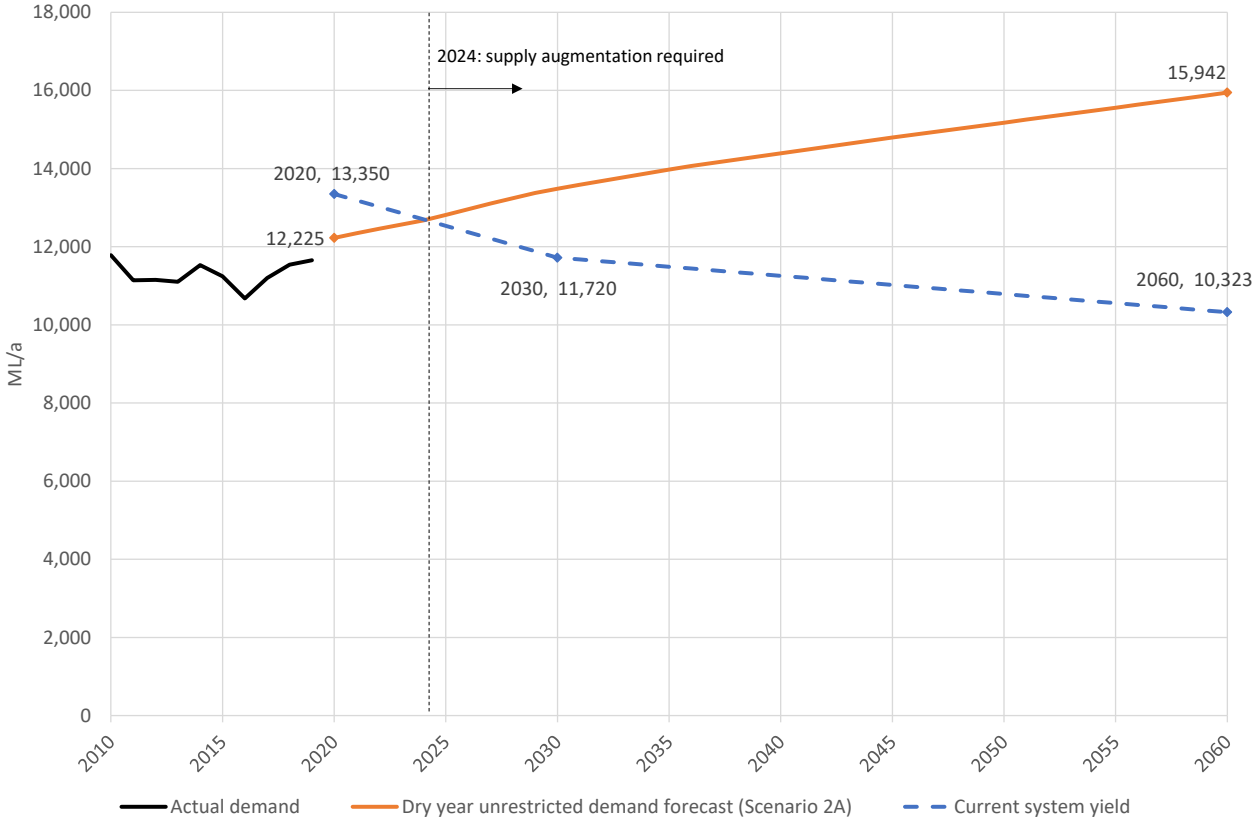

Figure 7: Comparison of existing system secure yield and demand forecast

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.

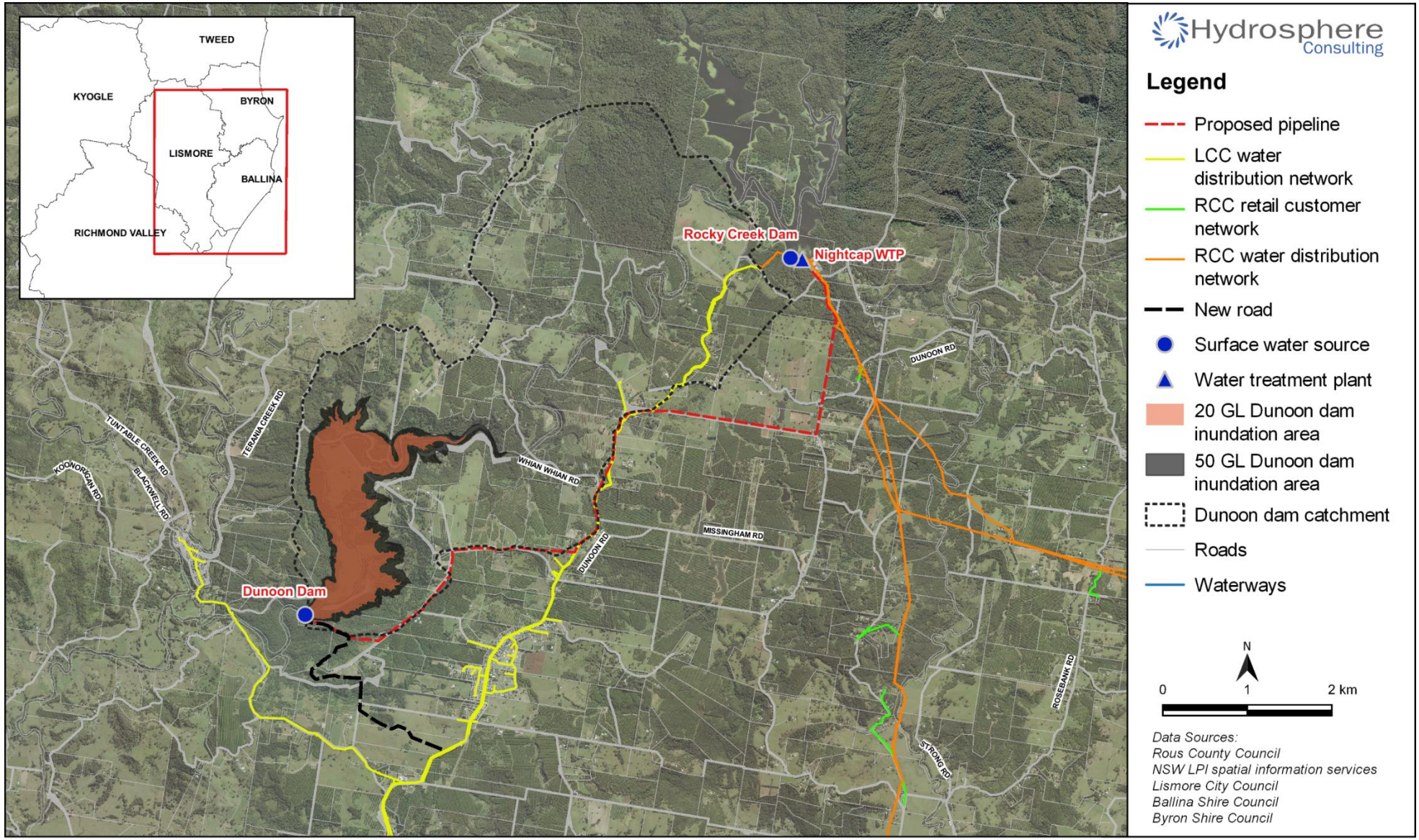

Figure 8: Dam location and inundation area for 20 GL and 50 GL storage options

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.

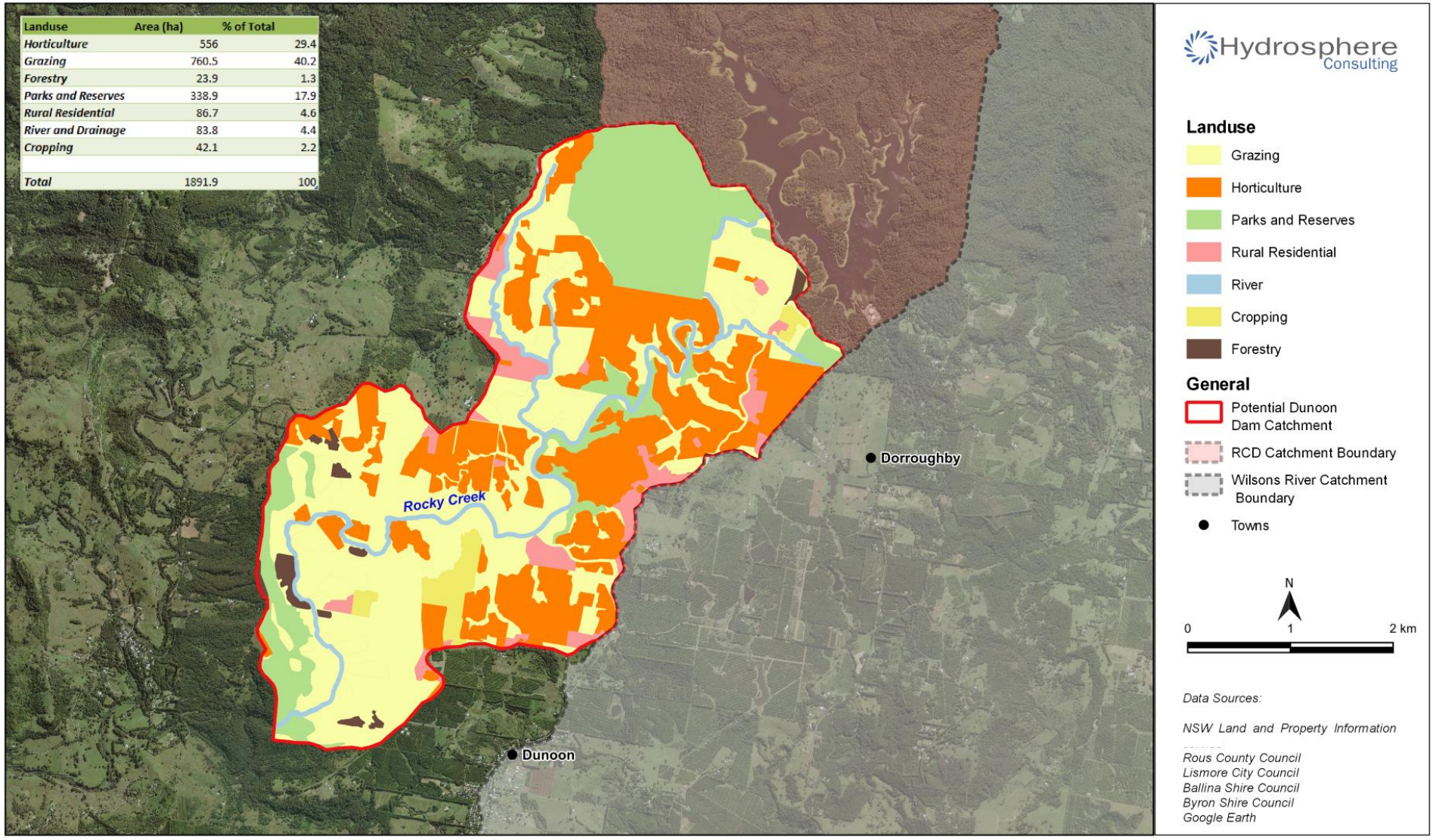

Figure 9: Dunoon dam catchment and existing land use

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.

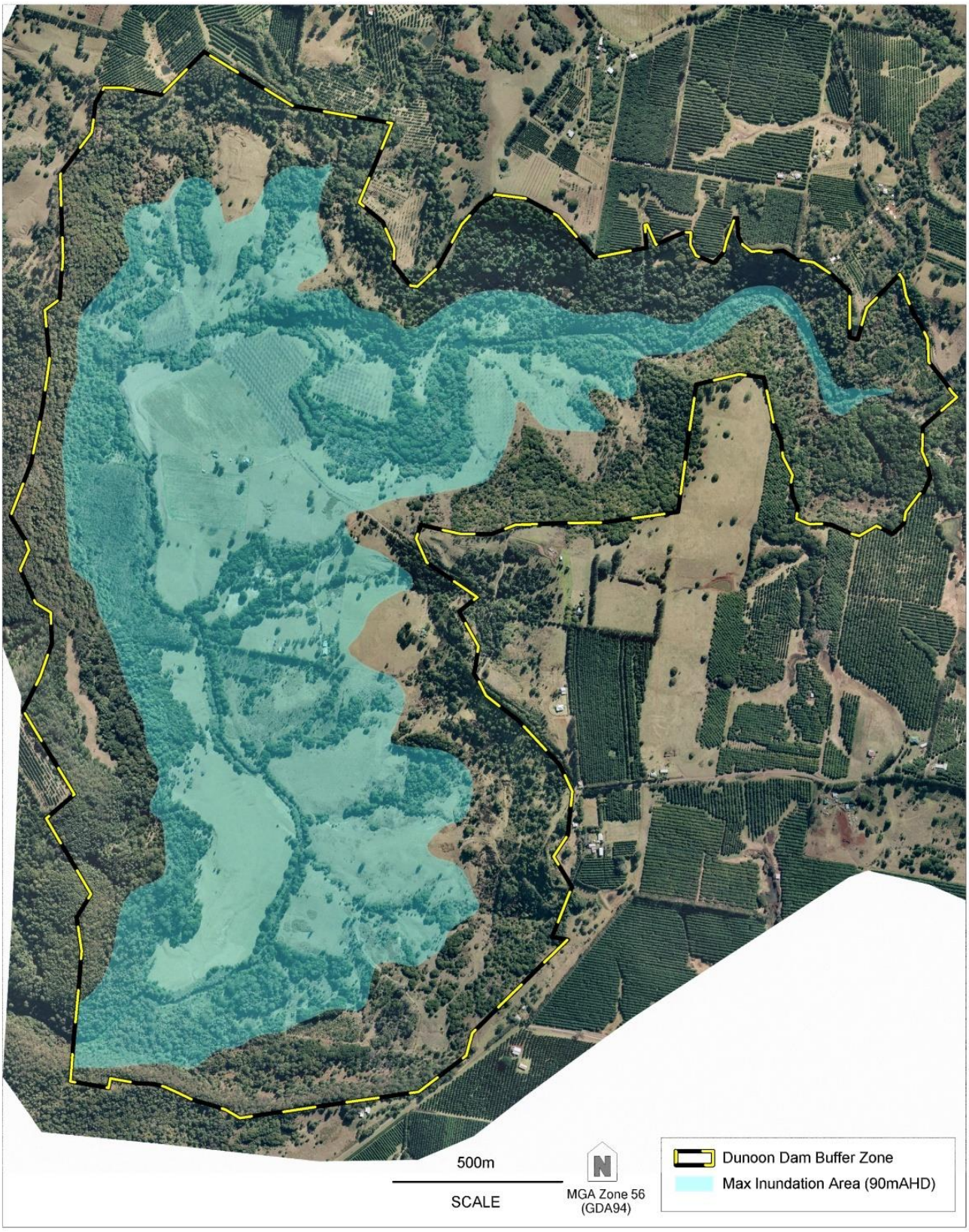

Figure 10: Proposed Dunoon dam (50 GL) buffer zone

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).

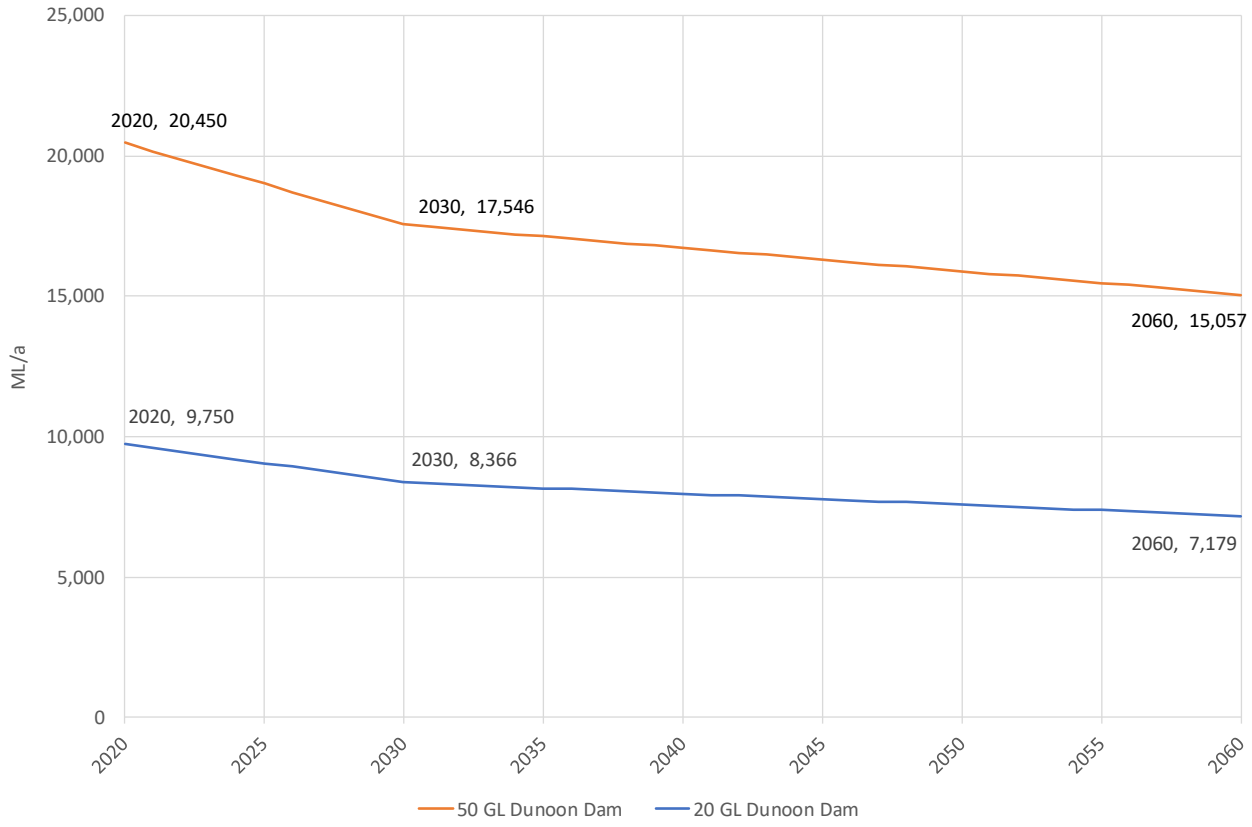

Figure 11: Secure yield estimates – Dunoon dam options

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).

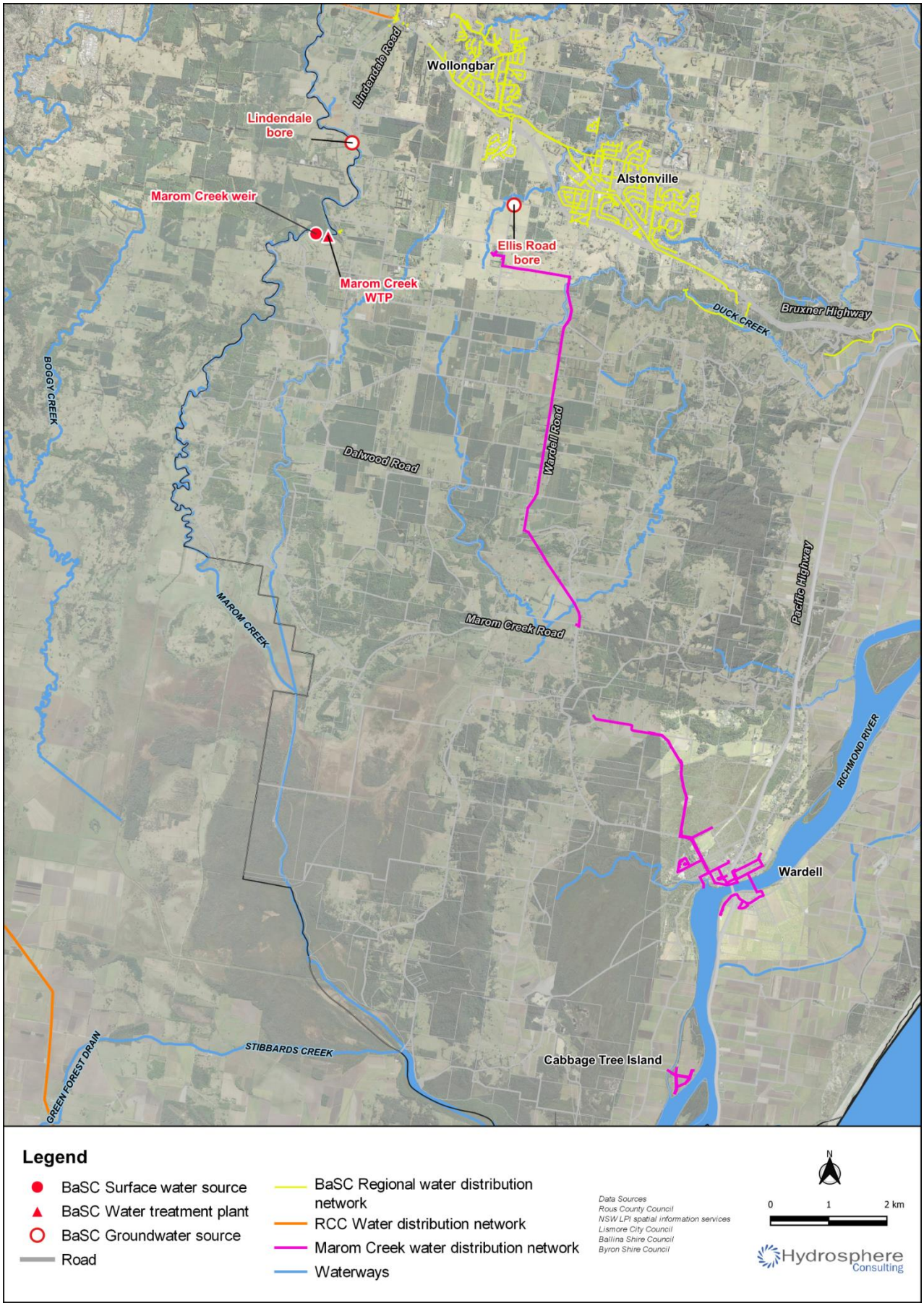

Figure 12: Marom Creek water supply

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.

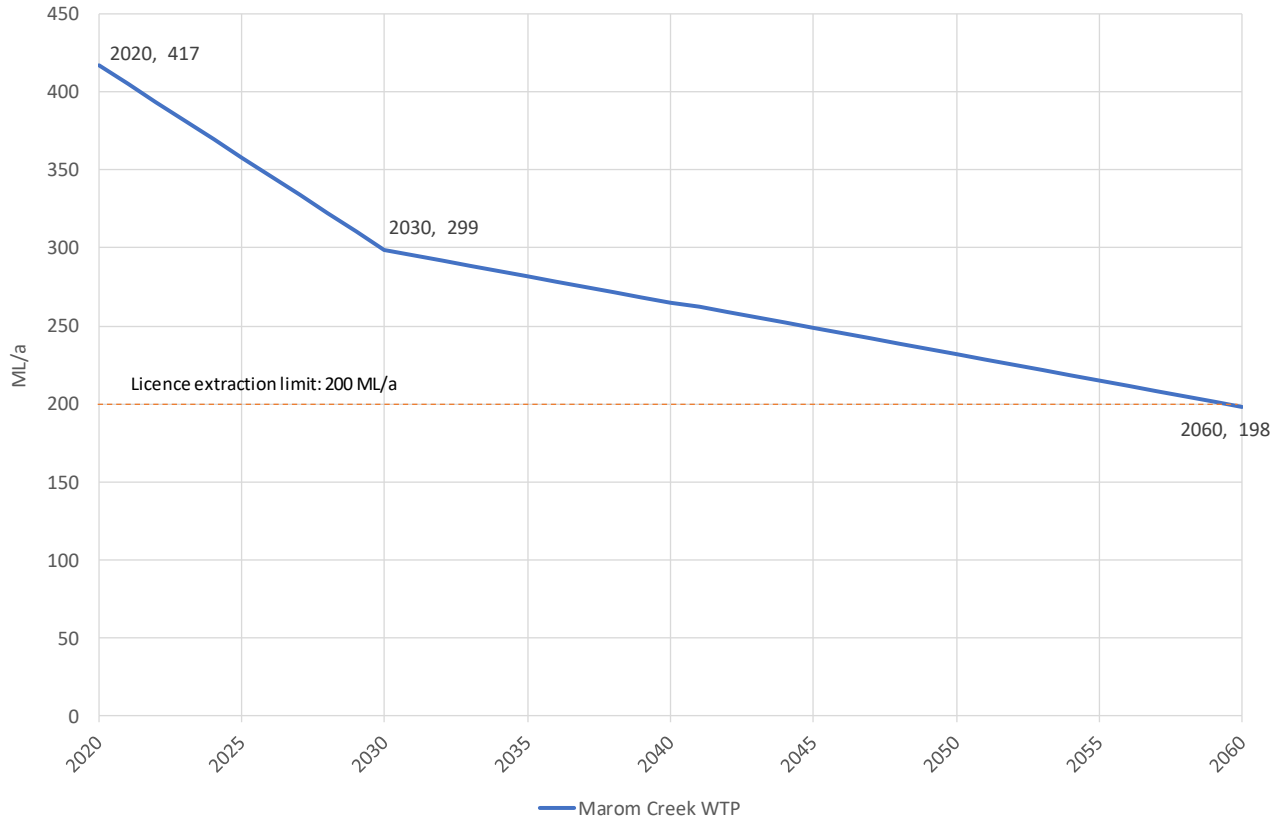

Figure 13: Secure yield estimates – Marom Creek

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.

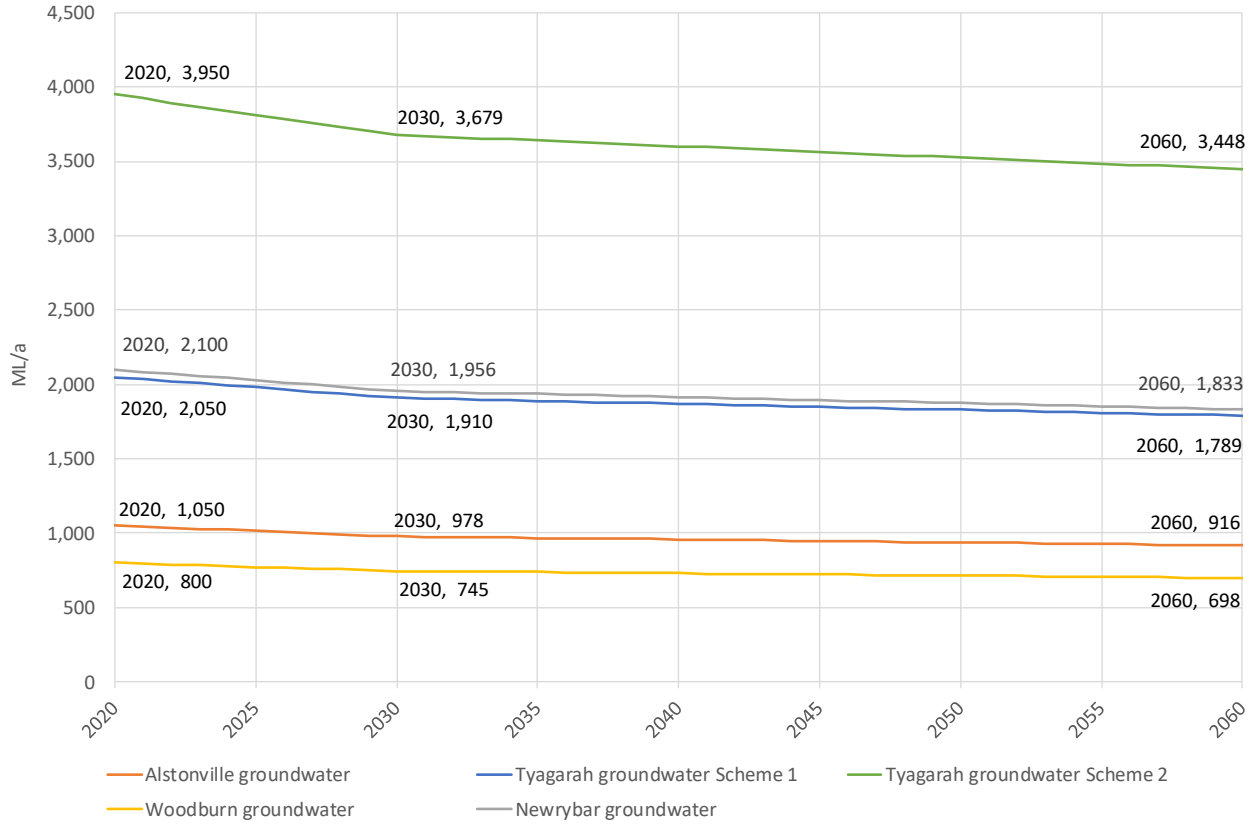

Figure 15: Secure yield estimates – groundwater options

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.

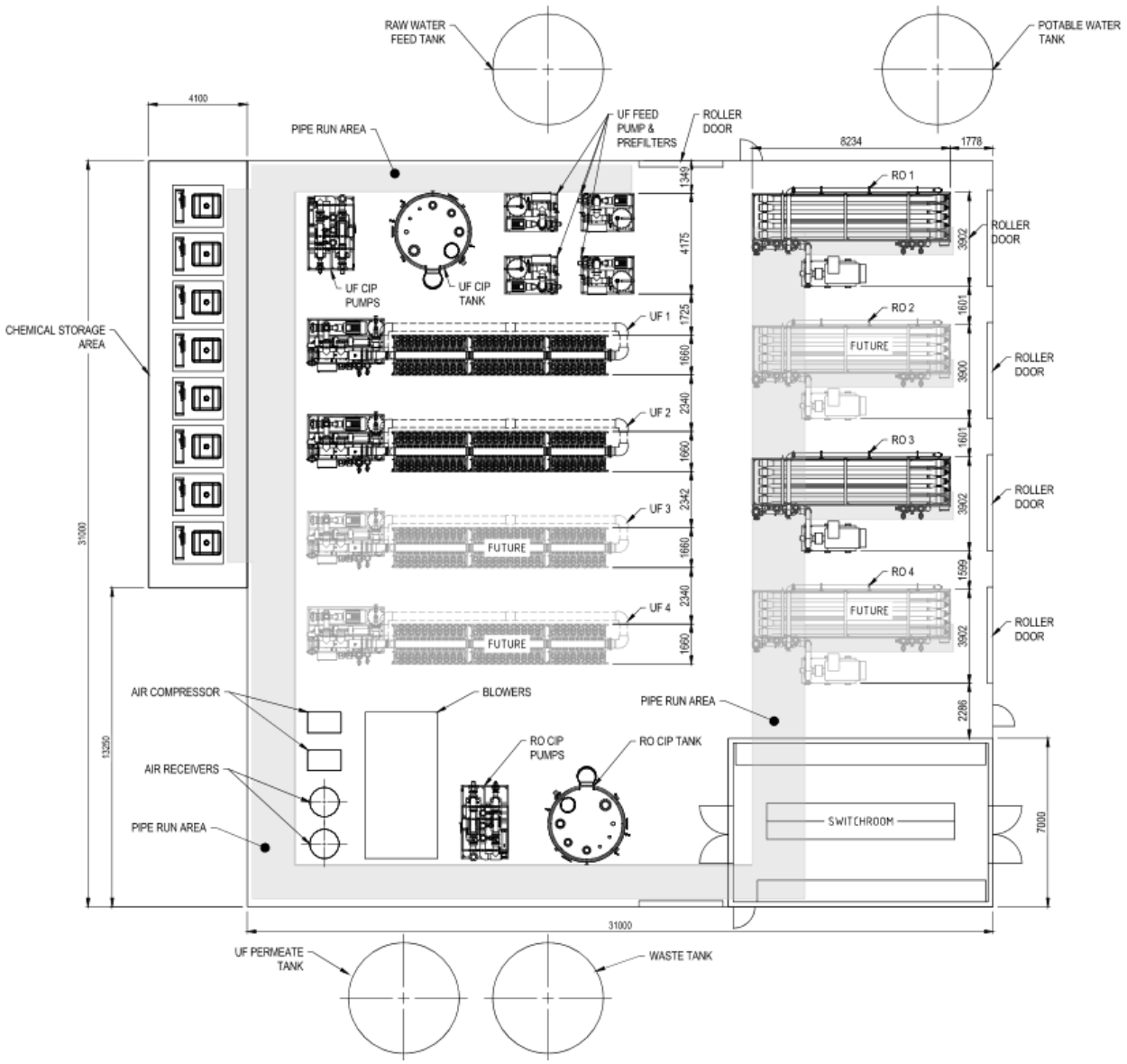

Figure 17: Concept design plant layout

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.

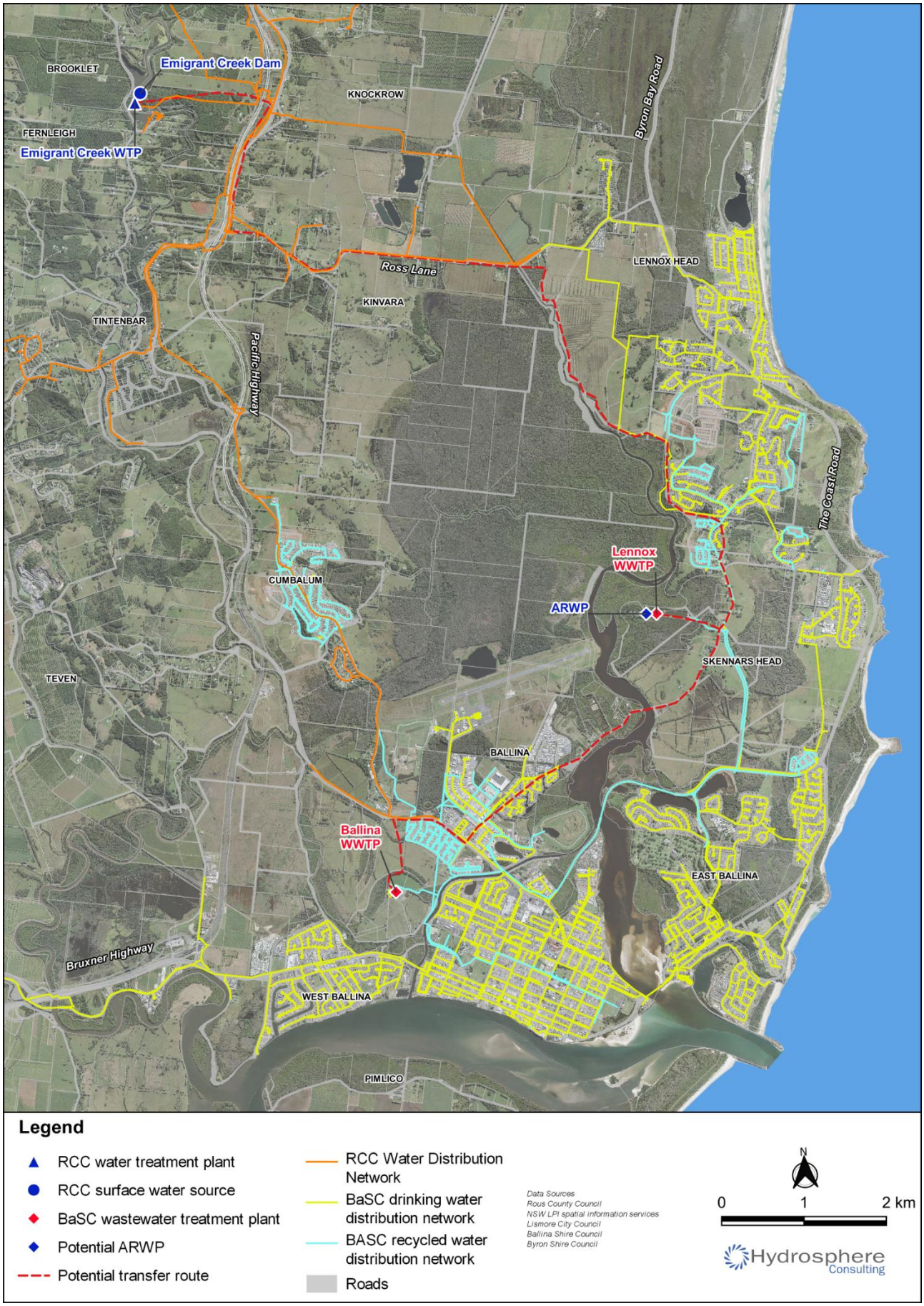

Figure 18: Potential Ballina IPR scheme

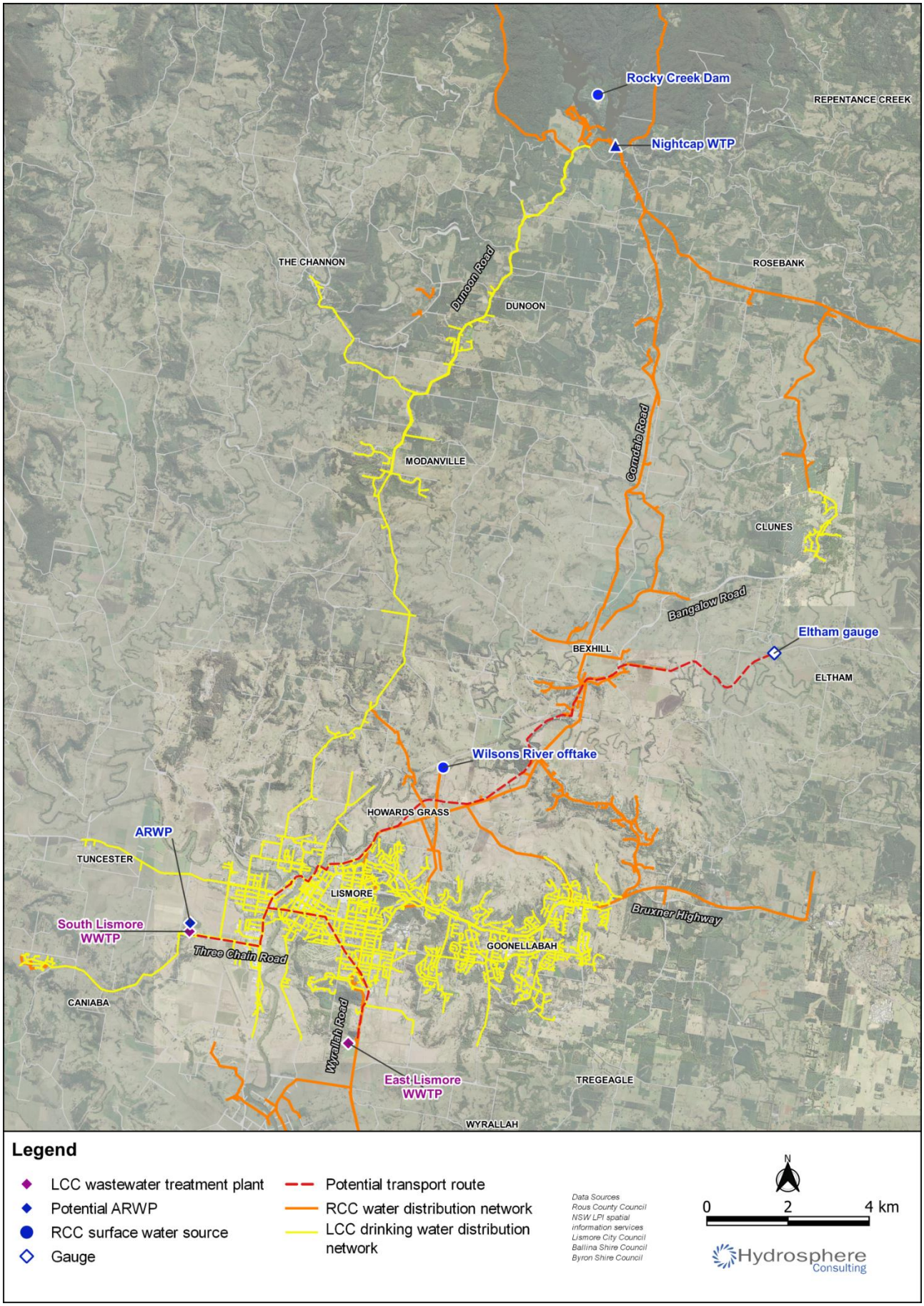

Figure 19: Potential Lismore IPR scheme

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	0.969	727
Ballina IPR scheme (5 ML/d to ECD)	900		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.

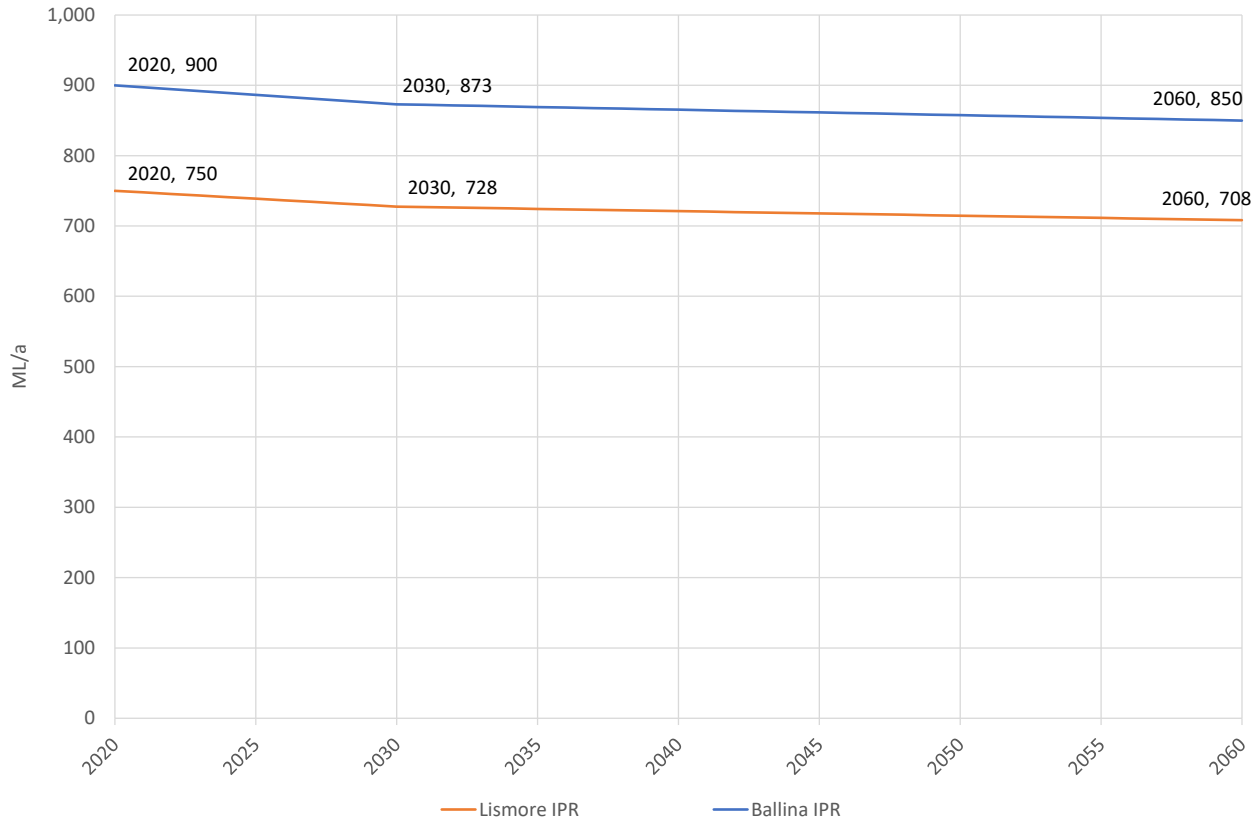

Figure 20: Secure yield estimates – IPR options

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.

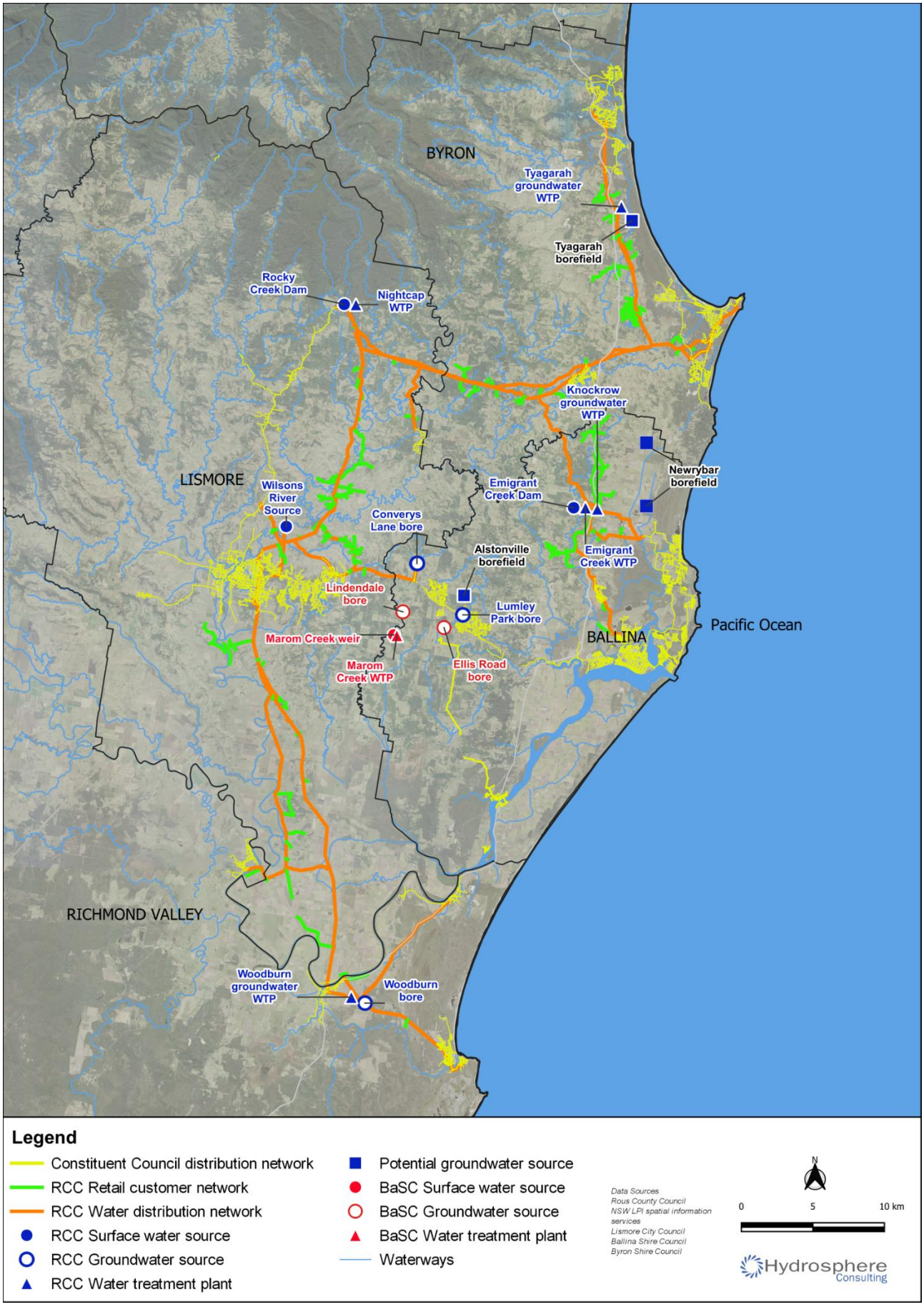

Figure 21: Scenario 1: Groundwater (with Marom Creek WTP)

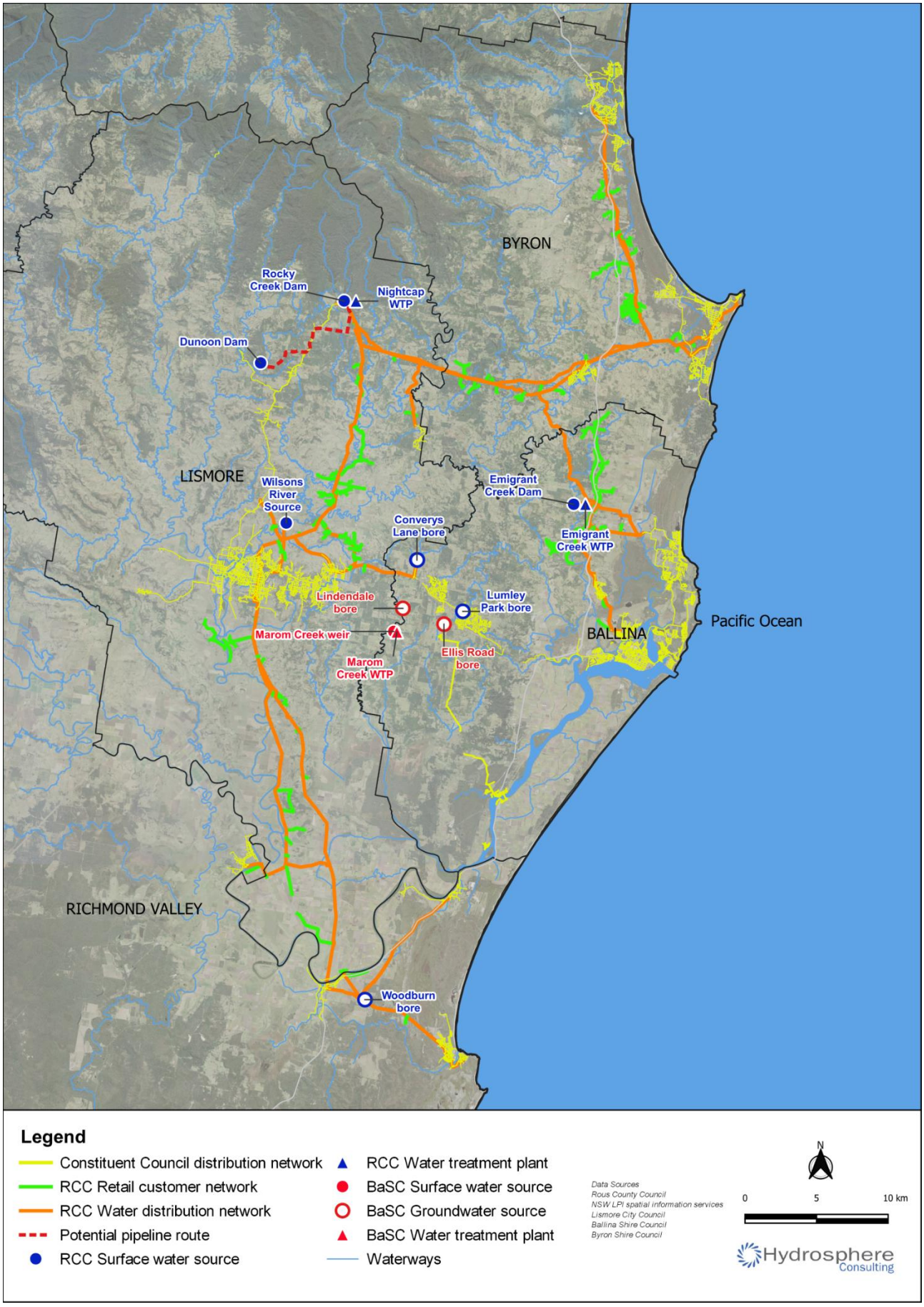

Figure 22: Scenario 2: Dunoon dam (with Marom Creek WTP)

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.

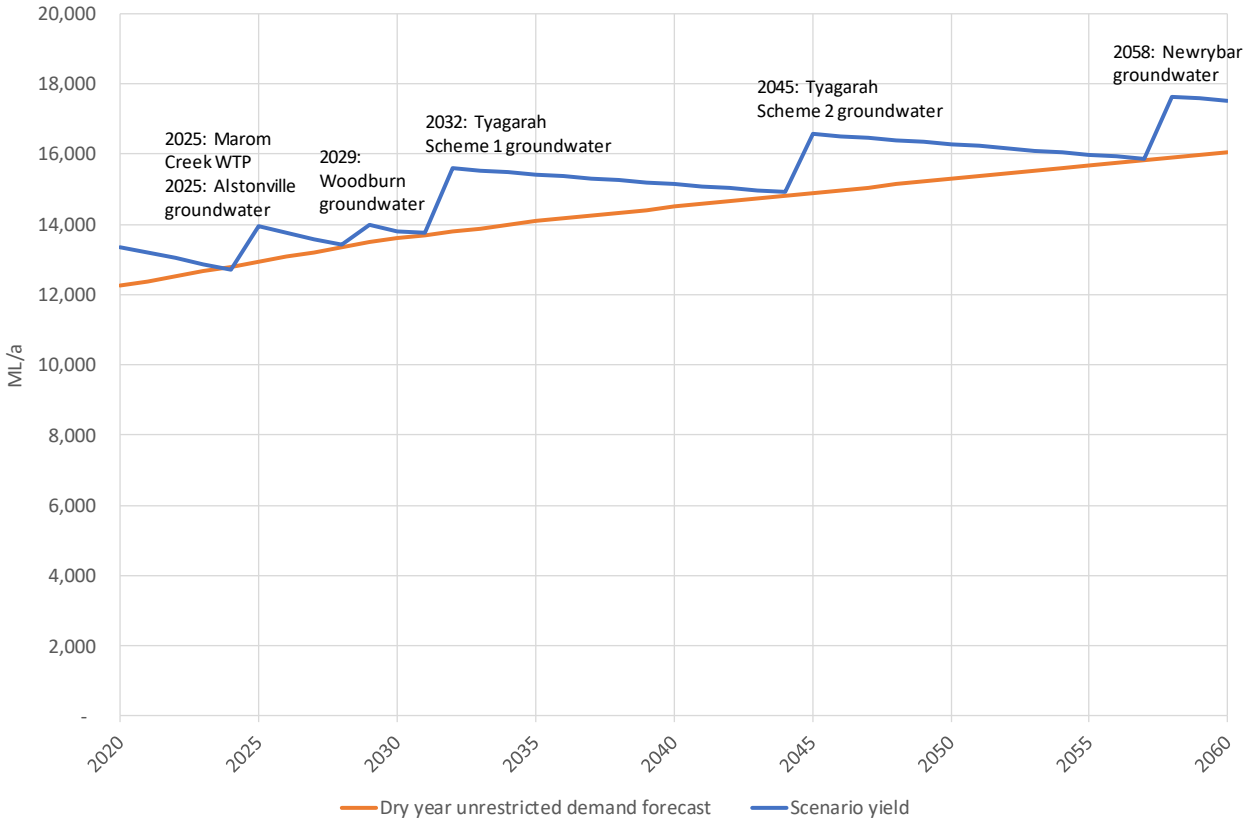

Figure 23: Secure yield and staging for scenario 1: groundwater

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.

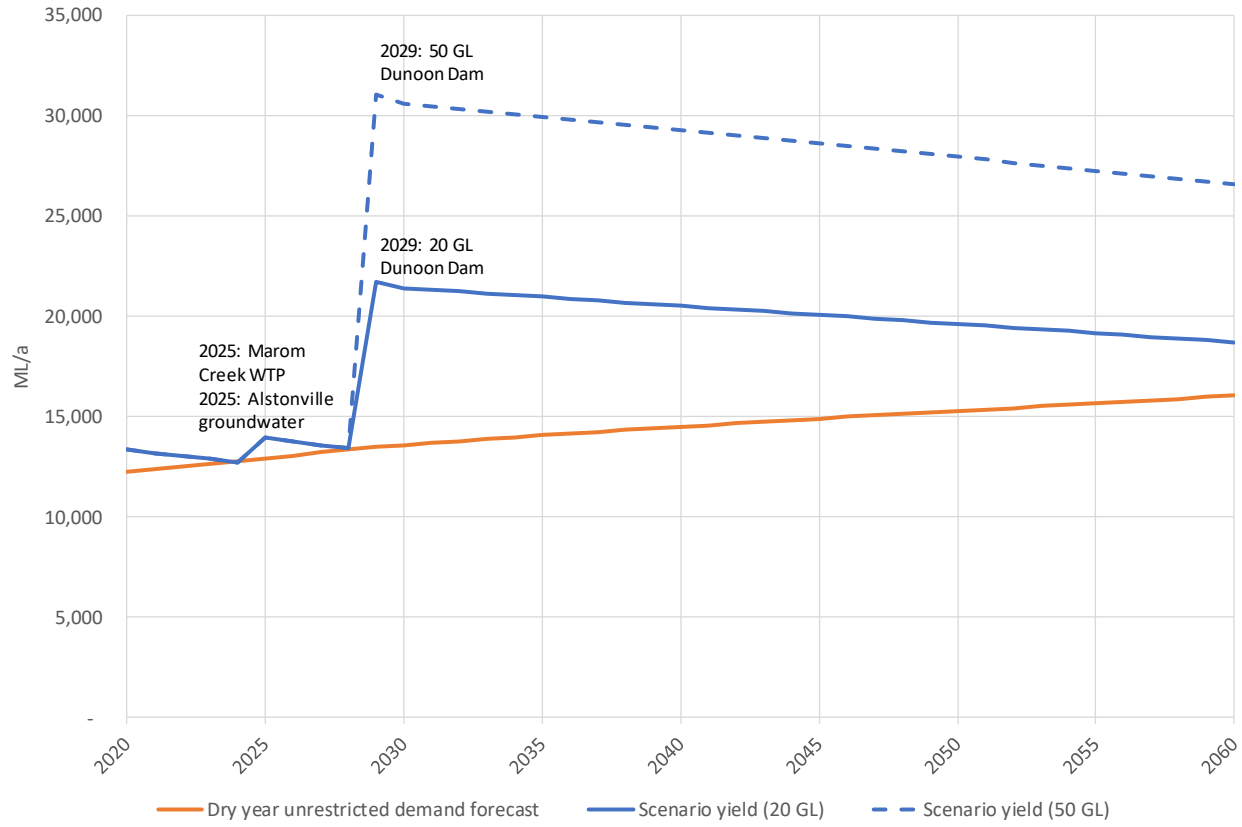

Figure 24: Secure yield and staging for scenario 2: Dunoon dam

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.

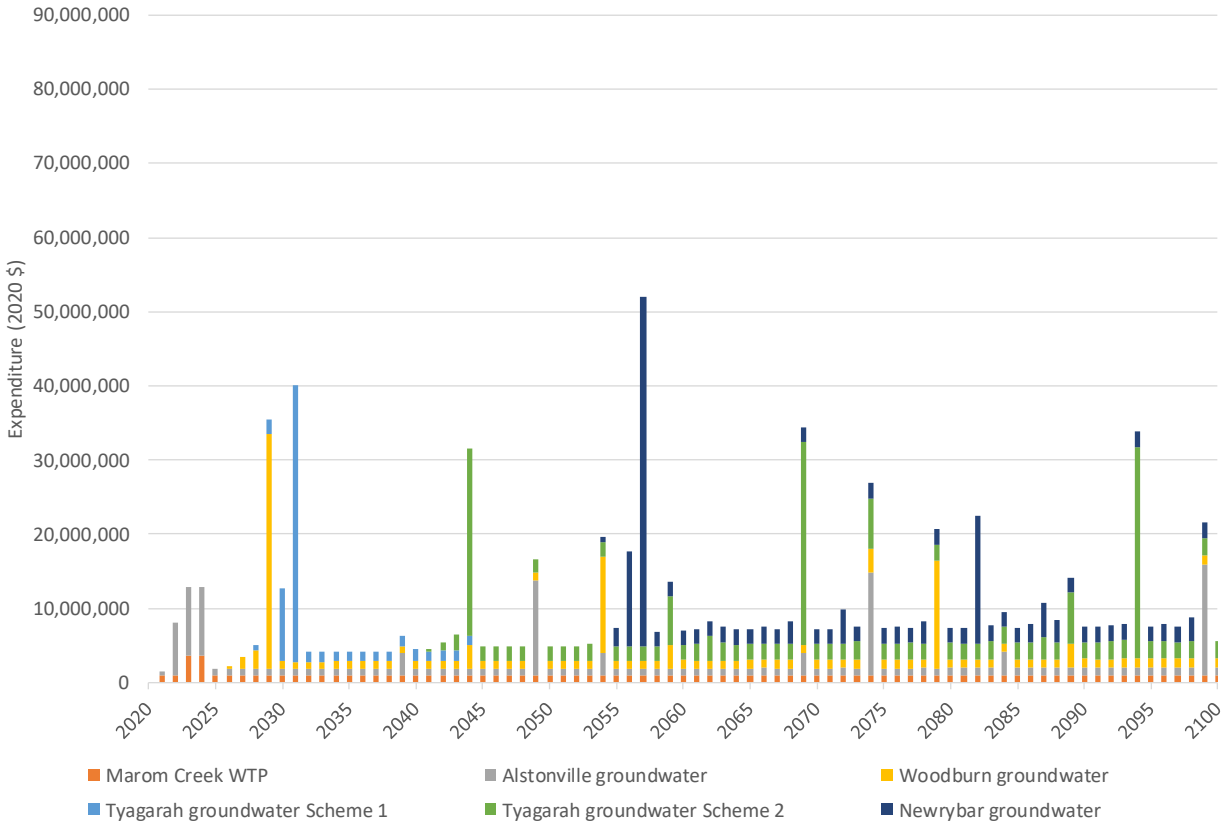

Figure 25: Expenditure profile – Scenario 1: groundwater

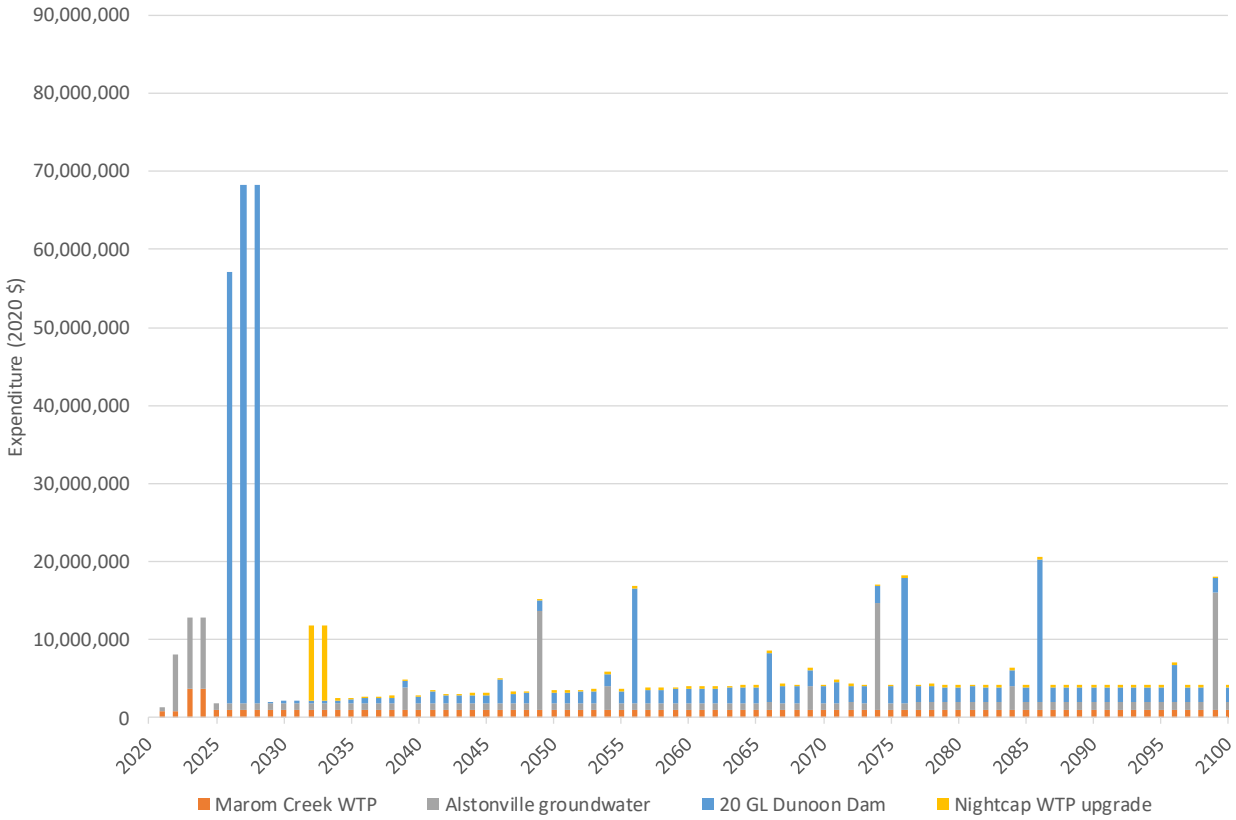

Figure 26: Expenditure profile – Scenario 2A: Dunoon dam (20 GL)

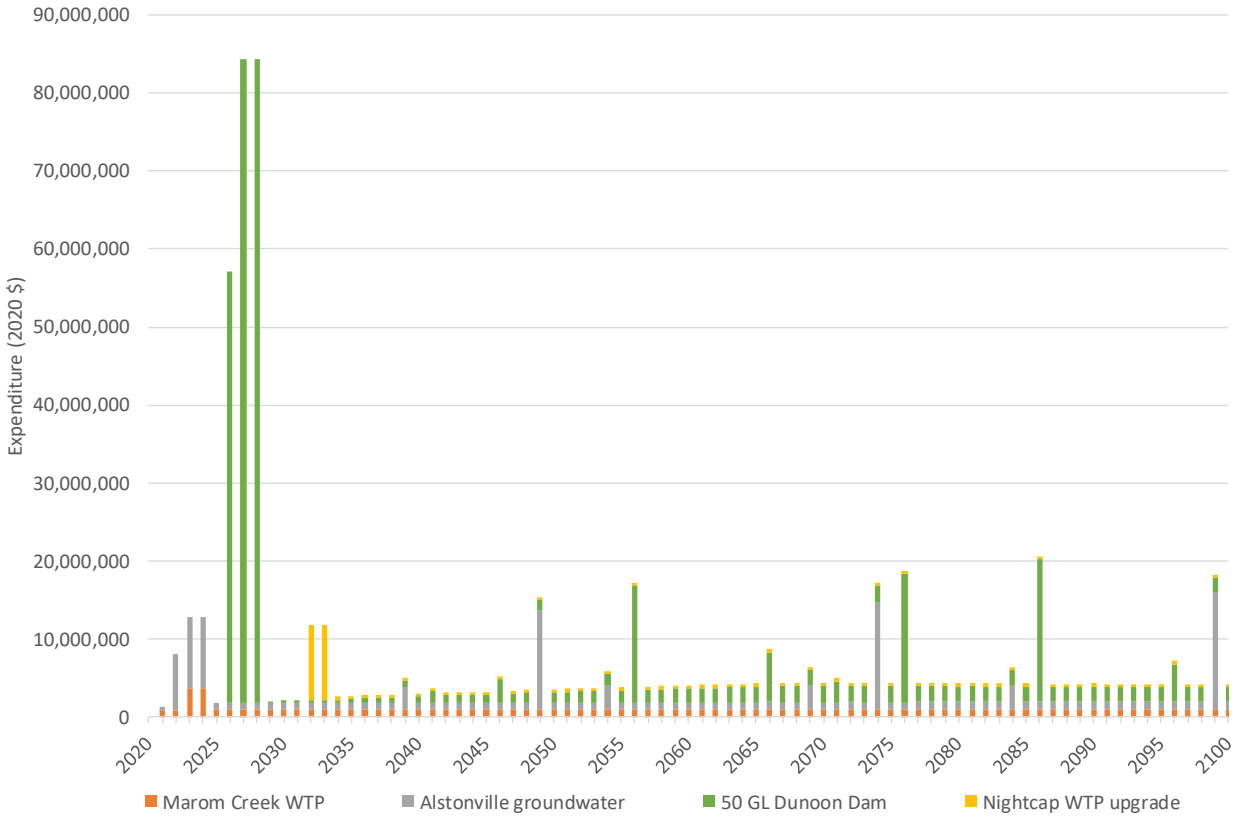

Figure 27: Expenditure profile – Scenario 2B: Dunoon dam (50 GL)

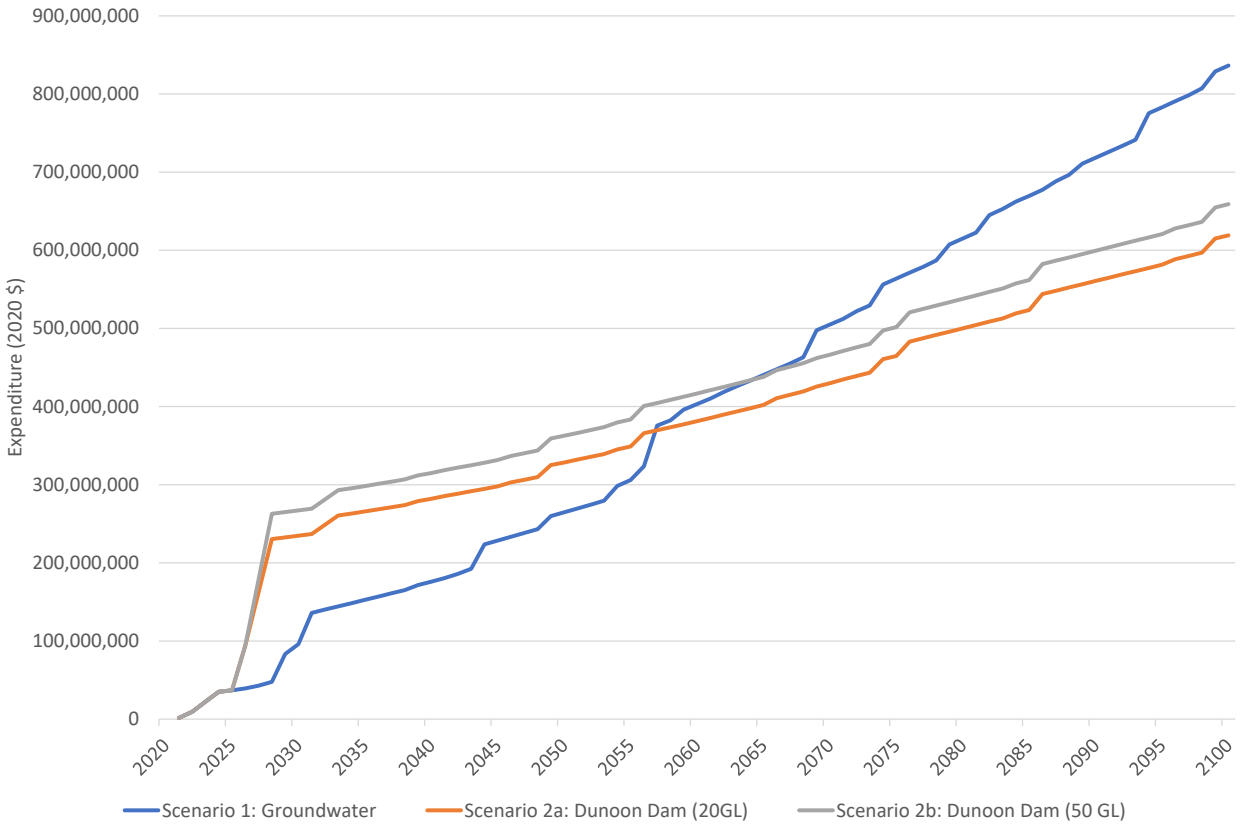

Figure 28: Expenditure profile (cumulative) – scenario comparison

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:

<u>i) Immediate actions</u>

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%		

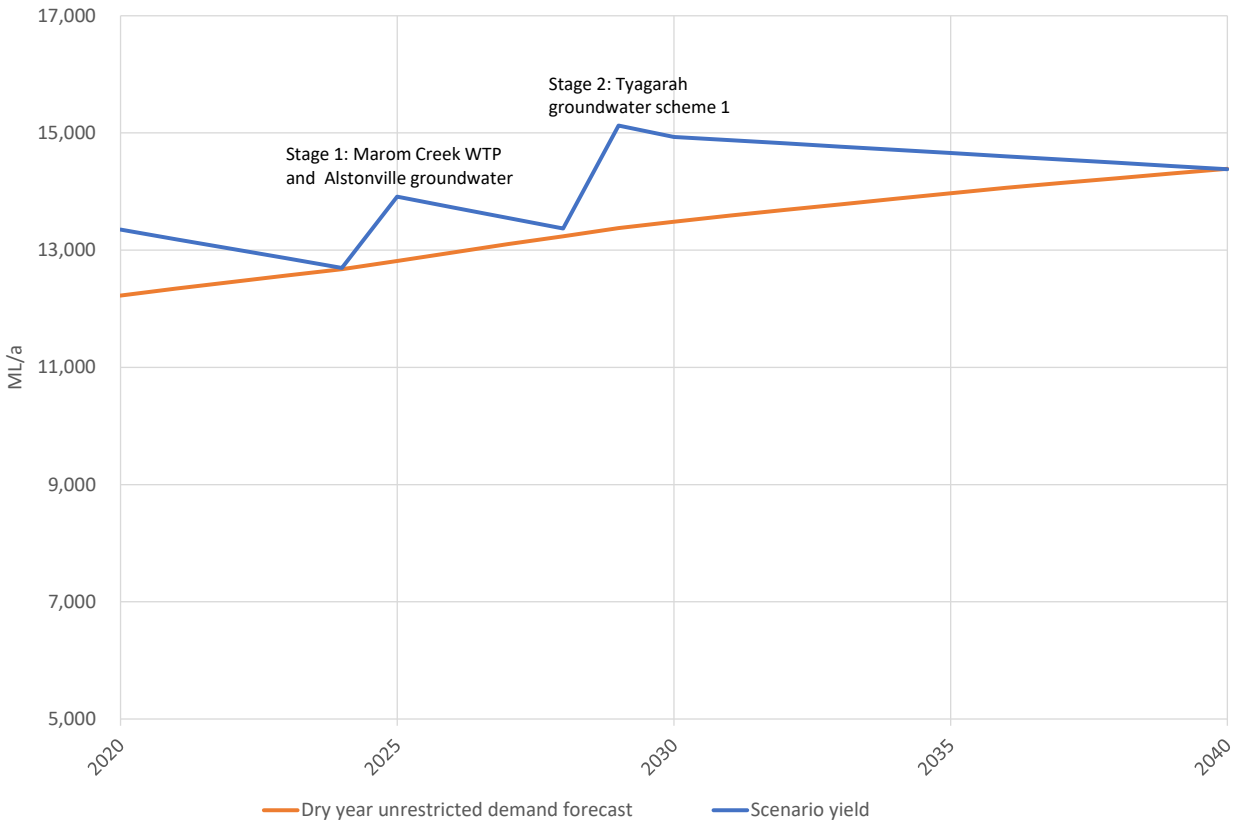

Figure 29: Preferred scenario: staging and secure yield

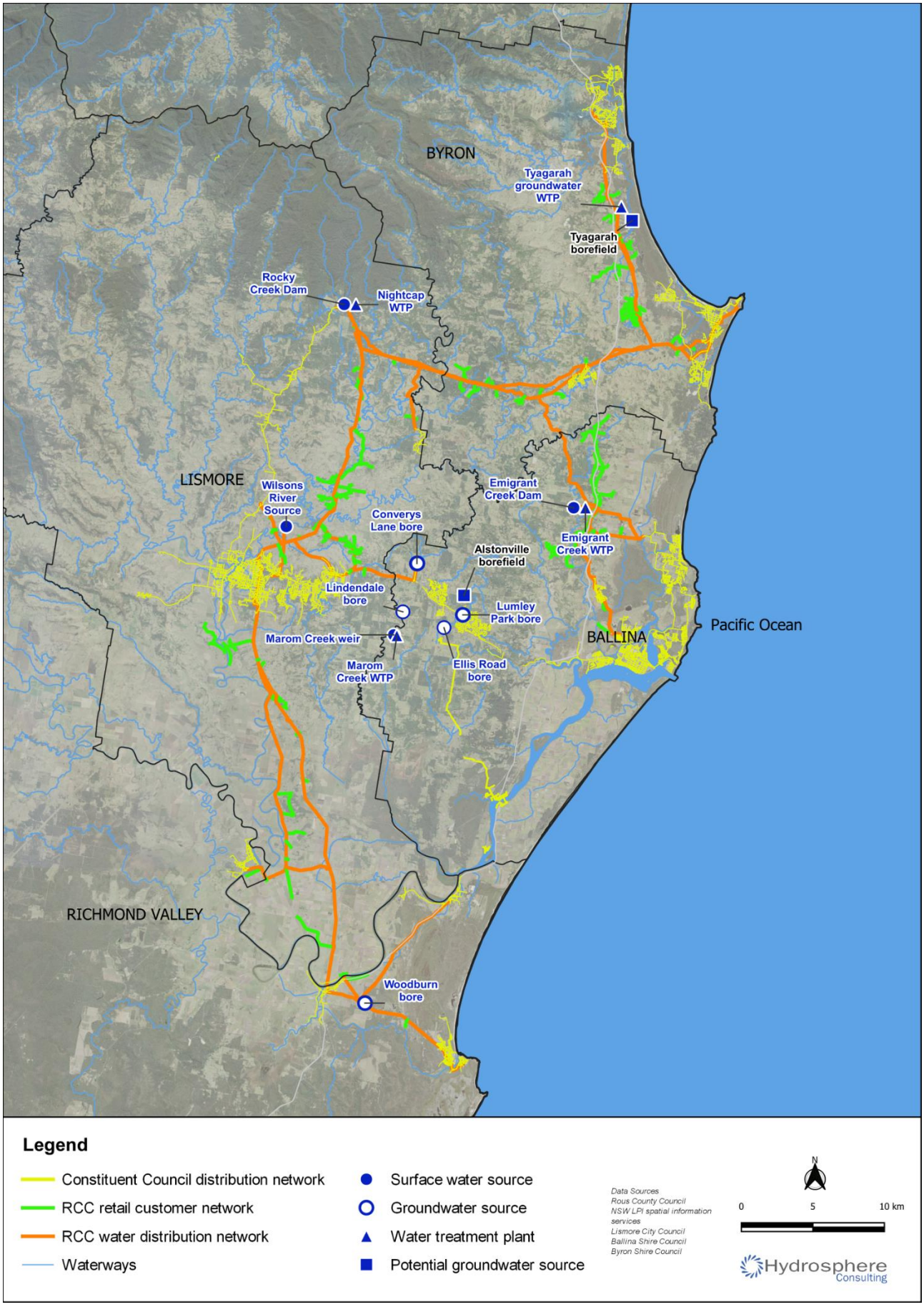

Figure 30: Preferred scenario: Marom Creek, stage 1 and 2 groundwater

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.

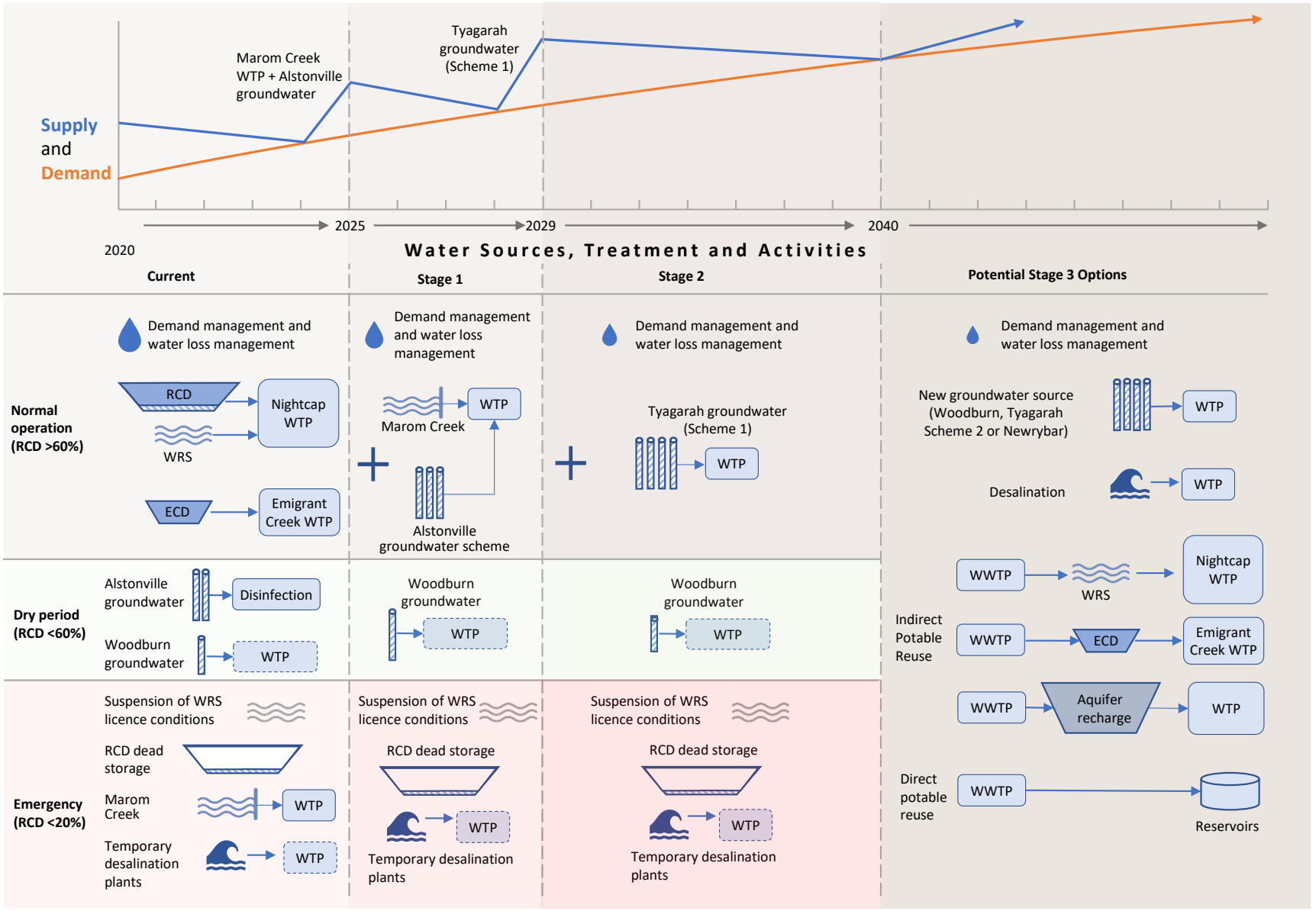

Figure 31: Staging of water source augmentation

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											
	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

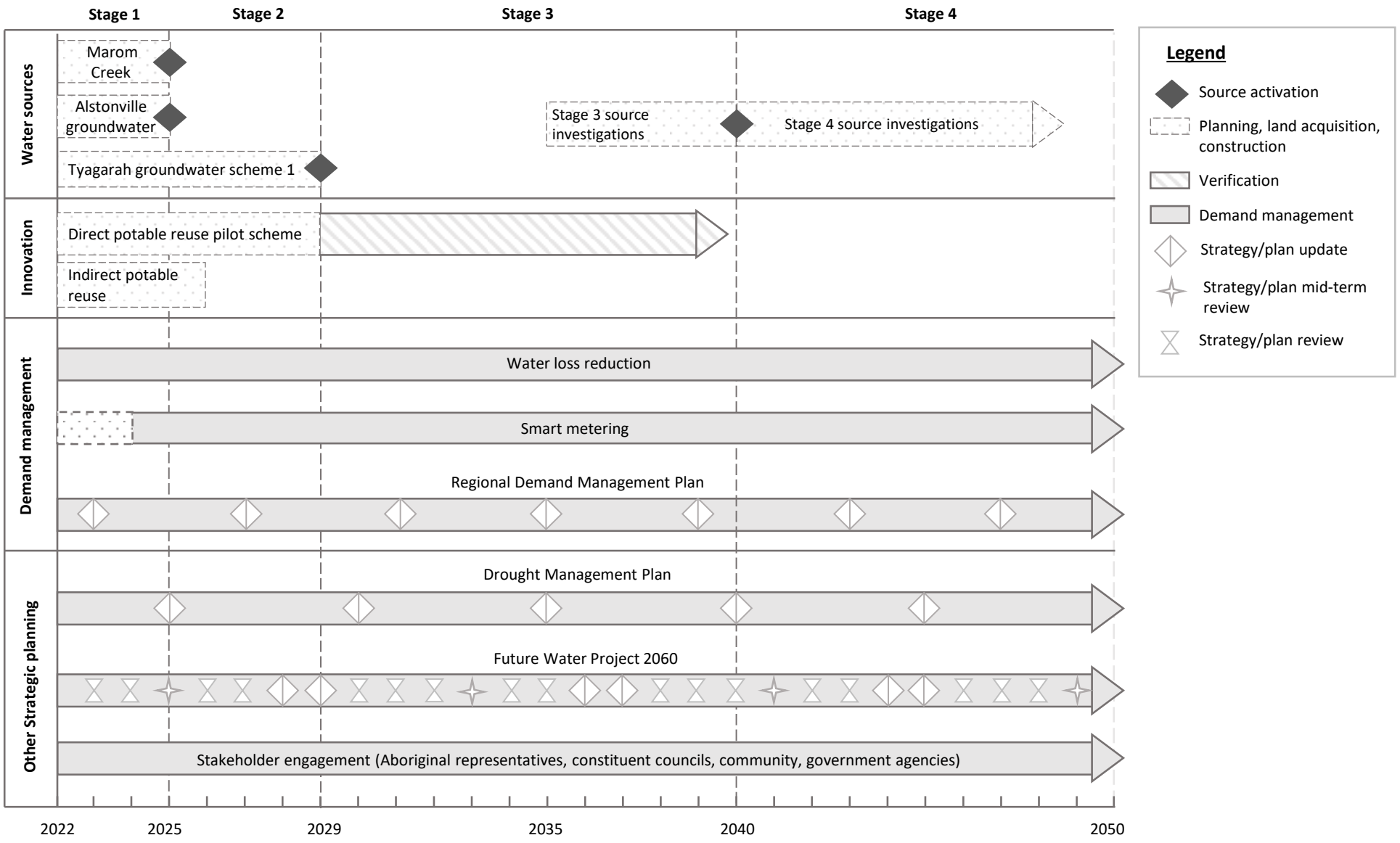

Figure 32: Future Water Project implementation planning

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.

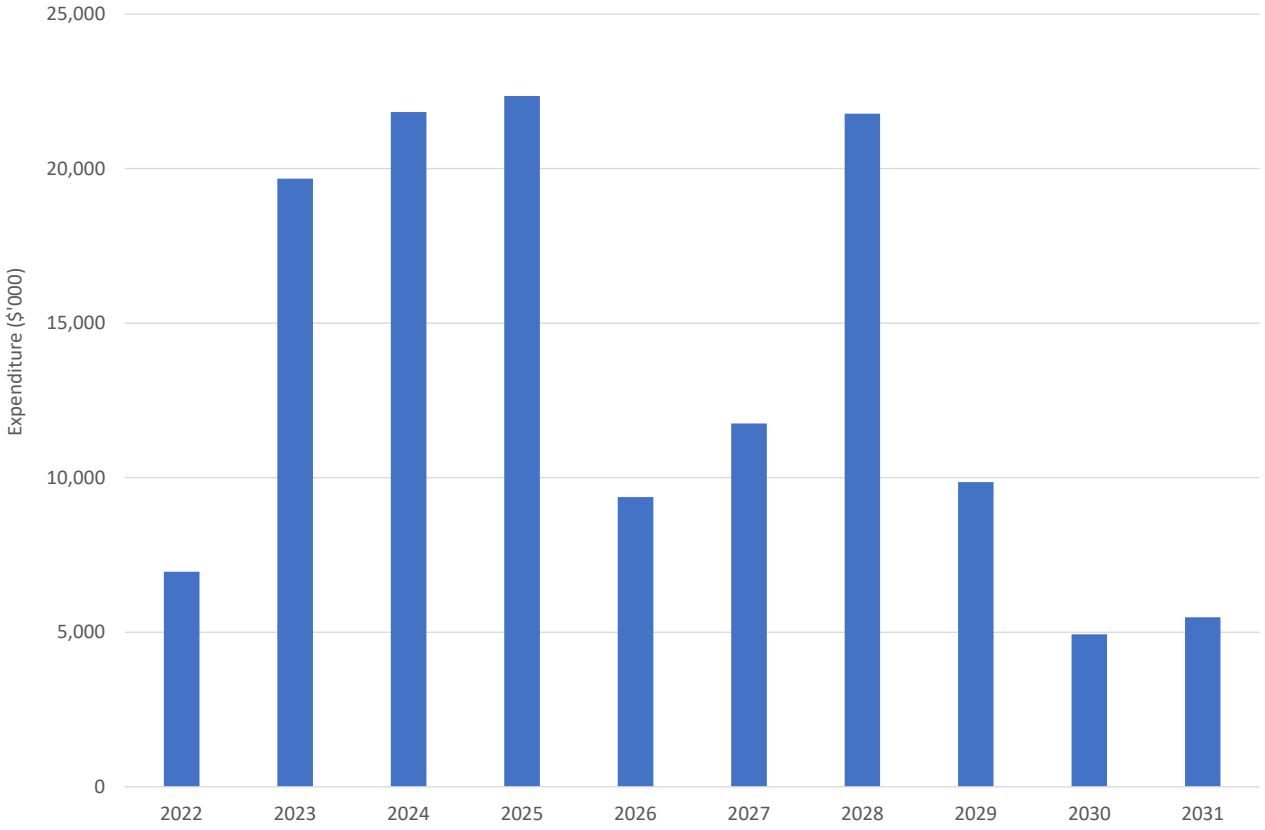

Figure 33: Future Water Project 2060 expenditure (2022 – 2031)

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).

REFERENCES

Ainsworth Heritage (2013) *Proposed Dunoon Dam Preliminary Cultural Heritage Impact Assessment*, for Rous Water, May 2013

Australian Museum Business Services (2012) *Peer Review of Dunoon dam Draft Cultural Heritage Impact Assessment, letter to Rous Water*, 23 February 2012

CWT (2018) *Marom Creek WTP 20 year Master Plan* for Ballina Shire Council

CWT (2020a) *Preliminary Feasibility Report: Investigation of Water Reuse as an Additional Water Source* for Rous County Council, RIF1341-04-B

CWT (2020b) *Preferred Option Power Estimates* (Indirect Potable Reuse) for Rous County Council

Detection Services (2019) *Water Loss Management Plan – Rous County Council Bulk Water Supply and Reticulation*

ELA (2012a) *Aquatic Ecology Assessment Proposed Dunoon dam,* prepared for Rous Water, 9 November 2012

ELA (2012b) *Environmental Flows Assessment Proposed Dunoon dam,* prepared for Rous Water, 9 November 2012

Engeny (2021) *Future Water Strategy Secure Yields: Modelling Report*, prepared for Rous County Council (M760000_009-REP-001-2)

GANDEN (2020) *Rous County Council Desalination Investigation*, Investigation Report Number: 1364-IR-001, Rev 0

GeoLink (2011) *Preliminary Feasibility Assessment of Desalination as a Water Supply Option*, Rous Water Future Water Strategy.

Geological Imaging (2017) *AgTEM survey investigating groundwater at Newrybar and Tyagarah*, For Rous County Council.

Hydrosphere Consulting (2009) Dunoon dam Buffer Zone Strategic Plan, June 2009

Hydrosphere Consulting (2013a) *Rous Water Future Water Strategy: Demand Forecast*, updated July 2013

Hydrosphere Consulting (2013b) *Northern Rivers Regional Bulk Water Supply Study*, NOROC, October 2013

Hydrosphere Consulting (2016) *Regional Water Supply Drought Management Plan*

Hydrosphere Consulting (2018) *Regional Demand Management Plan: 2019 – 2022*, April 2018

Hydrosphere Consulting (2020a) *Rous County Council Bulk Water Supply Demand Forecast: 2020 - 2060*, May 2020

Hydrosphere Consulting (2020b) *Rous County Council Future Water Strategy: Coarse Screening Assessment of Options*, March 2020

Hydrosphere Consulting (2020c) *Rous County Council Catchment Management Plan 2021-2025*

Hydrosphere Consulting (2020d) *Review of the effects of existing and proposed surface water sources on the downstream aquatic environment*, May 2020

Jacobs (2015a) *Working paper 1: Summary of Available Data and Project Requirements,* Rous Water – identification Groundwater Sources.

Jacobs (2015b) *Working Paper 2: Assessment of Sources,* Rous Water – identification Groundwater Sources.

Jacobs (2015c) *Working Paper 3: Identification of Groundwater Schemes,* Rous Water – identification Groundwater Sources.

Jacobs (2015d) *Working Paper 4: MCA assessment and prioritisation of schemes,* Rous Water – identification Groundwater Sources.

Jacobs (2015e) *Working Paper 5: Fieldwork Environmental and Planning Assessment,* Rous Water – identification Groundwater Sources.

Jacobs (2017a) *Drilling Program Stage 1: January 2016*, Groundwater Sources for Future Urban Water Supply Prepared for Rous Water

Jacobs (2017b) *Summary Report of Stage 2 Drilling Undertaken October - December 2016*, Groundwater Sources for Future Urban Water Supply Prepared for Rous Water

Jacobs (2017c) *Summary of Stage 3 Groundwater Investigations Undertaken April - December 2017*, Groundwater Sources for Future Urban Water Supply Prepared for Rous Water

Jacobs (2017d) *Woodburn Borefields Interim Technical Memorandum*

Jacobs (2018a) *Groundwater investigations – Woodburn – Woodburn Bore Site 3 Pumping Test Program*

Jacobs (2018b) *Groundwater Supply Augmentation Investigation Woodburn Borefield Water Supply Concept Design Report*

Jacobs (2020a) *Groundwater schemes & whole of life cycle costings - Report A*, Future Water Strategy

Jacobs (2020b) *Groundwater schemes & whole of life cycle costings - Report B*, Future Water Strategy

MWH (2014) *Future Water Strategy Integrated Water Planning Process.* Prepared for Rous Water, July 2014

NSW Department of Industry (2019) *IWCM Information Sheet 2 – Evaluation of integrated water cycle management scenarios*

NSW Government (2020) *Draft Regional Water Strategy: Far North Coast: Strategy*

NSW Urban Water Services (2013) *Rous Water Regional Water Supply Future Water Strategy Yield Modelling Report*, Draft 1.0 August 2017

NSW Urban Water Services (2017) *Wardell Water Supply Yield Study Report*, Draft 1.0 August 2017

NSW Urban Water Services (2018) *Rous Water Supply Yield Study Report*, Draft 1.0 October 2018

Public Works Advisory (2020a) *Dunoon dam – Preliminary Planning Pathway Advice*, letter to Rous County Council, 15 April 2020

Public Works Advisory (2020b) Cost Estimates, Microsoft Excel worksheets sent to Rous County Council, 8 May 2020

Public Works Dams and Civil (2013a) *Dunoon dam Options Study*. Report No. DC13014, April 2013

Public Works Dams and Civil (2013b) *Dunoon dam Concept Design Report.* Report No. DC13138, November 2013

Public Works Dams and Civil (2013c) *Dunoon dam 20,000 ML Storage Option*. Report No. DC13092, June 2013

Reid and ecodata (2019) *Rous County Council and constituent councils - Smart metering report*

Rous County Council (2020) *Future Water Project 2060 - Information for the community about the preferred options for securing the region's water supply*

Rous Water (2012) *Demand Management Plan 2012-2016*

SMEC (2011) Dunoon dam Terrestrial Ecology Impact Assessment, prepared for Rous Water, November 2011

SMEC (2012) Dunoon dam Aquatic Ecology Independent Peer Review, October 2012

Vaxa (2020) *Rous County Council Future Water Plan 2060 - Public exhibition outcomes*

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

			Source	Total 80 years	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																																											
	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																221,000															2,369,900									
		Pumping station	PWA	$ 25,875,200																343,200					832,000									8,552,700									
		Rising main	PWA	$ 10,093,200																																							
		Roads	PWA	$ 8,405,800																					821,600									2,463,500									
	Total renewal costs			**$ 54,280,200**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	$ -	**$ 1,653,600**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 13,386,100**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total acquisition costs			**$ 274,280,200**	**$ 55,384,835**	**$ 82,307,583**	**$ 82,307,583**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	$ -	**$ 1,653,600**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 13,386,100**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
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	18,069	36,138	36,138	36,138	36,138	35,348	35,743	35,743	35,743	35,743	35,743	41,558	41,558	41,558	41,558	41,558	41,953	41,953	41,953	41,953	27,368	45,437	45,437	45,437	45,437	45,437	45,437	45,437	45,437
	Pumping station	PWA		$ 5,075,287	-	35,333	35,333	35,333	35,333	35,333	35,333	35,333	35,333	35,333	35,333	70,666	70,666	70,666	70,666	68,218	69,442	69,442	69,442	69,442	68,162	98,702	98,702	98,702	98,702	98,702	99,926	99,926	99,926	99,926	14,753	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086
	Rising main	PWA		$ 1,918,620	-	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620
	Roads	PWA		$ 1,960,402	-	11,255	11,255	11,255	11,255	11,255	11,255	11,255	11,255	11,255	11,255	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510	21,246	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878	18,088	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343
	Total maintenance costs			**$ 12,190,755**	$ -	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 77,197**	**$ 154,394**	**$ 154,394**	**$ 154,394**	**$ 154,394**	**$ 151,156**	**$ 152,775**	**$ 152,775**	**$ 152,775**	**$ 152,775**	**$ 150,231**	**$ 187,218**	**$ 187,218**	**$ 187,218**	**$ 187,218**	**$ 187,218**	**$ 188,837**	**$ 188,837**	**$ 188,837**	**$ 188,837**	**$ 85,289**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**	**$ 162,486**
	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	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	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	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
	5-yearly Dam movement surve	PWA		$ 600,000						40,000					40,000					40,000					40,000					40,000					40,000					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	292,209	341,452	390,694	439,934	489,174	538,412	587,649	636,886	686,121	735,355	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	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			**$ 110,515,416**	$ -	**$ 215,977**	**$ 215,977**	**$ 215,977**	**$ 215,977**	**$ 255,977**	**$ 265,226**	**$ 314,474**	**$ 363,720**	**$ 412,965**	**$ 502,209**	**$ 511,452**	**$ 560,694**	**$ 609,934**	**$ 659,174**	**$ 748,412**	**$ 757,649**	**$ 806,886**	**$ 856,121**	**$ 905,355**	**$ 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**	**$ 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			**$ 122,706,171**	$ -	**$ 293,174**	**$ 293,174**	**$ 293,174**	**$ 293,174**	**$ 333,174**	**$ 342,423**	**$ 391,671**	**$ 440,917**	**$ 490,162**	**$ 579,406**	**$ 665,846**	**$ 715,088**	**$ 764,328**	**$ 813,568**	**$ 899,568**	**$ 910,424**	**$ 959,661**	**$ 1,008,896**	**$ 1,058,130**	**$ 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**	**$ 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			**$ 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**	**$ 579,406**	**$ 665,846**	**$ 715,088**	**$ 764,328**	**$ 813,568**	**$ 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**	**$ 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**	**$ 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

			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																																											
	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					3,398,200										3,474,900																221,000				
		Pumping station	PWA	$ 25,875,200	2,216,500				343,200					988,000										9,384,700										2,871,700				343,200				
		Rising main	PWA	$ 10,093,200										10,093,200																												
		Roads	PWA	$ 8,405,800	1,835,600																			3,285,100																			
	Total renewal costs			**$ 54,280,200**	**$ 4,052,100**	$ -	$ -	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	**$ 14,479,400**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 16,144,700**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 2,871,700**	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	$ -
	Total acquisition costs			**$ 274,280,200**	**$ 4,052,100**	$ -	$ -	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	**$ 14,479,400**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 16,144,700**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 2,871,700**	$ -	$ -	$ -	**$ 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	49,907	50,302	50,302	50,302	50,302	36,510	44,589	44,589	44,589	44,589	44,589	44,589	44,984	44,984	44,984	44,984	27,849	37,973	37,973	37,973	37,973	37,973	37,973	37,973	37,973	37,973	37,973	45,833	45,833	45,833	45,833	45,043	45,438	45,438	45,438
	Pumping station	PWA		$ 5,075,287	37,706	70,070	70,070	70,070	70,070	70,070	67,622	68,846	68,846	66,566	98,466	98,466	98,466	98,466	98,466	98,466	98,466	99,690	99,690	99,690	13,237	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761	39,134	73,707	73,707	73,707	73,707	71,259	72,483	72,483	72,483
	Rising main	PWA		$ 1,918,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	-	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
	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	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	25,404	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238
	Total maintenance costs			**$ 12,190,755**	**$ 146,502**	**$ 187,433**	**$ 187,433**	**$ 187,433**	**$ 186,643**	**$ 184,590**	**$ 185,814**	**$ 185,814**	**$ 185,814**	**$ 132,122**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,053**	**$ 186,448**	**$ 187,672**	**$ 187,672**	**$ 187,672**	**$ 79,030**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 136,745**	**$ 130,118**	**$ 175,858**	**$ 175,858**	**$ 175,858**	**$ 175,858**	**$ 172,620**	**$ 174,239**	**$ 174,239**	**$ 174,239**	**$ 174,239**
	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	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	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	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
	5-yearly Dam movement surve	PWA		$ 600,000	40,000					40,000					40,000					40,000					40,000					40,000					40,000					40,000				
	20-yearly Dam safety review	PWA		$ 600,000	200,000																				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	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	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	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			**$ 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**	**$ 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**	**$ 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**	**$ 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				**$ 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**	**$ 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**	**$ 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**	**$ 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				**$ 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**	**$ 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**	**$ 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**	**$ 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	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 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																221,000															2,174,900									
		Pumping station	PWA	$ 25,875,200																343,200					832,000										8,552,700									
		Rising main	PWA	$ 10,093,200																																								
		Roads	PWA	$ 8,405,800																					821,600										2,463,500									
		Total renewal costs		**$ 53,660,100**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	**$ 1,653,600**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 13,191,100**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total acquisition costs			**$ 241,857,615**	**$ 55,384,835**	**$ 66,406,340**	**$ 66,406,340**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	**$ 1,653,600**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 13,191,100**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
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	16,343	32,686	32,686	32,686	32,686	31,896	32,291	32,291	32,291	32,291	32,291	37,356	37,356	37,356	37,356	37,356	37,751	37,751	37,751	37,751	25,416	41,759	41,759	41,759	41,759	41,759	41,759	41,759	41,759	41,759
		Pumping station	PWA	$ 5,004,621	-			35,333	35,333	35,333	35,333	35,333	35,333	35,333	35,333	70,666	70,666	70,666	70,666	68,218	69,442	69,442	69,442	69,442	68,162	98,702	98,702	98,702	98,702	98,702	99,926	99,926	99,926	99,926	14,753	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086	50,086
		Rising main	PWA	$ 1,893,540	-			12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620	37,620
		Roads	PWA	$ 1,937,892	-			11,255	11,255	11,255	11,255	11,255	11,255	11,255	11,255	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510	22,510	21,246	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878	21,878	18,088	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343	29,343
		Total maintenance costs		**$ 11,750,275**	$ -	$ -	$ -	**$ 75,471**	**$ 75,471**	**$ 75,471**	**$ 75,471**	**$ 75,471**	**$ 75,471**	**$ 75,471**	**$ 75,471**	**$ 150,942**	**$ 150,942**	**$ 150,942**	**$ 150,942**	**$ 147,704**	**$ 149,323**	**$ 149,323**	**$ 149,323**	**$ 149,323**	**$ 146,779**	**$ 183,016**	**$ 183,016**	**$ 183,016**	**$ 183,016**	**$ 183,016**	**$ 184,635**	**$ 184,635**	**$ 184,635**	**$ 184,635**	**$ 83,337**	**$ 158,808**	**$ 158,808**	**$ 158,808**	**$ 158,808**	**$ 158,808**	**$ 158,808**	**$ 158,808**	**$ 158,808**	**$ 158,808**
		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	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	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	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
		5-yearly Dam movement surve	PWA	$ 600,000						40,000					40,000					40,000					40,000					40,000					40,000					40,000				
		20-yearly Dam safety review	PWA	$ 600,000																					200,000																			
		PUMPING STATION		$ -																																								
		Water pumping cost	PWA	$ 94,311,936				45,977	45,977	45,977	95,226	144,474	193,720	242,965	292,209	341,452	390,694	439,934	489,174	538,412	587,649	636,886	686,121	735,355	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	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		**$ 110,083,461**	$ -	$ -	$ -	**$ 215,977**	**$ 215,977**	**$ 255,977**	**$ 265,226**	**$ 314,474**	**$ 363,720**	**$ 412,965**	**$ 502,209**	**$ 511,452**	**$ 560,694**	**$ 609,934**	**$ 659,174**	**$ 748,412**	**$ 757,649**	**$ 806,886**	**$ 856,121**	**$ 905,355**	**$ 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**	**$ 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			**$ 121,833,736**	$ -	$ -	$ -	**$ 291,448**	**$ 291,448**	**$ 331,448**	**$ 340,697**	**$ 389,945**	**$ 439,191**	**$ 488,436**	**$ 577,680**	**$ 662,394**	**$ 711,636**	**$ 760,876**	**$ 810,116**	**$ 896,116**	**$ 906,972**	**$ 956,209**	**$ 1,005,444**	**$ 1,054,678**	**$ 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**	**$ 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			**$ 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**	**$ 577,680**	**$ 662,394**	**$ 711,636**	**$ 760,876**	**$ 810,116**	**$ 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**	**$ 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	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 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					2,934,100										3,513,900															221,000				
		Pumping station	PWA	$ 25,875,200	2,216,500					343,200					988,000										9,384,700										2,871,700					343,200				
		Rising main	PWA	$ 10,093,200											10,093,200																													
		Roads	PWA	$ 8,405,800	1,835,600																				3,285,100																			
		Total renewal costs		**$ 53,660,100**	**$ 4,052,100**	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	**$ 14,015,300**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 16,183,700**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 2,871,700**	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -
	Total acquisition costs			**$ 241,857,615**	**$ 4,052,100**	$ -	$ -	$ -	$ -	**$ 564,200**	$ -	$ -	$ -	$ -	**$ 14,015,300**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 16,183,700**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 2,871,700**	$ -	$ -	$ -	$ -	**$ 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	33,153	40,125	40,125	40,125	40,125	40,125	40,520	40,520	40,520	40,520	25,095	34,292	34,292	34,292	34,292	34,292	34,292	34,292	34,292	34,292	34,292	41,582	41,582	41,582	41,582	40,792	41,187	41,187	41,187	41,187
		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	66,566	98,466	98,466	98,466	98,466	98,466	98,466	99,690	99,690	99,690	13,237	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761	45,761	39,134	73,707	73,707	73,707	73,707	71,259	72,483	72,483	72,483	72,483
		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	-	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	12,540	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080	25,080
		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	29,046	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	30,458	25,404	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	27,931	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238	31,238
		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**	**$ 128,765**	**$ 181,589**	**$ 181,589**	**$ 181,589**	**$ 181,589**	**$ 181,589**	**$ 181,984**	**$ 183,208**	**$ 183,208**	**$ 183,208**	**$ 76,276**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 133,064**	**$ 126,437**	**$ 171,607**	**$ 171,607**	**$ 171,607**	**$ 171,607**	**$ 168,369**	**$ 169,988**	**$ 169,988**	**$ 169,988**	**$ 169,988**
		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	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	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	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
		5-yearly Dam movement surve	PWA	$ 600,000	40,000					40,000					40,000					40,000					40,000					40,000					40,000					40,000				
		20-yearly Dam safety review	PWA	$ 600,000	200,000																				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	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	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	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		**$ 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**	**$ 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**	**$ 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**	**$ 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			**$ 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**	**$ 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**	**$ 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**	**$ 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			**$ 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**	**$ 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**	**$ 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**	**$ 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 $)				**Total**																																								
				80 years	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 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	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	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		**$ 5,641,791**	$ -	$ -	$ 1	$ -	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 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			**$ 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	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 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			$ -	-	-	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	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 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	-	-	1	-	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	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		**$ 49,365,702**	$ -	$ -	$ 1	$ -	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 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	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 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		**$ 19,402,383**	$ -	$ -	$ -	$ -	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 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			**$ 68,768,085**	$ -	$ -	$ 1	$ -	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 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**	**$ 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**	**$ 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**
	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 $)				**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	81
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	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	73,270	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		**$ 5,641,791**	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 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			**$ 14,800,541**	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 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			**$ 14,800,542**	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 73,270	$ 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	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	641,113	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		**$ 49,365,702**	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 641,113	$ 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	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 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		**$ 19,402,383**	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 251,979	$ 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			**$ 68,768,085**	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 893,092	$ 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**	**$ 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**	**$ 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	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 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	148,613	150,099	151,600	153,116	154,647	156,194	157,756	159,333	160,926	162,536	164,161	165,803	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	Jacobs 2020	$ 600,000	-	-	-	-	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000
Spare parts and accessories	Jacobs 2020	$ 3,990,000	-	-	-	-	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	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
Bores Renewals (50 years)	Jacobs 2020	$ 1,485,000																																								
Mechanical Renewals (25 years)	Jacobs 2020	$ 20,220,000																													6,740,000											
Electrical Renewals (25 years)	Jacobs 2020	$ 15,360,000																													5,120,000											
Civil including Pipelines Renewals (85 years)		$ -																																								
Instrumentation Control Communications (15 yrs)	Jacobs 2020	$ 10,450,000																			2,090,000															2,090,000						
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	$ 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	$ 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		**$ 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	$ 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	$ 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
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	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	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	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	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	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 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	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	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	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	$ 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
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	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	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	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	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	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		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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)		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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	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	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	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 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	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 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**	**$ 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**	**$ 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**	**$ 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	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 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	221,264	223,477	225,712	227,969	230,248	232,551	234,876	237,225	239,597	241,993	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	Jacobs 2020	$ 600,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	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	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
Bores Renewals (50 years)	Jacobs 2020	$ 1,485,000														1,485,000																										
Mechanical Renewals (25 years)	Jacobs 2020	$ 20,220,000														6,740,000																									6,740,000	
Electrical Renewals (25 years)	Jacobs 2020	$ 15,360,000														5,120,000																									5,120,000	
Civil including Pipelines Renewals (85 years)		$ -																																								
Instrumentation Control Communications (15 yrs)	Jacobs 2020	$ 10,450,000									2,090,000															2,090,000															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	$ 282,264	$ 335,477	$ 288,712	$ 13,636,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993	$ 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		**$ 104,410,077**	$ 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	$ 13,636,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993	$ 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
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	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	158,425	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	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	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	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 172,425	$ 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	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	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	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	$ 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
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	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	144,000	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	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	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	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		$ -																																								
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)		$ -																																								
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	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	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	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 688,000	$ 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	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 860,425	$ 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**	**$ 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**	**$ 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**	**$ 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%																																									

Section	Item	Source	Total all years	1	2	3	4	5	6	7	8	9	10
Life cycle cost analysis - Alstonville Option													
Estimated costs ($'s)													
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	-	-	-	-	-	-	-	-
	<u>**Construction costs (asset renewal life)**</u>		$ -	-	-		-	-	-	-	-	-	-
	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	-	-	-	-	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	$ 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**	$ -	$ -	$ -	$ -	$ 155,000	$ 157,400	$ 159,814	$ 162,242	$ 164,685	$ 217,141
Total acquisition costs			**$ 93,374,077**	$ 492,000	$ 7,120,000	$ 9,164,500	$ 9,164,500	$ 155,000	$ 157,400	$ 159,814	$ 162,242	$ 164,685	$ 217,141
Ongoing operating and maintenance (recurring)													
Maintenance costs													
	Scheduled/preventative maintenance	Jacobs 2020	$ 3,482,510	-	-	-	-	45,823	45,823	45,823	45,823	45,823	45,823
	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		**$ 4,546,510**	$ -	$ -	$ -	$ -	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823
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	$ 7,296,000	-	-	-	-	96,000	96,000	96,000	96,000	96,000	96,000
	Utilities - GWTP	Jacobs 2020	$ 8,755,200					115,200	115,200	115,200	115,200	115,200	115,200
	Chemical Supplies and consumables	Jacobs 2020	$ 9,728,000	-	-	-	-	128,000	128,000	128,000	128,000	128,000	128,000
	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		**$ 45,843,200**	$ -	$ -	$ -	$ -	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200	$ 603,200
Total operating and maintenance costs			**$ 50,389,710**	$ -	$ -	$ -	$ -	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023
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**	**$ 818,023**	**$ 820,423**	**$ 822,837**	**$ 825,265**	**$ 827,707**	**$ 880,164**

Section	Item	11	12	13	14	15	16	17	18	19	20
	Scheme investigation costs	-	-	-	-	-	-	-	-	-	
	Design and documentation costs	-	-	-	-	-	-	-	-	-	
	Environmental approval costs	-	-	-	-	-	-	-	-	-	
	Project management costs	-	-	-	-	-	-	-	-	-	
	land acquistion costs	-	-	-	-	-	-	-	-	-	
	Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	
	Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	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
	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
	Scheduled/preventative maintenance	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
	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
	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	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
	Chemical Supplies and consumables	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
	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	$ 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
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs		**$ 832,635**	**$ 835,121**	**$ 837,622**	**$ 840,138**	**$ 842,670**	**$ 895,216**	**$ 847,778**	**$ 850,356**	**$ 2,942,949**	**$ 855,558**

Section	Item	21	22	23	24	25	26	27	28	29	30
	Scheme investigation costs				-	-	-	-	-	-	-
	Design and documentation costs				-	-	-	-	-	-	-
	Environmental approval costs				-	-	-	-	-	-	-
	Project management costs				-	-	-	-	-	-	-
	land acquistion costs				-	-	-	-	-	-	-
	Construction costs (asset renewal life)				-	-	-	-	-	-	-
	Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	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
	Mechanical Renewals (25 years)									6,740,000	
	Electrical Renewals (25 years)									5,120,000	
	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
	Scheduled/preventative maintenance	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
	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
	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	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
	Chemical Supplies and consumables	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
	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	$ 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
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs		**$ 858,184**	**$ 910,825**	**$ 863,483**	**$ 866,158**	**$ 868,849**	**$ 871,557**	**$ 874,283**	**$ 927,025**	**$ 12,739,785**	**$ 882,563**

Section	Item	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	-	-	-	-	-	-	-	-	-	-
	Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
	Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	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
	Instrumentation Control Communications (15 yrs)				2,090,000						
	Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
	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
	Scheduled/preventative maintenance	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
	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
	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	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
	Chemical Supplies and consumables	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
	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	$ 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
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs		**$ 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		

Section	Item	Source	Total all years	41	42	43	44	45	46	47	48	49	50
Life cycle cost analysis - Alstonville Option													
Estimated costs ($'s)													
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	-	-	-	-	-	-	-	-	-	-
	<u>**Construction costs (asset renewal life)**</u>		$ -	-	-	-	-	-	-	-	-	-	-
	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	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	$ 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									2,090,000	
	Other repair costs (specify)		$ -	-	-	-	-	-	-	-	-	-	-
	Major filter renewals		$ -										
			$ -	-	-	-	-	-	-	-	-	-	-
	Total renewal costs		**$ 67,433,077**	$ 251,308	$ 254,311	$ 257,334	$ 260,377	$ 263,441	$ 316,525	$ 269,631	$ 272,757	$ 2,365,904	$ 279,074
Total acquisition costs			**$ 93,374,077**	$ 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	$ 3,482,510	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823	45,823
	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		**$ 4,546,510**	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823	$ 59,823
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	$ 7,296,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
	Utilities - GWTP	Jacobs 2020	$ 8,755,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200	115,200
	Chemical Supplies and consumables	Jacobs 2020	$ 9,728,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000	128,000
	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		**$ 45,843,200**	$ 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			**$ 50,389,710**	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023	$ 663,023
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**	**$ 914,330**	**$ 917,333**	**$ 920,356**	**$ 923,400**	**$ 926,463**	**$ 979,548**	**$ 932,653**	**$ 935,779**	**$ 3,028,927**	**$ 942,096**

Section	Item	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	-	-	-	-	-	-	-	-	-	-
	Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
	Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
	Existing facility modifications	-	-	-	-	-	-	-	-	-	-
	Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	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)				990,000						
	Mechanical Renewals (25 years)				6,740,000						
	Electrical Renewals (25 years)				5,120,000						
	Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-
	Total renewal costs	$ 282,264	$ 335,477	$ 288,712	$ 13,141,969	$ 295,248	$ 298,551	$ 301,876	$ 355,225	$ 308,597	$ 311,993
Total acquisition costs		$ 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
	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	$ 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
	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	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
	Chemical Supplies and consumables	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
	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	$ 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
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs		**$ 945,287**	**$ 998,499**	**$ 951,734**	**$ 13,804,991**	**$ 958,271**	**$ 961,573**	**$ 964,899**	**$ 1,018,248**	**$ 971,620**	**$ 975,016**

Section	Item	61	62	63	64	65	66	67	68	69	70
	Scheme investigation costs	-	-	-	-	-	-	-	-	-	-
	Design and documentation costs	-	-	-	-	-	-	-	-	-	-
	Environmental approval costs	-	-	-	-	-	-	-	-	-	-
	Project management costs	-	-	-	-	-	-	-	-	-	-
	land acquistion costs	-	-	-	-	-	-	-	-	-	-
	Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
	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
	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
	Instrumentation Control Communications (15 yrs)				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
Total acquisition costs		$ 315,413	$ 318,858	$ 322,326	$ 2,465,819	$ 329,338	$ 332,881	$ 336,450	$ 340,044	$ 343,665	$ 397,311
	Scheduled/preventative maintenance	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
	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
	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	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
	Chemical Supplies and consumables	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
	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	$ 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
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**

Section	Item	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	-	-	-	-	-	-				
	Construction costs (asset renewal life)	-	-	-	-	-	-				
	Existing supply network modifications	-	-	-	-	-	-				
	Existing facility modifications	-	-	-	-	-	-				
	Other capital costs (specify)	-	-	-	-	-	-				
		-	-	-	-	-	-				
	Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -				
	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
	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	$ 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
	Scheduled/preventative maintenance	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
	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
	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	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
	Chemical Supplies and consumables	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
	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	$ 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
Total disposal costs		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs		**$ 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
Initial acquistion costs (non-recurring)												
Capital costs												
Scheme investigation costs (2%)	Jacobs, 2020	$ 600,000	590,000	-	-	-	-	-	-	-	-	-
Design and documentation costs (7%)	Jacobs, 2020	$ 2,087,000	-	2,055,000	-	-	-	-	-	-	-	-
Environmental approval costs (4%)	Jacobs, 2020	$ 1,193,000	-	-	1,175,000	-	-	-	-	-	-	-
Project management costs (2.5%)	Jacobs, 2020	$ 746,000	-	-	735,000	-	-	-	-	-	-	-
Land acquistion costs	Jacobs, 2020	$ 7,020,000	-	-	6,800,000	-	-	-	-	-	-	-
Construction costs (asset renewal life)		$ -	-	-	-		-	-	-	-	-	-
Bores (50 years)	Jacobs, 2020	$ 1,015,000				845,000						
Mechanical (25 years)	Jacobs, 2020	$ 9,940,000				9,720,000						
Electrical (25 years)	Jacobs, 2020	$ 7,045,000				6,925,000						
Civil including Pipelines (85 years)	Jacobs, 2020	$ 17,000,000				16,770,000						
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 3,013,000				2,990,000						
Integration costs Integration costs (4%)	Jacobs, 2020	$ 1,193,000	-	-	1,175,000	-	-	-	-	-	-	-
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	$ -	$ -	$ -	$ -	$ -	$ -
Renewals		$ -										
Repairs/unscheduled maintenance	Jacobs, 2020	$ 22,604,395	-	-	-	-	200,000	202,000	204,020	206,060	208,121	210,202
Upgrades and refurbishments	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	-	-	-	-	50,000
Spare parts and accessories	Jacobs, 2020	$ 4,370,000	-	-	-	-	20,000	21,000	22,000	23,000	24,000	25,000
Bores Renewals (50 years)	Jacobs, 2020	$ 1,015,000										
Mechanical Renewals (25 years)	Jacobs, 2020	$ 29,600,000										
Electrical Renewals (25 years)	Jacobs, 2020	$ 21,015,000										
Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ 69,000										
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 14,950,000										
Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-
Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-		-	-	-	-	-	-	-
		$ -	-	-	-	-	-	-	-	-	-	-
		$ -										
Total renewal costs		$ 96,773,395	$ -	$ -	$ -	$ -	$ 220,000	$ 223,000	$ 226,020	$ 229,060	$ 232,121	$ 285,202
		$ -										
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
		$ -										
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
		$ -										
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
Waste disposal	Jacobs, 2020	$ 2,456,000	-	-	-	-	14,000	14,000	14,000	14,000	14,000	14,000
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
		$ -										
Operating costs		$ -										
Staffing costs - Borefield and Transfer	Jacobs, 2020	$ 9,120,000	-	-	-	-	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
Utilities - Borefield and Transfer	Jacobs, 2020	$ 13,204,800					153,600	153,600	153,600	153,600	153,600	153,600
Utilities - GWTP	Jacobs, 2020	$ 15,845,760					184,320	184,320	184,320	184,320	184,320	184,320
Chemical Supplies and consumables GWTP	Jacobs, 2020	$ 17,606,400	-	-	-	-	204,800	204,800	204,800	204,800	204,800	204,800
Training	Jacobs, 2020	$ 114,000	-	-	-	-	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
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
		$ -										
		$ -										
Total operating costs		$ 72,420,960	$ -	$ -	$ -	$ -	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720
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
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**

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
Scheme investigation costs (2%)	-	-	-	-	-	-	-	-	10,000	-
Design and documentation costs (7%)	-	-	-	-	-	-	-	-	-	32,000
Environmental approval costs (4%)	-	-	-	-	-	-	-	-	-	-
Project management costs (2.5%)	-	-	-	-	-	-	-	-	-	-
Land acquistion costs	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,000	$ 32,000
Repairs/unscheduled maintenance	212,304	214,427	216,571	218,737	220,924	223,134	225,365	227,619	229,895	232,194
Upgrades and refurbishments	-	-	-	-	-	50,000	-	-	-	-
Spare parts and accessories	26,000	27,000	28,000	29,000	30,000	31,000	32,000	33,000	34,000	35,000
Instrumentation Control Communications (15 yrs									2,990,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals		-	300,000	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 238,304	$ 241,427	$ 544,571	$ 247,737	$ 250,924	$ 304,134	$ 257,365	$ 260,619	$ 3,253,895	$ 267,194
Total acquisition costs	$ 238,304	$ 241,427	$ 544,571	$ 247,737	$ 250,924	$ 304,134	$ 257,365	$ 260,619	$ 3,263,895	$ 299,194
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 238,304	$ 241,427	$ 544,571	$ 247,737	$ 250,924	$ 304,134	$ 257,365	$ 260,619	$ 3,263,895	$ 299,194
Lease payments	-	-	-	-	-	-	-	-	-	-
Residual lease payments	-	-	-	-	-	-	-	-	-	-
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250	186,250
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	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250	$ 200,250
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
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	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600
Utilities - GWTP	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320	184,320
Chemical Supplies and consumables GWTP	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800	204,800
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	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
Total operating costs	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720	$ 881,720
Total operating and maintenance costs	$ 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
End-of-life disposal costs of the equipment	-	-	-	-	-	-	-	-	-	-
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	**$ 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**

Estimated costs (2020 $)	21	22	23	24	25	26	27	28	29	30
Scheme investigation costs (2%)	-	-		-	-	-	-	-	-	-
Design and documentation costs (7%)	-	-		-	-	-	-	-	-	-
Environmental approval costs (4%)	18,000	-		-	-	-	-	-	-	-
Project management costs (2.5%)	11,000	-		-	-	-	-	-	-	-
Land acquistion costs	220,000	-		-	-	-	-	-	-	-
Construction costs (asset renewal life)	-			-	-	-	-	-	-	-
Bores (50 years)		170,000								
Mechanical (25 years)		220,000								
Electrical (25 years)		120,000								
Civil including Pipelines (85 years)		230,000								
Instrumentation Control Communications (15 yrs		23,000								
Integration costs (4%)	18,000	-		-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ 267,000	$ 763,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	234,516	236,861	239,229	241,622	244,038	246,478	248,943	251,433	253,947	256,486
Upgrades and refurbishments	-	50,000	-	-	-	-	-	100,000	-	-
Spare parts and accessories	36,000	37,000	38,000	39,000	40,000	41,000	42,000	43,000	44,000	45,000
Mechanical Renewals (25 years)									9,720,000	
Electrical Renewals (25 years)									6,925,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals		-	300,000	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 270,516	$ 323,861	$ 577,229	$ 280,622	$ 284,038	$ 287,478	$ 290,943	$ 394,433	$ 16,942,947	$ 301,486
Total acquisition costs	$ 537,516	$ 1,086,861	$ 577,229	$ 280,622	$ 284,038	$ 287,478	$ 290,943	$ 394,433	$ 16,942,947	$ 301,486
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 537,516	$ 1,086,861	$ 577,229	$ 280,622	$ 284,038	$ 287,478	$ 290,943	$ 394,433	$ 16,942,947	$ 301,486
Lease payments	-	-	-	-	-	-	-	-	-	-
Residual lease payments	-	-	-	-	-	-	-	-	-	-
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	186,250	190,065	190,065	190,065	190,065	52,000	52,000	52,000	52,000	52,000
Waste disposal	14,000	14,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 200,250	$ 204,065	$ 228,065	$ 228,065	$ 228,065	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
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
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	153,600	153,600	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	184,320	184,320	216,000	216,000	216,000	216,000	216,000	216,000	216,000	216,000
Chemical Supplies and consumables GWTP	204,800	204,800	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
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	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
Total operating costs	$ 881,720	$ 881,720	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000
Total operating and maintenance costs	$ 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
End-of-life disposal costs of the equipment	-	-	-	-	-	-	-	-	-	-
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	**$ 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**

Estimated costs (2020 $)	31	32	33	34	35	36	37	38	39	40
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	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
Spare parts and accessories	46,000	47,000	48,000	49,000	50,000	51,000	52,000	53,000	54,000	55,000
Civil including Pipelines Renewals (85 years)							23,000			
Instrumentation Control Communications (15 yrs				2,990,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals		-	300,000	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 305,051	$ 308,642	$ 612,258	$ 3,405,901	$ 319,570	$ 323,265	$ 349,988	$ 330,738	$ 334,515	$ 438,321
Total acquisition costs	$ 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	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 305,051	$ 308,642	$ 612,258	$ 3,405,901	$ 319,570	$ 323,265	$ 349,988	$ 330,738	$ 334,515	$ 438,321
Lease payments	-	-	-	-	-	-	-	-	-	-
Residual lease payments	-	-	-	-	-	-	-	-	-	-
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Waste disposal	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
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
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	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	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	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
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	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
Total operating costs	$ 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	$ 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
End-of-life disposal costs of the equipment	-	-	-	-	-	-	-	-	-	-
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	**$ 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
Initial acquistion 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 acquistion 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
Upgrades and refurbishments	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	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
Bores Renewals (50 years)	Jacobs, 2020	$ 1,015,000										
Mechanical Renewals (25 years)	Jacobs, 2020	$ 29,600,000							220,000			
Electrical Renewals (25 years)	Jacobs, 2020	$ 21,015,000							120,000			
Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ 69,000										
Instrumentation Control Communications (15 yrs	Jacobs, 2020	$ 14,950,000									2,990,000	
Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-
Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-	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
		$ -										
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
		$ -										
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
		$ -										
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
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
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
		$ -										
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
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	$ 13,204,800	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
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
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	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
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
		$ -										
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
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
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**

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	316,092	319,253	322,445	325,670	328,926	332,216	335,538	338,893	342,282	345,705
Upgrades and refurbishments	-	100,000	-	-	-	-	-	100,000	-	-
Spare parts and accessories	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000
Bores Renewals (50 years)				845,000						
Mechanical Renewals (25 years)				9,720,000						
Electrical Renewals (25 years)				6,925,000						
Civil including Pipelines Renewals (85 years)		23,000								
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals		-	300,000	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 382,092	$ 509,253	$ 690,445	$ 17,884,670	$ 398,926	$ 403,216	$ 407,538	$ 511,893	$ 416,282	$ 420,705
Total acquisition costs	$ 382,092	$ 509,253	$ 690,445	$ 17,884,670	$ 398,926	$ 403,216	$ 407,538	$ 511,893	$ 416,282	$ 420,705
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 382,092	$ 509,253	$ 690,445	$ 17,884,670	$ 398,926	$ 403,216	$ 407,538	$ 511,893	$ 416,282	$ 420,705
Lease payments	-	-	-	-	-	-	-	-	-	-
Residual lease payments	-	-	-	-	-	-	-	-	-	-
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Waste disposal	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
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
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	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	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	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
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	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
Total operating costs	$ 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	$ 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
End-of-life disposal costs of the equipment	-	-	-	-	-	-	-	-	-	-
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	**$ 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**

Estimated costs (2020 $)	61	62	63	64	65	66	67	68	69	70
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	349,162	352,654	356,180	359,742	363,339	366,973	370,642	374,349	378,092	381,873
Upgrades and refurbishments	-	-	-	100,000	-	-	-	-	-	100,000
Spare parts and accessories	76,000	77,000	78,000	79,000	80,000	81,000	82,000	83,000	84,000	85,000
Civil including Pipelines Renewals (85 years)							23,000			
Instrumentation Control Communications (15 yrs				2,990,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
Major filter renewals	-	-	300,000	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total renewal costs	$ 425,162	$ 429,654	$ 734,180	$ 3,528,742	$ 443,339	$ 447,973	$ 475,642	$ 457,349	$ 462,092	$ 566,873
Total acquisition costs	$ 425,162	$ 429,654	$ 734,180	$ 3,528,742	$ 443,339	$ 447,973	$ 475,642	$ 457,349	$ 462,092	$ 566,873
less Trade-in of item being replaced	-	-	-	-	-	-	-	-	-	-
Net acquisition costs	$ 425,162	$ 429,654	$ 734,180	$ 3,528,742	$ 443,339	$ 447,973	$ 475,642	$ 457,349	$ 462,092	$ 566,873
Lease payments	-	-	-	-	-	-	-	-	-	-
Residual lease payments	-	-	-	-	-	-	-	-	-	-
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Waste disposal	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
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
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	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	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	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
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	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
Total operating costs	$ 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	$ 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
End-of-life disposal costs of the equipment	-	-	-	-	-	-	-	-	-	-
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	**$ 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**

Estimated costs (2020 $)	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 acquistion costs	-	-	-	-	-	-	-	-	-	-
Construction costs (asset renewal life)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	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	-	-	-	-
Spare parts and accessories	86,000	87,000	88,000	89,000	90,000	91,000	92,000	93,000	94,000	95,000
Bores Renewals (50 years)		170,000								
Mechanical Renewals (25 years)		220,000						9,720,000		
Electrical Renewals (25 years)		120,000						6,925,000		
Instrumentation Control Communications (15 yrs									2,990,000	
Other repair costs (specify)	-	-	-	-	-	-				
Major filter renewals	-	-	300,000	-	-	-	-	-	-	
	-	-	-	-	-	-				
Total renewal costs	$ 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	$ 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	-	-	-	-	-	-				
Net acquisition costs	$ 471,692	$ 986,549	$ 781,444	$ 486,379	$ 491,353	$ 596,366	$ 501,420	$ 17,151,514	$ 3,501,649	$ 516,826
Lease payments	-	-	-	-	-	-	-	-	-	-
Residual lease payments	-	-	-	-	-	-	-	-	-	-
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000	52,000
Waste disposal	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000
Other maintenance costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total maintenance costs	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
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
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	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Utilities - GWTP	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	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
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	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500	62,500
Total operating costs	$ 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	$ 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
End-of-life disposal costs of the equipment	-	-	-	-	-	-	-	-	-	-
Total disposal costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Costs	**$ 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 $)		Source	Total 80 years	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 acquistion 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		32,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Project management costs (2.5%)	Jacobs, 2020	$ 420,000	-	-	400,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		20,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Land acquistion costs	Jacobs, 2020	$ 690,000	-	-	465,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		225,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Construction costs (asset renewal life)		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bores (50 years)	Jacobs, 2020	$ 760,000	-	-	-	425,000																		335,000																		
	Mechanical (25 years)	Jacobs, 2020	$ 6,877,500	-	-	-	6,437,500																		440,000																		
	Electrical (25 years)	Jacobs, 2020	$ 4,402,500	-	-	-	4,162,500																		240,000																		
	Civil including Pipelines (85 years)	Jacobs, 2020	$ 12,412,500	-	-	-	12,162,500																		250,000																		
	Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 2,063,750	-	-	-	2,018,750																		45,000																		
Integration costs	Integration costs (4%)	Jacobs, 2020	$ 667,000	-	-	635,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		32,000				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	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	$ 309,000	$ 1,310,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
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	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	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	50,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000
	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	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)	Jacobs, 2020	$ 1,520,000																																								
	Mechanical Renewals (25 years)	Jacobs, 2020	$ 45,490,000																													14,870,000											
	Electrical Renewals (25 years)	Jacobs, 2020	$ 20,990,000																													10,255,000											
	Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ -																																								
	Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 23,160,000																			4,605,000															4,605,000			45,000			
	Other repair costs (specify)	Jacobs, 2020	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-		-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-		-	300,000	-	-	-	-	-	-	-		-	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	$ 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			$ 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	$ 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
			$ -																																						
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	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	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	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	$ 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
			$ -																																						
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	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	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	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	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	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	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	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	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	$ 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	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	$ 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			**$ 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	$ 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			**$ 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**	**$ 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 $)		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 acquistion 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 acquistion costs	Jacobs, 2020	$ 690,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Construction costs (asset renewal life)		$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	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	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	Jacobs, 2020	$ 1,050,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	100,000	-	-	-	-	-	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	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)	Jacobs, 2020	$ 1,520,000														1,185,000																		335,000								
	Mechanical Renewals (25 years)	Jacobs, 2020	$ 45,490,000							440,000							14,870,000																		440,000							14,870,000	
	Electrical Renewals (25 years)	Jacobs, 2020	$ 20,990,000							240,000							10,255,000																		240,000								
	Civil including Pipelines Renewals (85 years)	Jacobs, 2020	$ -																																								
	Instrumentation Control Communications (15 yrs)	Jacobs, 2020	$ 23,160,000									4,605,000			45,000												4,605,000			45,000												4,605,000	
	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		$ 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	$ 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			$ 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	$ 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
			$ -																																						
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	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	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	$ 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	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	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	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	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	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	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	$ 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	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	$ 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	$ 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**	**$ 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
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
Upgrades and refurbishments	Jacobs (2020)	$ 1,200,000	-	-	-	-	-	-	-	-	-	100,000
Spare parts and accessories	Jacobs (2020)	$ 4,750,000	-	-	-	-	25,000	26,000	27,000	28,000	29,000	30,000
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										
Other repair costs (specify)	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-
RO membranes (10 years)	Jacobs (2020)	$ 7,000,000	-	-	-	-	-	-	-	-	-	-
Major filter renewals	Jacobs, 2020	$ 2,100,000	-	-		-	-	-	-	-	-	-
Total renewal costs		**$ 79,534,395**	$ -	$ -	$ -	$ -	$ 225,000	$ 228,000	$ 231,020	$ 234,060	$ 237,121	$ 340,202
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
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
Waste disposal	Jacobs (2020)	$ 1,064,000	-	-	-	-	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
Operating costs												
Staffing costs - Borefield and Transfer	Jacobs (2020)	$ 9,120,000	-	-	-	-	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
Utilities - Borefield and Transfer	Jacobs (2020)	$ 13,132,800	-	-	-	-	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
Chemical Supplies and consumables	Jacobs (2020)	$ 21,888,000	-	-	-	-	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
WQ monitoring	Jacobs (2020)	$ -	-	-	-	-	-	-	-	-	-	-
Licences	Jacobs (2020)	$ 1,900,000	-	-	-	-	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
Total operating costs		**$ 113,316,000**	$ -	$ -	$ -	$ -	$ 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
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**

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	212,304	214,427	216,571	218,737	220,924	223,134	225,365	227,619	229,895	232,194
Upgrades and refurbishments	-	-	-	-	-	100,000	-	-	-	-
Spare parts and accessories	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000
Instrumentation Control Communications (15 yrs)									2,560,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
RO membranes (10 years)	-		-	-	1,000,000	-	-	-	-	
Major filter renewals		-	300,000	-	-	-	-	-	-	-
Total renewal costs	$ 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	$ 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	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	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
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
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
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	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
Chemical Supplies and consumables	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
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	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
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
Total Costs	**$ 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
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)				-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	234,516	236,861	239,229	241,622	244,038	246,478	248,943	251,433	253,947	256,486
Upgrades and refurbishments	-	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
Mechanical Renewals (25 years)									9,250,000	
Electrical Renewals (25 years)									5,910,000	
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
RO membranes (10 years)	-	-	-		1,000,000					
Major filter renewals		-	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
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
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	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
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
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
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	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
Chemical Supplies and consumables	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
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	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
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
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**

Estimated costs (2020 $)	31	32	33	34	35	36	37	38	39	40
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	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
Spare parts and accessories	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000
Instrumentation Control Communications (15 yrs)				2,560,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
RO membranes (10 years)					1,000,000					
Major filter renewals		-	300,000	-	-	-	-	-	-	-
Total renewal costs	$ 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	$ 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	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	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
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
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
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	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
Chemical Supplies and consumables	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
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	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
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
Total Costs	**$ 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
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
Upgrades and refurbishments	Jacobs (2020)	$ 1,200,000	-	-	-	-	-	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
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**	$ 347,154	$ 351,015	$ 654,905	$ 358,825	$ 1,362,773	$ 466,750	$ 370,758	$ 374,796	$ 2,938,864	$ 382,962
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
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
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)	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
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
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)	$ 13,132,800	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
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
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	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
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
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
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
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**

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	316,092	319,253	322,445	325,670	328,926	332,216	335,538	338,893	342,282	345,705
Upgrades and refurbishments	-	100,000	-	-	-	-	-	100,000	-	-
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)				1,320,000						
Mechanical Renewals (25 years)				9,250,000						
Electrical Renewals (25 years)				5,910,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
RO membranes (10 years)					1,000,000					
Major filter renewals		-	300,000	-	-	-	-	-	-	-
Total renewal costs	$ 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	$ 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	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	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
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
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
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	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
Chemical Supplies and consumables	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
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	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
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
Total Costs	**$ 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
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)	-	-	-	-	-	-	-	-	-	-
Integration costs (4%)	-	-	-	-	-	-	-	-	-	-
Existing supply network modifications	-	-	-	-	-	-	-	-	-	-
Existing facility modifications	-	-	-	-	-	-	-	-	-	-
Other capital costs (specify)	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repairs/unscheduled maintenance	349,162	352,654	356,180	359,742	363,339	366,973	370,642	374,349	378,092	381,873
Upgrades and refurbishments	-	-	-	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
Instrumentation Control Communications (15 yrs)				2,560,000						
Other repair costs (specify)	-	-	-	-	-	-	-	-	-	-
RO membranes (10 years)					1,000,000					
Major filter renewals	-	-	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
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
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scheduled/preventative maintenance	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
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
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
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	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
Chemical Supplies and consumables	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
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	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
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
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**

Estimated costs (2020 $)	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 acquistion costs	-	-	-	-	-	-				
Construction costs (asset renewal life)	-	-	-	-	-	-				
Integration costs (4%)	-	-	-	-	-	-				
Existing supply network modifications	-	-	-	-	-	-				
Existing facility modifications	-	-	-	-	-	-				
Other capital costs (specify)	-	-	-	-	-	-				
	-	-	-	-	-	-				
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -				
Repairs/unscheduled maintenance	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	-	-	-	-
Spare parts and accessories	91,000	92,000	93,000	94,000	95,000	96,000	97,000	98,000	99,000	100,000
Other repair costs (specify)	-	-	-	-	-	-				
RO membranes (10 years)					1,000,000					
Major filter renewals		-	300,000	-	-	-	-	-	-	
Total renewal costs	$ 476,692	$ 481,549	$ 786,444	$ 491,379	$ 1,496,353	$ 601,366	$ 506,420	$ 511,514	$ 516,649	$ 521,826
Total acquisition costs	$ 476,692	$ 481,549	$ 786,444	$ 491,379	$ 1,496,353	$ 601,366	$ 506,420	$ 511,514	$ 516,649	$ 521,826
Total leasing costs	$ -	$ -	$ -	$ -	$ -	$ -				
Scheduled/preventative maintenance	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
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
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
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	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
Chemical Supplies and consumables	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
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	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
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
Total Costs	**$ 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
Initial acquistion costs (non-recurring)														
	Capital costs													
		Capital cost - SeaPak 2500	GANDEN, 2020	$ 54,000,000	47,000,000									
	Integration costs			$ -										
		Existing supply network modifications		$ -										
		Existing facility modifications		$ -										
		Other capital costs (specify)		$ -										
		Total initial capital costs		**$ 54,000,000**	$ 47,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Renewals													
		Replacement UF Modules (6 years)	GANDEN, 2020	$ 23,760,000							990,000			
		Replacement RO modules (5 years)	GANDEN, 2020	$ 13,034,547						465,520				
		Total renewal costs		**$ 36,794,547**	$ -	$ -	$ -	$ -	$ -	$ 465,520	$ 990,000	$ -	$ -	$ -
	Total acquisition costs			**$ 90,794,547**	$ 47,000,000	$ -	$ -	$ -	$ -	$ 465,520	$ 990,000	$ -	$ -	$ -
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
		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
		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
		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
		Total maintenance costs		**$ 20,765,000**	$ -	$ 350,000	$ 325,000	$ 300,000	$ 275,000	$ 275,000	$ 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
		Chemical consumption	GANDEN, 2020	$ 68,640		480	480	480	480	480	480	480	480	480
		Consumables	GANDEN, 2020	$ 14,300		100	100	100	100	100	100	100	100	100
		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
		Total operating costs		**$ 103,138,940**	$ -	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580	$ 824,580
	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
	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**
	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**									

Estimated costs (2020 $)	11	12	13	14	15	16	17	18	19	20
Capital cost - SeaPak 2500					7,000,000					
Total initial capital costs	$ -	$ -	$ -	$ -	$ 7,000,000	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)			990,000						1,980,000	
Replacement RO modules (5 years)	465,520					931,039				
Total renewal costs	$ 465,520	$ -	$ 990,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Total acquisition costs	$ 465,520	$ -	$ 990,000	$ -	$ 7,000,000	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Labour (maintenance & management)	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	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	480	480	480	480	480	480	960	960	960	960
Consumables	100	100	100	100	100	100	200	200	200	200
Labour (operation)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs	$ 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	$ 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	**$ 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 $)	21	22	23	24	25	26	27	28	29	30
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)					1,980,000					
Replacement RO modules (5 years)	931,039					931,039				
Total renewal costs	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -
Total acquisition costs	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -
Labour (maintenance & management)	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	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	960	960	960	960	960	960	960	960	960	960
Consumables	200	200	200	200	200	200	200	200	200	200
Labour (operation)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs	$ 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	$ 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	**$ 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 $)	31	32	33	34	35	36	37	38	39	40
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)	1,980,000						1,980,000			
Replacement RO modules (5 years)	931,039					931,039				
Total renewal costs	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -
Total acquisition costs	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -
Labour (maintenance & management)	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	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	960	960	960	960	960	960	960	960	960	960
Consumables	200	200	200	200	200	200	200	200	200	200
Labour (operation)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs	$ 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	$ 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	**$ 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**

Life cycle cost analysis - Byron Desalination

Estimated costs (2020 $)			Source	Total 80 years	41	42	43	44	45	46	47	48	49	50
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	
		Replacement RO modules (5 years)	GANDEN, 2020	$ 13,034,547	931,039					931,039				
		Total renewal costs		**$ 36,794,547**	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
	Total acquisition costs			**$ 90,794,547**	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 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
		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
		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
		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
		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
	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
		Chemical consumption	GANDEN, 2020	$ 68,640	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
		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
		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
	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
	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**
	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%											

Estimated costs (2020 $)	51	52	53	54	55	56	57	58	59	60
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)					1,980,000					
Replacement RO modules (5 years)	931,039					931,039				
Total renewal costs	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -
Total acquisition costs	$ 931,039	$ -	$ -	$ -	$ 1,980,000	$ 931,039	$ -	$ -	$ -	$ -
Labour (maintenance & management)	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	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	960	960	960	960	960	960	960	960	960	960
Consumables	200	200	200	200	200	200	200	200	200	200
Labour (operation)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs	$ 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	$ 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	**$ 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 $)	61	62	63	64	65	66	67	68	69	70
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)	1,980,000						1,980,000			
Replacement RO modules (5 years)	931,039					931,039				
Total renewal costs	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -
Total acquisition costs	$ 2,911,039	$ -	$ -	$ -	$ -	$ 931,039	$ 1,980,000	$ -	$ -	$ -
Labour (maintenance & management)	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	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	960	960	960	960	960	960	960	960	960	960
Consumables	200	200	200	200	200	200	200	200	200	200
Labour (operation)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs	$ 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	$ 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	**$ 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**

Estimated costs (2020 $)	71	72	73	74	75	76	77	78	79	80
Total initial capital costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement UF Modules (6 years)			1,980,000						1,980,000	
Replacement RO modules (5 years)	931,039					931,039				
Total renewal costs	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Total acquisition costs	$ 931,039	$ -	$ 1,980,000	$ -	$ -	$ 931,039	$ -	$ -	$ 1,980,000	$ -
Labour (maintenance & management)	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000
Product support	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Environmental monitoring	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Water quality monitoring	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Total maintenance costs	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000	$ 260,000
Electricity	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	960	960	960	960	960	960	960	960	960	960
Consumables	200	200	200	200	200	200	200	200	200	200
Labour (operation)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
Total operating costs	$ 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	$ 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	**$ 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**

NPV Analysis												
Scenario 1: Groundwater					ML/a							
		Year available			Ultimate Proc	kWh/kL						
Stage 1	Marom Creek WTP	2025			1,570	0.91				CWT (2018)	177	kW
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**
	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 2	Woodburn groundwater							492,000	1,720,000	2,585,000	31,685,000	1,015,425
Stage 3	Tyagarah groundwater Scheme 1									590,000	2,055,000	9,885,000
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**
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							
Energy use	Marom Creek WTP	kWh/kL					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
	Alstonville groundwater	kWh/kL					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
	Woodburn groundwater	kWh/kL										1.21
		kL										1,600
	Tyagarah groundwater Scheme 1	kWh/kL										
		kL										
	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**
80 year NPV	279,388	3%										
	154,104	5%										
	96,281	7%										

Stage 1	Marom Creek WTP	22	hrs/d	4300	kL/d						
	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 2	Woodburn groundwater	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	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	**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**
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
		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
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1		1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
			2,048	2,048	2,048	2,048	2,048	2,048	2,048	2,048	2,048
	Tyagarah groundwater Scheme 2										
	Newrybar groundwater										
	Total Scheme	**4,016**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**	**7,304**

	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 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
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
Stage 5	Newrybar groundwater										
	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**
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
		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
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		2,048	2,048	2,048	2,048						
	Tyagarah groundwater Scheme 2					1.61	1.61	1.61	1.61	1.61	1.61
						4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater										
	Total Scheme	**7,304**	**7,304**	**7,304**	**7,304**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**

	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 2	Woodburn groundwater	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										
Stage 4	Tyagarah groundwater Scheme 2	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	**4,840,475**	**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**
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
		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
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
	Tyagarah groundwater Scheme 2	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater									2.21	2.21
										2,304	2,304
	Total Scheme	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**10,438**	**15,533**	**15,533**

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**
	Lifecycle expenditure	**2020**	**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 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
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
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
	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**
80 year whole-of-life cost	**836,397,007**											
80 year NPV	306,176,008	3%										
	195,922,792	5%										
	141,351,422	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
		kL	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
		kL	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
		kL	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
		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
		kL	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
		kL	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**
80 year NPV	279,388	3%										
	154,104	5%										
	96,281	7%										

	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 2	Woodburn groundwater	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	2,148,939	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	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	**7,243,957**	**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**
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
		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
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
	Tyagarah groundwater Scheme 2	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
		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**

	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 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
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
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
	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**
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
		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
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
	Tyagarah groundwater Scheme 2	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
		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**

	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 2	Woodburn groundwater	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	2,240,240	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	2,076,538	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	**7,490,453**	**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**
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
		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
		1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
	Woodburn groundwater	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
		1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	Tyagarah groundwater Scheme 1	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
	Tyagarah groundwater Scheme 2	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Newrybar groundwater	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
		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**

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%																				

	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	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	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	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		**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**

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%																				

	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	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	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	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		**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**	**11**	**12**	**13**
	Lifecycle expenditure	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
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
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
Stage 3	50 GL Dunoon Dam							55,384,835	82,600,757	82,600,757	293,174	293,174	333,174	342,423	391,671
2034 capital+2%p.a. recurrent	Nightcap WTP upgrade													9,691,073	9,691,073
	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**	**2,132,172**	**11,834,979**	**11,886,728**

	Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Lifecycle expenditure	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**
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
Stage 1	Alstonville groundwater	840,138	842,670	895,216	847,778	850,356	2,942,949	855,558	858,184	910,825	863,483	866,158	868,849	871,557	874,283
Stage 3	50 GL Dunoon Dam	440,917	490,162	579,406	665,846	715,088	764,328	813,568	1,463,768	910,424	959,661	1,008,896	1,058,130	2,998,418	1,191,037
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	387,643	387,643	387,643	387,643
	Total Scheme	**2,635,060**	**2,686,837**	**2,828,627**	**2,867,629**	**2,919,448**	**5,061,282**	**3,023,131**	**3,675,957**	**3,175,254**	**3,177,149**	**3,229,058**	**3,280,984**	**5,223,981**	**3,419,325**

	Year	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	Lifecycle expenditure	**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
Stage 1	Alstonville groundwater	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 3	50 GL Dunoon Dam	1,240,268	1,289,497	1,338,726	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	387,643	387,643	387,643
	Total Scheme	**3,521,298**	**15,383,288**	**3,575,294**	**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**	**51**	**52**	**53**
	Lifecycle expenditure	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**
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
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
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	2,687,898	2,073,873	2,067,360
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	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**	**4,987,189**	**4,426,377**	**4,373,099**

	Year	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**
	Lifecycle expenditure	**2074**	**2075**	**2076**	**2077**	**2078**	**2079**	**2080**	**2081**	**2082**	**2083**	**2084**	**2085**	**2086**	**2087**
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
Stage 1	Alstonville groundwater	13,804,991	958,271	961,573	964,899	1,018,248	971,620	975,016	978,436	981,880	985,349	3,128,842	992,360	995,903	999,472
Stage 3	50 GL Dunoon Dam	2,059,658	2,051,991	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	18,247,810	1,913,562
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	387,643	387,643	387,643	387,643
	Total Scheme	**17,218,654**	**4,364,267**	**18,825,645**	**4,355,903**	**4,401,687**	**4,347,529**	**4,343,429**	**4,379,386**	**4,335,796**	**4,333,093**	**6,469,224**	**4,325,413**	**20,597,718**	**4,267,039**

	Year	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
	Lifecycle expenditure	**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
Stage 1	Alstonville groundwater	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 3	50 GL Dunoon Dam	1,906,331	1,899,133	1,891,967	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	387,643	387,643	387,643
	Total Scheme	**4,263,403**	**4,259,825**	**4,306,306**	**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%		33%	33%	33%	100%			
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**	50%	1.30	Significant impacts are partially offset by environmental flow regime and extraction rules	Significant impacts are unlikely to be mitigated	**2.16**	50%	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											

Attachment B

Vaxa

Rous County Council
Future Water Plan 2060

Public Exhibition of revised Integrated Water Cycle Management Strategy

Report on outcomes

July 2021

Report Index

Rous County Council consultation statement

The Future Water Project 2060 (FWP2060) placed on Public Exhibition in 2021 was updated from the version placed on Public Exhibition in 2020. This followed the decision of Rous County Council (RCC) in 2020 to not proceed with the Dunoon Dam proposal.

These planning updates and stakeholder engagement are undertaken to meet RCC's obligation to the community to ensure ongoing and long-term water security in response to rising water consumption and current supply limitations.

Information provided within the FWP2060 explained RCC's need to confirm a preferred and definitive long-term water security plan. This is to provide long term water security for residents and business and reduce the risk of critical water shortages, water restrictions and other responses.

RCC greatly appreciates the time invested by constituents, residents, consumers and others who made submissions. RCC recognises there are also many stakeholders who are interested in and value water security, but who didn't make a submission during the April to May 2021 Public Exhibition phase.

RCC will again carefully consider the recent Public Exhibition submissions, building on the community's input in 2020.

Future decisions based on the scientific investigations and community feedback requires the balancing of a number of priorities including environmental, social, and economic outcomes to achieve water security to underpin to the region's future.

Ongoing communication and engagement with key stakeholders and the broader community will occur during the determination and delivery of the region's long-term water security solution.

July 2021

Independent assessment

RCC engaged the Vaxa Group, a specialist stakeholder engagement and communications agency to independently review the 2021 Public Exhibition submission data and to prepare this report.

The key author, Greg Bourke, prepared the July to September 2020 Public Exhibition submission outcomes report and was previously involved in stakeholder engagement during the preparation of the Future Water Strategy (2014). Greg was also supported by colleagues with experience in consultation and data analysis.

Greg was selected to review data and prepare the following report based on his subject matter expertise, knowledge of the region, and demonstrated impartiality during previous water strategy engagement and reporting.

1. Executive summary and high level findings

Total submissions received:	
RCC online survey:	558
Written:	1,854 (1,849 unique submitters)
Petition respondents:	11,318
Late written:	50
Through website:	7
Total:	13,782

Rous County Council (RCC) is responsible for the ongoing, secure delivery of bulk and potable water supply for the majority of areas across the four (4) constituent Councils of Lismore, Ballina, Byron, and Richmond Valley.

RCC's key responsibility is to ensure sufficient water security to meet current and longer-term demand. Water security planning factors variables such as population growth, consumption trends, climate change, along with the capability of key water infrastructure assets, such as the Rocky Creek Dam.

To meet these responsibilities and consumer expectations, across 2018-2019 RCC reviewed and updated their strategic outlook on water demand and supply. This built upon the direction set within the Future Water Strategy, adopted by RCC in 2014.

This process led to the development of the **Future Water Project 2060 (FWP2060)**, which presents options to ensure water security to at least 2060, including short and longer-term actions.

Highlights

- **13,782 "submissions"** received through a variety of means, representing a 10-fold increase from 2020 Public Exhibition phase
- Majority of submissions from the Lismore Local Government Area (LGA).
- High levels of support for the Dunoon Dam based on it being a long-term solution and able to cater for future growth needs
- Environmental and cultural / heritage factors seen as key to success, followed by agriculture & the economic
- **Online submissions only** - conditional and cautious support for groundwater as a water supply option - other options are more strongly supported.

Report context

The FWP2060 (2020 version) was placed on Public Exhibition in 2020, with the results contained in a consultation report provided to Council and made public in late 2020.

RCC decided to revise the FWP2060 based on the outcomes of the 2020 Public Exhibition to omit the Dunoon Dam option from future consideration and dispose of the land held by Council.

RCC elected to invite a further round of public review and comment about the FWP2060 (2021 version) during the most recent Public Exhibition period, which was open from 1 April to 28 May 2021.

The outcomes of the 2021 Public Exhibition phase are the subject of this report.

Key documents were made available to the public to inform submissions via the '*Future water for our region*' webpage, including the revised FWP2060, *Future Water Project 2060 IWCM Strategy, March 2021*.

The revised FWP2060 *excludes* the Dunoon dam proposal and proposes alternative water sources through groundwater harvesting and treatment, desalination, direct potable water and indirect potable water re-use. These uses would complement ongoing water extraction from Rocky Creek Dam.

Despite RCC's decision to discontinue work on the Dunoon Dam option, and the revised FWP2060 clearly reflecting this decision, the prospect of the Dunoon Dam remains in focus for engaged stakeholders.

1.1 High level findings:

Distinctly different data sets

The data received during Public Exhibition has been generated and organised through different channels and formats create three (3) distinct data sets:

- Survey content – with response to set questions
- Written submissions – based on pre-prepared proforma submission format
- Petition signatures.

The survey data generated quantitative data and rich anecdotal information, and the submissions and petitions provided more standardised wording to support set positions with respect to the FWP2060.

The data is therefore reported separately, based on considerable differences in format and origin.

The variation in submitter origin provides further reason not to co-mingle this data, as follows:

- Survey: 95.5% within constituent Council areas
- Petition: ~83% within constituent Council areas
- Submissions: 74% within constituent Council areas.

In addition to this profile, there was differing levels of contribution from the four (4) constituent Council areas across the various formats/channels. For example, 66% of online surveys originated from the Lismore LGA, whereas 25% of 'for' petitions originated from the Lismore LGA. Contribution from Byron Shire was generally low, however 47.25% of 'for' petitions originated from Byron Shire (with 2.75% within the separate 'against' submission).

While the survey was able to collect data on the proportion of town water customers versus non-town water customers, this information is not available through submissions and petitions. However the profile of town water versus non-town water consumers will vary from the profile of survey submitters and petitioners.

There is also uncertainty about the degree to which the FWP2060 document on Public Exhibition was referenced, with likely variability among the data sets. A higher percentage of FWP2060 review is presumed through survey responses, as these were both available through the project webpage.

Online survey data and support for the FWP2060

The written (proforma) submissions and petitions clearly state a position for or against the FWP2060, primarily based on a stance towards the Dunoon Dam.

With reference to support for the FWP2060 within survey data, support for groundwater can be seen as a proxy for support for FWP2060, as this is one of the lead water security strategies. The slight majority of survey respondents support the use of groundwater (50.25%); however support is stronger for:

- Indirect potable recycled water (64.25%) and direct potable recycled water (68%)
- Desalination (56.75%).

There is less support for these options among supporters of the Dunoon Dam, and the majority of respondents were from the Lismore City Council LGA. The level of support expressed for the above alternatives cannot be assumed for coastal populations.

Within the 'free text' field at the conclusion of the survey, over 70% of respondents took the opportunity to express a stance towards the Dunoon Dam (45% against, 27% for). However, as this field did not seek a view on Dunoon Dam and not all submitters took this opportunity, this proportion should be viewed with some caution.

Submissions and petition data

Based on submissions and petition data, the majority of respondents support further work being undertaken on the Dunoon Dam proposal as part of the region's water security solution, with less confidence in other water source options.

The petition data (11,318) dominated the overall data set, particularly the 10,208 respondents who expressed support for Dunoon Dam.

The minority ('for' the revised FWP2060) of petition respondents also expressed support for groundwater, in addition to:

- Water loss management focused on RCC assets
- Drought management planning
- Smart metering.

With respect to petition submissions 'for' the revised FWP2060 and in relation to groundwater, there was support expressed provided this is sustainable and not sourced from the existing upper-level Alstonville aquifer.

Key common interest from all data

While different in origin, channels and format, the data tends to converge on various preferences to secure longer term water security. The Dunoon Dam proposal is a common interest across all surveys and submissions received.

Number of unique submitters

With respect to online and written submissions, data matching shows some respondents made more than one submission. Analysis by RCC shows that between 40 and 50 respondents made both online and written submissions. However, a total of 50 double submissions within this large data set is considered statistically insignificant and could not distort the outcomes.

Data origin

The majority of submissions were received from Lismore and Ballina, and nearby surrounding areas, with the greatest number originating from the Lismore City Council LGA across almost all data sets. A significant difference was the large contribution from Byron Shire in the 'for' FWP2060 petitions, wherein 47.25% of petitions were received from this LGA, which was far greater than any other LGA.

2. Context and communications & consultation methodologies

RCC made background reports available via a dedicated page on the RCC website (https://rous.nsw.gov.au/future-water-for-our-region). To ensure the content was accessible and engaging, RCC provided the following information and tools:

- Community summary brochure
- Key documents & summaries (PDF for review and/or download)
- Responses to frequently asked questions categorised as: General, Groundwater, Other questions & Dunoon Dam.

RCC promoted the opportunity to make comment through the Public Exhibition in various ways:

- **Advertisements within media** - Information advertisement campaigns ran on two television stations with a total of 307 x 30 second advertisements being run (estimated viewer reach was over 150,000)
- **Flyers** – A combined ~33,000 information flyers were distributed in RCC constituent rate notices and via direct mail
- **Print media** - three media releases, with media coverage
- **Social media** - four social media posts on RCC's Facebook page, with 'shares' and content re-purposing by third parties
- **Information events** – 16 community and industry information events were held (direct reach over 400)
- **Radio interviews** – separate interviews on two (2) local radio stations with RCC Chair or RCC's General Manager.

Access to information to support submissions during the Public Exhibition phase

RCC updated the FWP2060 website, which also included a prominent banner on the RCC website landing page (as pictured). Based on website analytical data, there was relatively high traffic during the Public Exhibition phase. There were access peaks which likely coincided with RCC promotion, media and community activism.

RCC was able to collect information from participants about their information sources, with lead sources through social media and referral from others ('word of mouth').

Figure 1 - RCC landing page with promotion of FWP2060

Relative to the data generated there was relatively low levels of download of core FWP2060 documents. This is consistent with other anecdote (see following discussions about RCC information sessions) wherein those participating in engagement opportunities either have set views and/or have sufficient knowledge to guide or support their views.

Evidently, access to FWP2060 information was not a limitation to participation. Based on the use of standard wording within proforma submissions and petitions, many participants were satisfied to align with prepared statements.

Information events

RCC hosted 16 information events, one immediately before 1 April 2021 and 15 between 1 April to 28 May 2021. These events were attended by representatives of local industry, local government, business, and the general community. Following is the outcomes of this engagement, as provided by RCC:

- Over 400 people attended the 16 information events
- All events had a high degree of engagement and interest in the information being provided
- RCC received many questions and generally the events ran over the allocated time
- Typically, industry groups focused on specific elements of the FWP2060. Community groups' interests spanned all elements of the revised FWP2060, including why certain options were omitted from the FWP2060, i.e. stormwater harvesting or Dunoon Dam. RCC spent most time during these sessions addressing misconceptions
- Of the questions received, only a small number of questions demonstrated a high degree of knowledge of the revised FWP2060 and related documentation
- Feedback provided to RCC by event attendees was very positive - attendees actively demonstrated their appreciation for the time invested to host events, answer questions and openly share information
- Events held in the Byron Shire area had lower attendance rates and generally a lower level of engagement. (This was somewhat unexpected given potential FWP2060 actions planned for this region, and the otherwise high level of engagement in lifestyle, liveability and sustainability)
- RCC observed, during most sessions, a very clear demarcation between those who did not support the former Dunoon Dam proposal and those who did (very little grey area). While the Dunoon Dam is not part of the revised FWP2060, it was top of mind for many event attendees, which translated into the submissions received.

Aboriginal Stakeholder engagement - FWP2060

No specific FWP2060 meetings were held with Aboriginal stakeholders during the Public Exhibition phase. However, RCC provided project updates through Reconciliation Action Plan meetings, along with discussions with the Ngulingah Local Aboriginal Land Council (LALC) and Widjabul Wia-bal Peoples Native Title Claim group.

However, due to the time bounds and constraints of Public Exhibition, genuine consultation could not be accommodated. However, RCC commits to ongoing Aboriginal stakeholder engagement during the further planning and delivery of the FWP2060.

Ongoing representation following 2020 FWP2060 Public Exhibition

Submissions continued to be made by stakeholders following the 2020 Public Exhibition and leading into the 2021 Public Exhibition of the FWP2060.

Information about these submissions are included in this report, however they are not calculated as data from the 2021 FWP2060 Public Exhibition.

3. Knowledge about the FWP2060 – online survey statistics only

(Q8. How did you hear about the Future Water Project 2060?)

Table 1 - How online survey submitter was informed

Response	How did you hear about the Future Water Project 2060?	%
Word of mouth	135	24
Facebook group	114	20.5
Print newspaper	71	12.5
Rous County Council website	43	7.75
FWP brochure in our rates notice	38	6.75
Facebook + other	21	3.75
Radio	17	3
Word of mouth + other	14	2.5
Print newspaper + other	13	2.25
Online newspaper	10	1.75
Television	10	1.79
Email	7	1.25
Local government news	7	1.25
Formal information session	6	1
FWP brochure in our rates notice + other	6	1
Lismore App	6	1
Grand Total	558	

Social media, online/print newspapers and word-of-mouth were the highest rating responses, followed by information received in rates notices. Information appearing in social media and newspapers became catalysts for word of mouth.

This information demonstrates that multi-channel promotion is important for broad reach and the most effective means to convey public information. This result also demonstrates traditional print advertising remains important to RCC constituents and stakeholders. This is likely to also suit older demographics who tend to be more interested in public/ Government strategy and associated engagement, and tend to have more discretionary time.

3.1 Participation and contribution through the Public Exhibition phase

The **1 April to 28 May 2021** public exhibition phase generated four (4) core sets of data:

Table 2 – Submissions by specific channel

Format of response	Submissions
RCC online survey	558
Written submissions (largely proforma driven)	1,854
Petitions	11,317
Late (written submissions)	50

Unique submitters: 98% were unique submitters, as RCC assessed ~2% of respondents made submissions through online and written channels. This is not statistically significant or influential on the overall balance of views expressed.

Origin of submitters: Of the online and written data sets:

Table 3 – Origin of all data types

Format of response	% within constituent Councils
RCC online survey	95.5
Written submissions (largely proforma driven)	74
Petitions	~83
Late (written submissions)	Not tallied

The balance of submissions across the four (4) constituent Councils is listed further in this submission.

Online survey results

4. Online submissions

To help structure stakeholder submissions, RCC prepared an online survey seeking:

- Demographic and location data
- Information about how submitters heard about the revised FWP2060 which prompted their involvement (this is reported earlier)
- Whether they had participated in the 2020 Public Exhibition and whether their input had been accommodated
- Support for or objection to the options within the revised FWP2060 (groundwater, desalination, direct potable recycled water, indirect potable recycled water & other)
- Ranking of key aspects of FWP2060 success, as a choice between agriculture, cultural heritage, economy or environment).

A link to the online survey was provided on the dedicated page on the RCC website (https://rous.nsw.gov.au/future-water-for-our-region).

All questions in the online survey, apart from those relating to personal contact details and question 11 (a free text field) were mandatory.

Reporting explanation – data calculation

Percentages have been rounded to nearest 0.25. This was done to reduce the distraction of precise percentages (e.g. 14.67 becomes 14.75). This treatment was applied as the review of the findings doesn't require exact understanding of fractions of a percent.

Therefore, the percentage count may not always add up to 100%.

4.1 Format of survey

Table 4 - Online survey fields

Online survey fields
• Name • Age range • Contact details • Whether identified as Aboriginal or Torres Strait Islander • Postcode • Suburb • Local Government Area • Whether participated in earlier consultation • Whether town water customer, or not • Whether feedback has been included in revised FWP2060 • How did you hear about the FWP2060 • Whether support groundwater • If no, Reasons • Whether support desalination • If no, Reasons • Whether support direct potable re-use • If no, Reasons • Whether support indirect potable re-use • If no, Reasons • Other feedback (free text field) • Success outcomes from FWP (with guidance – agriculture, economic, cultural heritage, environmental (and able to make 4 choices).

4.2 Respondent information

Respondents were given the option to provide personal details as follows, and most respondents obliged. This information is held by RCC and not included in this report.

4.2.1 Age category

Q2. Please select your age category to help RCC to better understand generational visions for our region's future water security.

Data received:

Table 5 – Demographic data received through on-line survey

Age category	Count	%
15-24 years	12	2.25
25-34 years	36	6.50
35-44 years	78	14.00
45-54 years	118	21.25
55-64 years	99	17.75
65-74 years	159	28.50
75-84 years	48	8.50
85 years and older	2	0.25
No Response	6	1.00
Total	**558**	**100.00**

Discussion:

A high-level view of the demographic data reveals this is an older population profile compared to the regional population profile. This appears to be representative of residents with an interest in water security, who are likely to participate in formal consultation processes.

An older demographic is also likely to be responsible for water consumption (i.e. making decisions about their level of water consumption, paying bills, whether to install a rainwater tank etc.).

This is a very similar demographic profile of the 2020 FWP2060 online survey participants.

4.2.2 Identification as Aboriginal and/or Torres Strait Islander

Q3. Do you identify as Aboriginal and/or Torres Strait Islander?

Table 6 – Whether identify as Aboriginal or Torres Strait Islander

Response	Identify as Aboriginal and/or Torres Strait Islander	%
No	538	96.50
Yes	20	3.50
Total	558	100.00

4.2.3 Location

Q4. Postcode of your usual place of residence? Q5. Suburb of your usual place of residence?

Q6. Local government area is your usual place of residence?

Table 7 – Local Government location of respondents

Response	Count - Local government area	%
Ballina Shire	**104**	**18.75**
Bonner	1	0.25
Brisbane	1	0.25
Byron Shire	**55**	**9.75**
City of Lismore	**351**	**63.00**
Clarence Valley Council	1	0.25
Inner West Council	1	0.25
Kyogle Shire	4	0.75
Lower North Shore Sydney	1	0.25
Mid Coast Council	1	0.25
Mossman Council	1	0.25
Richmond Valley Council	**23**	**4.00**

Response	Count - Local government area	%
Rous	1	0.25
Scenic Rim	1	0.25
Tweed Shire	6	1.00
No Response	6	1.00
Total	**558**	**100.00**

Table 8- representation for constituent Councils (only)

Constituent Council Areas	Count	% of 558
Lismore City Council		**66**
*Most common location by postcode - 2480 – Lismore and environs	360	64.50
Byron Shire Council		**10**
*Most common locations by postcode - 2479 2481 2483 2482	 15 21 13 11	 2.75 3.75 2.25 2.00
Ballina Shire Council		**19.5**
*Most common locations by postcode – 2478 2477	 67 31	 12.00 5.50
Richmond Valley Shire		**4.5**
*Most common location by postcode – 2470	 8	 1.50

This is most common only, not all postcodes

Discussion: As is clear from the data above, there is larger representation from the Lismore City Council area, compared to other Council areas.

The proportions are not explained by population variations, as for example the Ballina Shire Council and Lismore City Council areas have similar populations.

The high rate of response from Lismore areas may be due to an assumption the options in the revised FWP2060 and/or the prospect of Dunoon Dam will most impact Lismore City Council area. The Dunoon Dam remains a prominent issue and has more than likely motivated responses from Lismore and the Dunoon & Channon areas in particular.

Total responses by those in Byron Shire Council and Richmond Valley Shire areas equates to ~14%, which is disproportionate to the overall implications of the FWP2060 and population distribution.

4.3 Historical participation and whether feedback included

Q7. Did you previously make a submission in response to the 'Future Water Project 2060' publicly released for feedback in 2020?

Table 9 - Whether participated previously

Response	Count - Previously made a submission in 2020	%
No	380	68.00
Yes	178	32.00

Discussion

The majority of new participants in the FWP2060 appear to have been motivated to advocate for the re-inclusion of Dunoon Dam.

4.3.1 Feedback from respondents who contributed to the previous Public Exhibition phase

Do you believe your previous feedback has been reflected in the revised 2021 release of the 'Future Water Project 2060'?

Table 10 - Whether feedback was reflected in updated FWP2060

Response	%
Yes	67.50
No	32.50

Discussion: This data suggests:

- Satisfaction among 2020 respondents ("yes") who did not support Dunoon Dam, with the 2020 decision to not progress the Dunoon Dam
- Respondents who support the Dunoon Dam identify their preference is not accommodated in the revised FWP2060 ("no" response)
- This generally aligns with 75-25 ratio of objection to the Dunoon Dam in 2020, through the then online survey.

Further data analysis re whether feedback had been accommodated.

The analysis was undertaken to check whether there were any useful associations and consistency between responses. Following are the findings in relation to groundwater support and whether 2020 feedback had been accommodated.

Whether feedback was addressed, compared to groundwater sentiment.

Table 11 - feedback re groundwater

Response	%
Whether FWP2060 included feedback – "no"	**100.00%**
'Against' (sentiment on groundwater)	50.75%
'For' (sentiment on groundwater)	44.00%
No response (sentiment on groundwater)	5.00%
Whether FWP2060 included feedback – "yes"	**100.00%**
'Against' (sentiment on groundwater)	18.75%
'For' (sentiment on groundwater)	75.50%
No response (sentiment on groundwater)	5.75%

Discussion

The most coherent outcome from this data set is that respondents who considered their feedback has been considered, supported groundwater (which is consistent with opposition to the Dunoon Dam). Supporters of the Dunoon Dam (those who didn't believe their earlier feedback had been accommodated) are mostly against groundwater, inferring this is not their preferred option.

4.4 Water source and customer base

Q6a. Are you a town water customer via either your local council or directly connected to Rous?

Table 12- Customer profile

Response	Count - Town water customer (RCC/other LGA)	%
No	187	33.50
Yes	346	62.00
No response	25	4.50

4.5 Support for water source options in the FWP2060

Respondents were asked whether they support a range of water supply sources (with no reference to Dunoon Dam or other dams, which is consistent with the revised FWP2060). Participants were also asked to provide reasons for their opposition.

(Q9 in the online survey)

Results, related to the four survey options are recorded in the following tables.

4.5.1. Groundwater

Table 13 – Relative level of support for groundwater

Response	Sentiment - 'for' or 'against' Groundwater	%
'Against'	236	42.25
'For'	280	50.25
No response	42	7.50

Discussion

When considering the overall data set, the level of acceptance of groundwater can be considered as the key proxy in gauging support for the FWP2060. Justification of objection to groundwater is listed in the following table.

4.5.1.1 Reasons for this position – opposition to groundwater use

Table 14 – Reasons for not supporting groundwater as a FWP2060 option

Responses – reason for this position (oppose)	Number of responses	%
Unsustainable, already strained, unreliable, risk of contamination	106	50.5
Insufficient knowledge/ evidence-base	33	16
Expensive	25	12
Unacceptable impacts to farming	22	10.5
Build the Dunoon Dam	18	8.5
Prefer water tanks	3	1.5
Do not build Dunoon Dam	2	1
Need population cap	1	0.5
Total	**210***	**100**

Note * This data includes multiple points made by respondents, and does not mean 210 respondents provided input.

4.1.2 Desalination

Table 15 – Relative levels of support for desalination

Response	Sentiment - 'for' or 'against' Desalination	%
'Against'	216	38.75
'For'	316	56.75
No response	26	4.75

Discussion

Within this response, there is high certainty, with only a low 'skip' rate. The degree of support for desalination is much greater than earlier consultation phase; while noting the opportunity to comment about desalination is framed differently within this 2021 online survey. The context is also different, as FWP2060 no longer includes the Dunoon Dam proposal.

This result would very likely be different if there were more respondents from coastal areas, which is also true of all responses.

4.1.1.1 Reasons for this position (do not support desalination)

When asked their reason for this position, respondents provided the following reasons within a free-text fields, with no prompts.

Table 16 – Reasons for not supporting desalination

Responses * - Reason for this position (oppose)	Number of responses	%
Too expensive, energy intensive, climate change impacts	44	29
Ecological impacts from brine	35	23
Dam more sustainable	34	23
Example of other projects which are unsuccessful, not used	24	16
Should not be needed in region with high rainfall	10	6.5
RCC does not have authority, approvals risk	3	2
Useful contingency	2	1
Other misc. responses	2	1
Total	**154***	**~100.00**

Note * This data includes multiple points made by respondents, and does not mean 154 respondents provided input.

4.5.3 Direct potable recycled water

Table 17 – Relative levels of support for direct potable reuse

Response	Sentiment - 'for' or 'against' Direct potable recycled water	%
'Against'	168	30.00
'For'	358	64.25
No response	32	5.75

4.5.4 Indirect potable recycled water

Table 18 - Relative levels of support for indirect potable re-use

Response	Sentiment - 'for' or 'against' Indirect potable recycled water	%
'Against'	139	25
'For'	379	68
No response	40	7

4.5.4.1 Reasons for this position

There were only very few responses to explain objection to this option. This may mean respondents didn't completely understand the technique and technologies, or at least to a lesser degree compared to desalination. The cited key concerns included:

- Cost of treatment, including high infrastructure costs
- Lack of community confidence
- Contamination risks
- Concern about use of chemicals
- Regulatory issues
- Support for gardening only
- If this is being seriously considered, then RCC should build dam.

4.5.5 Summary

These online survey results demonstrate there is not strong majority support for groundwater extraction, and surprisingly high support for desalination and indirect and direct potable re-use, at least compared to groundwater.

When considering the positive response to potable re-use, this result is likely to be caused by 'push' factors (away from groundwater and Dunoon Dam), rather than 'pull' factors, as these results are aberrant when considering contemporary community views across Australia.

The extent of positive support for desalination, for example, is not likely to be as strong in coastal areas compared to the hinterland (as the responses where more weighted to the Lismore City Council LGA).

(However, readers may note the large number of petitions 'for' the FWP2060 from the Byron Shire, with the inclusion of 'sustainably powered temporary desalination plants on the coast'.

4.5.5 Free text field 'Other'

Question 9e) The 'Other' field within the survey also invited additional rationale. This generated a large array of comments associated with FWP2060 inclusions and water security more broadly. This is listed below.

Table 19 - Response to free-text field 'other'

Responses – reason for this position (oppose)	Number of responses	% of respondents
Do not build Dunoon Dam	***252***	***45***
Support water re-use/ stormwater harvesting	213	38
Further application of water tanks needed	175	31
More, ongoing demand management and water efficiency	167	30
Build Dunoon Dam	***134***	***27***
Supported revised FWP2060	74	13
Support desalination	56	10
Address network leaks to save water	56	10
No use of groundwater (particularly upper levels)	34	6
Support use of groundwater	30	6
Upgrade other dams	22	4
Find alternative storage (dam) location	19	3.5
Select modular combination of sources	19	3.5
Support potable re-use	15	3
Do not support desalination	11	2
Total	**1,412**	**~100.00**

Discussion

This data set includes all comments made, with multiple points made by respondents. Over 70% of respondents used this opportunity to express a view on the Dunoon Dam as highlighted in italics. However not all respondents did so, with other using the opportunity to provide comments on new subjects. 27 respondents (~5%) did not leave additional comments.

4.6 Key aspects of measurable success

Q10. Which of the following key aspects is the most important for you to consider the measurable success of our region's Future Water Project 2060 plan? Choices are environment, cultural/heritage, economic & agriculture (+other as a free text field).

Table 20 – Measures of success of the FWP2060

Response	%
Environment	51
Economic	30
Cultural / Heritage	13
Agriculture	6

Discussion

Evidently the majority of respondents consider the highest success factor should be the environment. As follows, analysis was undertaken to assess whether there were any useful associations between the various responses.

4.6.1 Comparison between 'economic' as *most* important success factor and groundwater sentiment.

Table 21 – Comparison of economic importance compared to support for groundwater

Response	%
Economic	
No response	4.25
Do not support groundwater use	74.25
'Support groundwater use	21.50

Evidently, respondents who most value economic outcomes, have low confidence in groundwater providing sufficient long term water security.

4.6.2 Comparison between 'Environment' as most important success factor and groundwater sentiment.

Table 22 Comparison between 'Environment' as most important success factor and groundwater sentiment.

Response	%
Environment	100
Do not support groundwater	32.5
Support use of groundwater	60
No response (sentiment on groundwater)	7.5

Discussion

This is a stronger result in favour of groundwater, compared to the earlier rating. This data sub-set suggests respondents who prioritise environmental outcomes prefer groundwater instead of Dunoon Dam. This cohort tends to place higher value in demand management, water re-use and water tanks.

Which of the following key aspects is the second most important for you to consider the measurable success of our region's Future Water Project 2060 plan?

Table 23 – Second highest response

Response	%
Cultural / Heritage	42
Agriculture	27
Environment	21
Economic	15

Discussion:

Cultural/heritage didn't rank strongly as a first order success factor compared to the environment, but is dominant as a second order success factor. This would be closely associated with the prospect of the Dunoon Dam. This result is a close 'proxy' for level of support for the FWP2060, based on the close alignment of cultural heritage concerns with Dunoon Dam.

Which of the following key aspects is the third most important for you to consider the measurable success of our region's Future Water Project 2060 plan?

Table 24 – Third highest response

Response	%
Agriculture	44
Cultural / Heritage	17
Economic	24
Environment	16

Which of the following key aspects is the fourth most important for you to consider the measurable success of our region's Future 'Water Project 2060 plan?

Table 25 – 4th most important response

Response	%
Agriculture	27
Cultural / Heritage	27
Economic	41
Environment	5

Summation

Response	1st choice	2nd choice	3rd choice	4th choice
Agriculture	4	2	1	2*
Cultural / Heritage	3	1	3	2*
Economic	2	4	2	1
Environment #	1	3	4	4

** These values are the same (equal 5 rating)*

 # The lower rating for environment beyond 1st choice is explained by the number of respondents entering this as their first option

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Discussion

Respondents were able to progress beyond their highest success outcome (environment) to provide values for the remaining outcomes. The high rating for cultural heritage seems to be associated with the Dunoon Dam prospect rather than specific elements within the revised FWP2060. Economic rated behind agriculture but was still an important success factor for respondents.

Written submissions

5. Written submissions

RCC received a total of 1,854 written submissions (non-survey). Of the 1,854 submissions, **1,849** were unique submitters, as five respondents provided more than one (1) submission.

Of the 1,849 unique submitters, **681 are 'for'** the revised FWP2060 and **1,168 are 'against'**. These submissions were largely driven by separate standardised proforma documents. In addition, Council received petitions which is described in the following section.

The focus of these responses was either:

- Support for the revised FWP2060 with expressed opposition to the prospect of the Dunoon Dam and/or support for options contained within the FWP2060
- Opposition to the revised FWP2060 with expressed support for progressing the Dunoon Dam proposal (which was exempted from the FWP2060 in 2020).

5.1 Location of respondents

Of the total **1,849** written submissions received, 1,372 (~74%) were from constituent Council areas, as follows:

Table 26 – location of submitters (written submissions/ non-survey)

Location	Count	% of 1,849 *Constituent councils only*
Constituent Council Areas		**74%**
Lismore City Council	727	39.25
Most common locations -		
Lismore	206	
Dunoon/The Channon	107	
Goonellabah	145	
Tuntable Creek	25	
Nimbin	21	
Byron Shire Council	196	10.50
Most common locations -		
Byron Bay	15	
Mullumbimby	27	
Brunswick Heads	13	
Suffolk Park	22	
Ballina Shire Council	362	19.50
Most common locations -		
Ballina	119	
Alstonville	93	
Lennox Head	39	

Location	Count	% of 1,849 *Constituent councils only*
Richmond Valley Council	87	4.75
Most common locations – Richmond Valley Casino	 17 47	
Non-Constituent Council Areas		**26%**
Other Council areas (NSW and Australia)	144	-
Location not specified	333	-

Note – It is also likely some of the 333 (18%) submissions received, where location has not been specified are also from locations within constituent Council areas.

Discussion

Approximately 8% of written submissions originated from non-constituent Council areas. This percentage may be greater, as some of the 333 submissions where location is not specified are likely to be from non-constituent Council areas.

5.1.2 Percentage by constituent Councils

Table 27 - Percentage responses by constituent Councils

Council	%
Lismore City Council	53
Ballina Shire Council	26.5
Byron Shire Council	14.25
Richmond Valley Council	6.25

Non-constituent respondent locations

In addition to submissions from constituent Council areas, submissions were received from:

Table 28 – Origin of submissions outside of the constituent Council areas

State and Council	Count
NSW	
Tweed Shire Council	14
Kyogle Council	19
Coffs Harbour City Council	7
City of Sydney	6

State and Council	Count
Camden City Council	2
Clarence Valley Council	6
Queensland	
Brisbane City Council	22
Johnstone Shire Council	3
Victoria	
Nillumbik (Eltham) Shire Council	8

Submissions from organisations

Written submissions were received by individuals and organisations. Following are the submissions received by organisations and their general stance in response to the revised FWP2060. These are included, as the submitter represents broader members.

Table 29 - Submissions from organisations 'for' the FWP2060

Responses 'for' the FWP2060
• Ballina Environment Society • Byron Environment Centre • Friends of the Koala Inc. • Institute for Sustainable Futures • Lismore City Council • Lismore Greens • Member for Ballina • Tuntable Creek Landcare • Water Services Association of Australia.

Table 30 – Submissions from organisations 'against' the FWP2060

Responses 'against' the FWP2060 *
• Casino Food Co-Op • Richmond Valley Council • Save Alstonville Aquifer.

**A range of small businesses also submitted against the revised FWP2060.*

5.2 Results – 'for' the revised FWP2060

Written 'for' results & response coding ('%' are calculated using 1,849 responses)

Table 31- Support for FWP2060 and rationale

Coded responses	Count
Support for the revised FWP2060	**681**
DO NOT support Dunoon Dam	**670**
Must focus on demand management (system-wide efficiency)	634
Support sustainable groundwater harvesting (not from the upper zone of the Alstonville aquifer)	633
Smart metering	626
Potable reuse scheme	625
Drought management planning	625
Support water recycling	622
Support desalination	621
Protect Indigenous culture	599
Rainwater tanks	104
Education programs for recycling	18
Directly impacted by the Dunoon Dam	6
Prefer other dams	2

Discussion:

Consistency of responses is due to the common use of standardised proforma submissions. The 'written' submissions inclusion of the words, 'I DO NOT SUPPORT the Dunoon Dam' identifies that despite its well-publicised omission from the revised FWP2060, respondents have used the opportunity to reinforce their opposition.

There is strong support for groundwater, provided the water isn't harvested from Alstonville in direct competition with agricultural users. If RCC is not able to demonstrate this is not the case, the expressed level of support 'for' groundwater would be expected to reduce substantially.

Rainwater tanks were not one of the standard alternatives on the pro-forma, but rate relatively strongly among those 'for' the revised FWP2060.

5.3 Results 'against' the revised FWP2060

Table 32 – Results in opposition to the revised FWP2060

Responses	Count
Do not support revised FWP2060	**1,168**
Support for alternative options, including the Dunoon Dam option	**1,150**
Support for Dunoon Dam option	**1,144**
Long term solution	1,143
Cost efficiency	239
Population management/growth	223
Drought management	144
Most environmentally friendly	125
Health concerns of recycled water	117
Flood management	79

Discussion:

The use of pro-forma submissions explains the consistency in the sentiment around the first two key points. Among the free text (reasons) comments, the Dunoon Dam is favoured as a long-term option among these submitters, to the effective exclusion of all alternatives proposed in the revised FWP2060.

In the view of these respondents, the Dunoon Dam would be able to provide a long term solution. Around 10% of those 'against' view the Dunoon Dam option as the most environmentally-friendly option.

Responses regarding health concerns of recycled water can be largely explained by the wording in the pro-forma, which reads, '*I DO NOT support potable water reuse (toilet to tap) as drinking water*'.

5.4 Written submission results

Of the 1,854 written submissions received, five respondents made more than one submission and 1,652 (~90%) were in proforma format or included standardised wording from proformas. The **net result is 1,849** submissions and this is the number upon which all comparisons are based.

Table 33 – Submission count and stance towards FWP2060

Submissions	Count	%
Oppose FWP2060		
Proforma (oppose)	1,110	60.00
Individual written submissions (non-proforma) – oppose FWP2060	53	2.75
		62.75
Support FWP2060		
Proforma (Support)	542	29.25
Individual written submissions (non-proforma) – support FWP2060	139	7.50
		37.25

The revised FWP2060 proposes a suite of water security measures, which the minority of 'written' respondents (~37%) support. Groundwater received support, but not from the upper levels of the Alstonville aquifer.

The majority of 'written' respondents (63%) support further work on the Dunoon Dam option, and the majority of these respondents do not support any of the alternatives proposed in the revised FWP2060.

5.5 Submission formats

Submissions in support of the revised FWP2060 predominantly used the following proforma:

To: General Manager, Rous County Council
council@rous.nsw.gov.au
PO Box 230, Lismore NSW 2480

'Submitter name'
'Submitter address'
Free text field - *PERSONALISE your feedback here by introducing yourself, and sharing the reasons why you want our water supply to come from alternative sources to the Dunoon Dam.

I strongly appreciate the revision of the Water Future Project 2060, and the decision to remove the Dunoon Dam from further consideration in the revised IWCM, and I also acknowledge the complexity of the work Rous does to provide water for our region.

I SUPPORT these aspects of the revised IWCM, for the reasons given in the IWCM

- Water loss (including leak) management focused on Rous assets
- Section 15.4.2, development and implementation of direct potable reuse scheme beginning with a pilot scheme
- Section 15.4.3, indirect potable water reuse, especially its potential to recharge harvested aquifers
- Sustainable groundwater usage NOT from the existing upper level Alstonville aquifer used by farmers but from the untapped Alstonville deeper aquifer
- Smart metering
- Drought management/ contingency planning
- Sustainably powered temporary desalination plants on the coast in times of drought
- The disposal of land zoned for the Dunoon Dam, set out in Table 41

I DO NOT SUPPORT the Dunoon Dam.

I reject attempts by a minority of councillors continuing to campaign for the dam. The revised IWCM clearly states, "..based on the MCA [multi-criteria analysis], the most favourable scenario is groundwater."

As the IWCM recognises, the Dunoon Dam has been, and continues to be, strongly rejected by the community on many grounds, including:

● Destruction of important Widjabul Wia-bal heritage, including ancient burial sites.(1)
● Destruction of an Endangered Ecological Community of Lowland Rainforest, in particular the very rare warm-temperate rainforest on sandstone in The Channon Gorge, and impacts on endangered wildlife.(2)

● Lost opportunity to invest in system-wide water efficiency and stop potable water wastage. Only 2% of the Rous supply is used for drinking, the rest is down the toilet and in the garden. Water efficiency is the cheapest & fastest way to ensure supply-demand balance. By focussing on system efficiency, Sydney added an additional 950,000 people without a rise in consumption.(3)

● 21st century water security requires diversity in water sources. Adding another dam to the portfolio decreases the drought resilience of the water system for our region (4)

● Industrial/construction zone for The Channon/Dunoon community; noise, machinery, trucks, visual impact. Ongoing sound impact from pump house etc.

Version 1 of this section: The IWCM recognises the Dunoon Dam as an inferior option compared to a "diversified portfolio of actions to meet the region's water security needs". I object to the wording of Section 8.13 as follows: The last

sentences should read: “Further detailed studies would have been required prior to a decision to proceed with the dam option. These studies were expected to take three years to complete”, as further studies related to the dam are now redundant.

Or

Version 2 of this section: The dam option has been rejected multiple times by both the community and the Rous County Council, and has been recognised in the IWCM as an inferior option compared to a “diversified portfolio of actions to meet the region’s water security needs”. I object to the wording of Section 8.13 as follows: The last sentences should read: “Further detailed studies would have been required prior to a decision to proceed with the dam option. These studies were expected to take three years to complete”. Further studies related to the dam are now redundant, and the IWCM wording should reflect that.

I urge Rous County Council to adopt the revised IWCM as exhibited and to proceed to implement it with urgency. This will lead our region forward with wise and well informed water options for a sustainable future.

(1) Ainsworth Heritage, Cultural Heritage Impact Assessment, 2013

(2) SMEC Australia, Terrestrial Ecology Impact Assessment, 2011

(3) Metropolitan Water Plan 2006, NSW Government. Exec Summary section of the doc

https://www.dropbox.com/s/pu9898oq6kocrph/NSW%20Govt%202006%20MWP%20summary.pdf?d

(4) Australian Water Services Association, All Options on the Table, 2020

_____

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To learn more about web protocol RFC 3834 visit: https://tools.ietf.org/html/rfc3834

Written 'against' submissions were submitted predominantly using the following proforma:

Dear General Manager,

Thank you for the opportunity to comment on the Revised Draft Integrated Water Cycle Management (IWCM) Strategy.

As a permanent water supply source:
I DO NOT support groundwater (aquifer) harvesting at Woodburn, Tyagarah, Newrybar or Alstonville.
I DO NOT support desalination.
I DO NOT support potable water reuse (toilet to tap) as drinking water.

Additionally,
I DO NOT support the proposed Dunoon Dam land disposal.
I DO support the recommencement of work on the proposed Dunoon Dam option, so that reports may be completed which may result in the dam proposal being identified as a new water supply source to ensure long-term water supply security for the region.

Name: 'Submitter name'

Address: 'Submitter address'

Reasons: Free text field

'Submitter name'

5.6 Submissions received through RCC website contact portal

Seven (7) submitters provided feedback through the general feedback function on the RCC website.

Of the seven submitters, five (5) expressed objection to the prospect of the Dunoon Dam and two (2) submitters expressed support for the Dunoon Dam. It is unknown whether these submitters also provided responses through the online survey or written submissions, as this was not identified.

Petition-based Submissions

6. Petition signatures

A total of **11,318 responses in petition format** were received during the Public Exhibition period, comprised of:

- **10,208** 'against' FWP2060 (~90%) (support for Dunoon Dam)
- **1,110** 'for' FWP2060 (~10%) the revised Strategy (essentially re-expressing opposition to the prospect of the Dunoon Dam).

The 'against' submissions are evidently responding to RCC's December 2020 decision to cease work on the Dunoon Dam option.

Whilst the formats of the petitions and written submissions proformas are dissimilar, the content is very similar indicating a concerted effort by organisers to convey consistent cross-platform messaging.

6.1 Location of petitioners

A full count of the petitions was undertaken to identify location for both 'for' and 'against' the FWP2060.

6.1.1 Petitioners 'for' the FWP2060 (#1,110)

Table 34 - Petitioner locality – 'for' the FWP2060

Council	%
Byron Shire Council	47.25
Lismore City Council	25
Ballina Shire Council	11.5
Richmond Valley Council	~0
Unknown/ non-constituent LGAs	16.25

The following table identifies the ratio of petitions by constituent Councils only, when unknown/ other is removed from the data set.

Table 35 - Petitioner by constituent Council only – 'for' the FWP2060

Council	%
Byron Shire Council	56.25
Lismore City Council	30
Ballina Shire Council	13.5
Richmond Valley Council	0.25

In total, 83.75% of petitioners resided in a constituent Council LGA at the time of signing a petition, and 16.25% were from another LGA (13%) or unknown/ not provided (3.25%).

6.1.2 Petitioners 'against' the FWP2060 (#10,208)

Table 36 - Petitioner locality – 'against' the FWP2060

Council	%
Lismore City Council	39.5
Ballina Shire Council	30
Richmond Valley Council	10.75
Byron Shire Council	2.75
Unknown/ non-constituent LGAs	17.25

The following table identifies the ratio of petitions by constituent Councils only, when unknown/ other is removed from the data set.

In total, 82.75% of petitioners resided in a constituent Council LGA at the time of signing a petition, and 17.25% were from another LGA (12.75%) or unknown/ not provided (4.5%).

Table 37 - Petitioner by constituent Council only – 'against' the FWP2060

Council	%
Lismore City Council	47.5
Ballina Shire Council	36
Richmond Valley Council	13
Byron Shire Council	3.25

Discussion

There is significant differences between petitions received from Byron LGA and Richmond Valley LGA across both data sets, and also compared to other data sources. This suggests 'recruitment' of petitioners is localised and highly variable, depending on location and opportunity.

Re: LGA allocations: An error factor will exist for the large 'against' data set in particular. This is due to factors such handwriting and locations described by contractions (e.g. g'ba for Goonellabah), and human error in manually counting and tabulating over 10,000 responses. The error considerations would account for very minor variation in the LGA allocation percentage, not the number of petitioners 'for' and 'against' the FWP2060.

6.2 Petitions 'against' the revised FWP2060

The 'against' petitions are in the following formats:

Petition – 1 April 2021

Sharon Cadwallader PO Box 230 Lismore 2480 **PETITION** 1st April 2021

To the General Manager Chairman & Councillors of Rous County Council
We the undersigned send a clear message to you that we

1. DO NOT SUPPORT THE AQUIFERS at Tyagarah, Newrybar, Alstonville and Woodburn being used as a permanent water source for the regional population into the future
2. DO NOT SUPPORT DESALINATION as a permanent water supply for our region
3. DO NOT SUPPORT TOILET TO TAP RECYCLED WATER as a permanent water supply for our region
4. DO NOT SUPPORT THE SALE OF THE DUNOON DAM LAND SITE
5. **DO SUPPORT CONTINUED EXPERT TECHNICAL INVESTIGATION OF THE DUNOON DAM SO THAT AN INFORMED DECISION CAN BE MADE AS TO IT'S VIABILITY AS A WATER SOURCE**

NAME (Print)	ADDRESS	Email	PHONE No.	SIGNATURE

Petition - 1 April 2021, reverse side

This is about planning for our future water supply for the region, because by 2024 an additional water source will need to be identified to meet future demand

If it stopped raining today there is only one year's supply of water in the Rocky Creek Dam to meet the demand for our Northern Rivers growing population

For 25 years Rous County Council has been planning and spending millions of dollars on investigating a new dam at Dunoon

Without notice in December 2020

5 out of 8 Rous County Councillors suddenly changed their minds and axed the Dunoon Dam as a water source option

This leaves no alternative but to source water from Aquifers or Desalination or Toilet to Tap (recycled water) or all three

On April 1 Rous County Council invited community feedback regarding using the Aquifers as a permanent water supply into the future

10,000 signatures are needed to send a strong message to Rous County Council & State Government that the adopted options without the Dunoon Dam being fully investigated is unacceptable. Ballina Shire Council & Richmond Valley Council have already sent a strong message to Rous County Council that they want the Dunoon Dam studies to continue while Lismore & Byron Bay Councils have not supported this action.

Petition - dated 10 April 2021

Return to Your Coordinator before May 28 or
Sharon Cadwallader PO Box 230 Lismore 2480

PETITION 10th April 2021

To the General Manager Rous County Council **Re: Revised Draft Integrated Water Cycle Management (IWCM) Strategy**
We the undersigned send a clear message to you that we

1. DO NOT SUPPORT THE AQUIFERS (Groundwater) at Tyagarah, Newrybar, Alstonville and Woodburn being used as a permanent water source for the regional population into the future
2. DO NOT SUPPORT DESALINATION as a permanent water supply for our region
3. DO NOT SUPPORT TOILET TO TAP (Potable Recycled Water) as a permanent water supply for our region
4. DO NOT SUPPORT THE PROPOSED DUNOON DAM LAND DISPOSAL
5. **DO SUPPORT RECOMMENCEMENT OF WORK ON THE PROPOSED DUNOON DAM OPTION, SO THAT REPORTS MAY BE COMPLETED WHICH MAY RESULT IN THE DAM PROPOSAL BEING IDENTIFIED AS A NEW WATER SUPPLY SOURCE TO ENSURE LONG-TERM WATER SUPPLY SECURITY**

NAME (Print)	ADDRESS	PHONE No.	SIGNATURE

Petition – dated 12 February 2021

Sharon Cadwallader PO Box 230 Lismore 2480 PETITION 12th February 2021

To the General Manager and Directors of Rous County Council

We the undersigned send a clear message to you that we want and need

1.The Dunoon Dam Studies to continue, so that an informed decision can be made as to the viability of The Dunoon Dam

2.We object to the Dunoon Dam land to be sold off or gifted, prior to securing a clean, cost effective alternative water source

NAME (Print)	ADDRESS	Email	PHONE No.	SIGNATURE

Although '12 February 2021' falls outside the public exhibition period, the petitions dated as such were submitted during the public exhibition period, 1 April and 28 May 2021, and are counted.

The preambles in the 'against' petitions are noteworthy on two counts: 1. There is essentially no reference to costs, save, '*For 25 years Rous County Council has been spending millions of dollars on investigating a new dam at Dunoon*' and 2. Signatories support further work/investigation on the proposed Dunoon Dam option so Council can make an informed decision. Also noteworthy is there was no free text field available for 'against' signatories to comment.

6.3 Petitions 'for' the revised FWP2060

The 'for' petitions were provided in the following formats:

Submission

Revised Future Water Project 2060 – Integrated Water Cycle Management strategy

To: General Manager, Rous County Council

PO Box 230, Lismore NSW 2480

Name: ……

Address: ……..

Email: …….

Phone: ……..

I'm surprise to see the Dunoon Dam appear so prominently in the IWCM as it has been rejected by the Rous Board and community multiple times.

I want Rous Councillors to know …….. (free text field)

I SUPPORT these aspects of the IWCM, for the reasons given in the IWCM

Water loss management focused on Rous assets

Section 15.4.2, development and implementation of direct potable reuse scheme

Sustainable groundwater usage NOT from the existing upper level Alstonville aquifer

Drought management planning

Section 15.4.3 Indirect potable water reuse, & its potential to recharge harvested aquifers

Sustainably powered temporary desalination plants on the coast

Table 41, the disposal of land zoned for the Dunoon Dam

Signed: **Date:**

I'd like to keep in touch with the campaign with updates from Water Northern Rivers ('check box')

I want to be more actively involved ('check box')

The following sentence: *'I'm surprise (sic) to see the Dunoon Dam appear so prominently in the IWCM as it has been rejected by the Rous Board and community multiple times*', are omitted from an alternative petition template.

This may be an earlier format and omission could be interpreted as recognition by those 'for' the revised Strategy that RCC is firm in its decision not to progress the Dunoon Dam option, despite references to it in the revised FWP2060.

However, the reference to Dunoon Dam is deliberately prominent and a clear indication the Dunoon Dam prospect remains a major concern for these submitters.

7. Late submissions

A total of **50 submissions** were received after the Public Exhibition period concluded on 28 May 2021. Of the 50 late submissions, 29 (58%) are 'against' and 21 (42%) are 'for' the revised FWP2060.

The submissions are noted, with the quantity of submissions not influential on the overall balance of responses received during the Public Exhibition phase.

8. Pre-exhibition submissions

Representations about the FWP2060 were received by RCC following the close of the 2020 Public Exhibition and leading into the 2021 Public Exhibition phases. This representation focused on the inclusion or exclusion of Dunoon Dam from the FWP2060.

This is represented in the following Table, prepared by RCC. Note, within this table the 'for' and 'against' refers to support for the Dunoon Dam and the 2020 FWP2060.

Table 38- Representation received by RCC between the 2020 Public Exhibition and 2021 Public Exhibition phases

Pre-exhibition submissions (submissions made post 9 September 2020* & pre-1 April 2021)						
Stance	**For**			**Against**		
Format	**Petitions**	**Petition signatures**	**Individual**	**Petitions**	**Petition signatures**	**Individual**
After 9/9/20 & before 16/12/2020^	-	-	1	-	-	210
Post 16/12/20 & pre-February 21	19	348	119	-	-	35
Post-February 2021	5	65	8	1	59#	2
Total	**24**	**413**	**128**	**1**	**59**	**247**
Grand total (signatures & individual)		**541**			**306**	

*9 September 2020 (or 9/9/20) marks the end of the first public exhibition period.

^16/12/2020 marks the date of the RCC meeting/decision to omit the Dunoon Dam option from the FWP2060.

From traditional owners.

Postcards

According to the covering letter below, '915' people signed postcards following RCC's December 2020 decision, which were then presented to RCC during the pre-Public Exhibition period. This number has not been able to be independently verified.

All signatories to the postcards are 'against' the Dunoon Dam and are in addition to the 'against' submissions tallied in the above table.

The covering letter includes a breakdown of participation statistics by the proponent, which have not been separately verified.

Covering letter

WATER Northern Rivers
5 Penelope Place
East Lismore

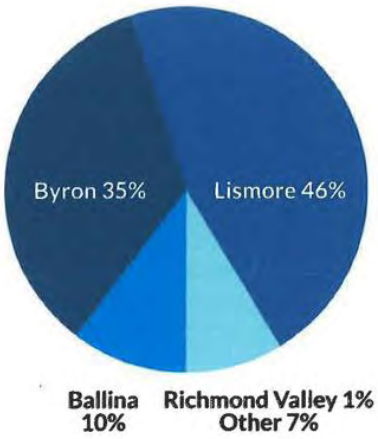
To the General manager and Rous County Councilors,

In response to this rescission motion, WATER Northern Rivers invited community members to write Thank You postcards to the Rous Board for stopping the Dunoon Dam. There was an overwhelming response. In just 15 days, after hundreds of volunteer hours and many conversations, 915 people from across the Northern Rivers have signed the postcards in support of the decision made on 16 December 2020 to cease all work on the Dunoon Dam.

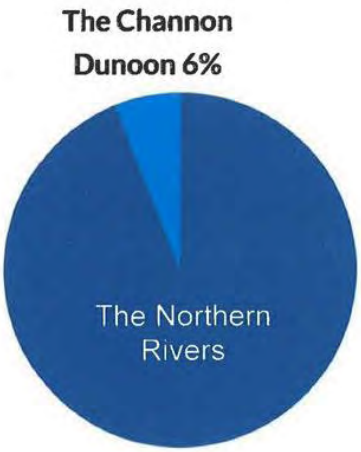
Today we present to you the 915 postcards that were signed. The text on each of these postcards reads:

> Dear Rous County Councilors,
> At the last Rous County Council meeting on December 16, 2020, you accepted the Traditional Owners' statement of opposition and acknowledged that 90% of submissions were opposed to the Dunoon Dam. You also authorised the General Manager to cease all work on the Dunoon Dam and revoke zoning entitlement and begin disposal of land
>
> Thank you! You have said ***Yes*** to saving koala and platypus habitat. ***Yes*** to preserving endangered rainforest communities. And above all, ***Yes*** to respecting Aboriginal people and their heritage.
>
> The Northern Rivers is ready to showcase 21st Century water solutions while preserving the natural beauty, ecological diversity and Aboriginal heritage which makes our region such a wonderful place.

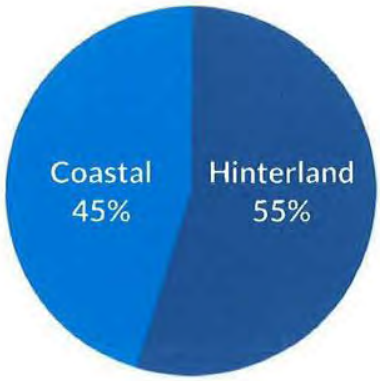
Of the 915 people who signed the postcards 35% were from Byron Shire, 10% were from Ballina Shire, 47% from Lismore City Council, and 8% from Richmond Valley Council and other areas.



Only 6% were from the area directly impacted by the proposed Dunoon Dam, a fact that proves the movement for Smart Water Options is broadly supported across the region.



In total 45% were from Coastal areas with 65% from the Hinterland.



Community support for smart water options continues to grow.

These Thank You postcards come on top of the 90% of submissions made against the dam during Rous County Council's public exhibition of the Integrated Water Management Plan. And further to the petition presented to Rous County Council on 16 November 2020 signed by 525 residents of the Northern Rivers region asking them to Stop the Dunoon Dam and rethink water options.

The WATER Northern Rivers Alliance urges Rous County Council to stay true to the intention and wording of the original motion as passed on 16 December 2020.

Sincerely,

[redacted]

On behalf of WATER Northern Rivers

WATER Northern Rivers ALLIANCE

Example postcard

Dear Rous County Councillors,

At the last Rous County Council meeting on December 16, 2020, you accepted the Traditional Owners' statement of opposition and acknowledged that 90% of submissions were opposed to the Dunoon Dam.

You also authorised the General Manager to cease all work on the Dunoon Dam, revoke the zoning entitlement and begin disposal of land.

Thank you! You have said ***Yes*** to saving koala and platypus habitat. ***Yes*** to preserving endangered rainforest communities. And above all, ***Yes*** to respecting Aboriginal people and their heritage.

The Northern Rivers is ready to showcase 21st Century water solutions while preserving the natural beauty, ecological diversity and Aboriginal heritage which makes our region such a wonderful place.

[redacted]

WATER Northern Rivers ALLIANCE

<u>Discussion:</u>

Including signed postcards, 541 (31%) 'for' and 1,219 (69%) 'against' submissions were received outside of the Public Exhibition phases. Inclusion of this data and any related analysis is not within the scope of this report.

9. Data comparison and discussion

The three main data sets (online, written & petition) have been coded and reported separately, as they have originated through different channels and formats. Only a small number of respondents provided both online survey responses and written submissions (~50 people). There is also likely to be submitters who also signed a petition.

The written and petition submissions are very similar in their content and intent, based on organised and structured responses.

The online survey was structured to guide responses around options within the revised FWP2060, which excluded the Dunoon Dam option. The online survey results provided slight majority and conditional support for groundwater extraction, with higher support for desalination and potable re-use.

Groundwater, in particular, is considered a proxy in gauging support for the revised FWP2020, at least through the online survey. However, in the broader context of 2021 Public Exhibition outcomes, Dunoon Dam remains a clear and dominant focus of all participants.

The majority of respondents within pro-forma submissions and petitions do not support the revised FWP2060, and support re-inclusion of the Dunoon Dam. There slightly stronger support for the FWP2060 in the online survey, when groundwater is accepted as a proxy for support.

Responses from the Lismore LGA was consistently high. In this context regional water security may be seen as more relevant to the Lismore 'district' and hinterland, where the Rocky Creek Dam (main water storage) and Dunoon are located, and consequences will be more directly noticeable. In this respect, the inputs received across the data sets may not represent the broader views of stakeholders across all constituent LGAs.

RCC's experience during the FWP2060 2021 information sessions, combined with the relatively low level of engagement in the FWP2060 reports (at least to the extent evident through the project website analytics) suggests many participants haven't needed project reports to guide their decision making. However, there is a demonstrable depth of understanding of the strategic change of intent in revised FWP2060, which would account for the large number of responses generated through the 2021 FWP2060.

Attachment C

abn: 71 098 971 209
w: www.ntscorp.com.au

30 June 2021
Our ref: NTS 149

General Manager – Phillip Rudd
Rous County Council
218 – 232 Molesworth Street
Lismore NSW 2480

By email only: Anthony.Acret@rous.nsw.gov.au

Dear Mr Rudd,

Re: Widjabul Wia-bal – Future Water Project 2060 Dunoon Dam Project

1 Thank you for attending the Widjabul Wia-bal Native Title Claim Group meeting on 11 June 2021. This was a valuable meeting, which shows Rous County Council's (**RCC**) commitment to developing an ongoing relationship with the Widjabul Wia-bal Native Title Claim Group (**Widjabul Wia-bal**).

Reconciliation Action Plan Advisory Group (RAPAG)

2 Firstly, and as discussed with Widjabul Wia-bal on 11 June 2021, it appears some of the RAPAG members listed in the table provided on 11 June 2021 are out of date.

3 NTSCORP Limited (NTSCORP), on behalf of the Widjabul Wia-bal Applicant, requests that RCC provide:

(a) an updated list of the current members of RAPAG;

(b) the current terms of reference governing the RAPAG members;

(c) details as to the intended process involved for reviewing the terms of reference; and

(d) details as to the election process for new members to the RAPAG, specifically how can members of the Widjabul Wia-bal People claim group become RAPAG members.

Dunoon Dam Project Aboriginal Cultural Heritage report

4 I refer to:

(a) the 2013 Ainsworth Heritage Preliminary Cultural Heritage Impact Assessment (**Ainsworth Report**);

(b) RCC's letters to Sarah Bartrim on 12 August 2020 and 15 October 2020; and

(c) the discussions had between RCC and Widjabul Wia-bal on 11 June 2021.

5 NTSCORP Limited (**NTSCORP**) has also been instructed to write to RCC to express Widjabul Wia-bal's frustration and disappointment in RCC's approach and conduct thus far concerning Aboriginal cultural heritage protection and the consultation process undertaken in relation to the proposed Dunoon Dam Project.

6 The site of the proposed Dunoon Dam (**the Project Area**) is, as RCC is aware, of particular cultural and spiritual importance to Widjabul Wia-bal, as it contains numerous Aboriginal sites, including burial sites of the ancestors of Widjabul Wia-bal People. The protection of these sites and of all Aboriginal cultural heritage across Widjabul Wia-bal country is of utmost importance.

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Obligations under the *National Parks and Wildlife Act 1974* (NSW)

7 Under Part 6 of the *National Parks and Wildlife Act 1974* (NSW) (**NPWA**), RCC has general obligations to undertake a due diligence process when dealing with Aboriginal cultural heritage. Under s90N of the NPWA and r57 of the *National Parks and Wildlife Regulation 2019* (NSW), RCC has specific obligations to conform with the requirements of the *'Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW'* and the '*Aboriginal cultural heritage consultation requirements for proponents 2010*'.

8 The Applicant considers that RCC has failed to fulfil their obligations under the NPWA, as RCC **did not**:

(a) employ a person who was an "appropriately skilled and experienced person", to produce the preliminary Aboriginal Cultural Heritage Assessment;[1]

(b) ensure that all Aboriginal objects observed during the survey were recorded and reported on AHIMs and to the Chief Executive of NPWA;[2] or

(c) comply with any of the specified requirements concerning the protection of Aboriginal burial sites.[3]

9 Further, the Applicant considers that RCC has breached section 89A of the NPWA, which provides that (emphasis added):

> "**A person who is aware of the location of an Aboriginal object** that is the property of the Crown or, not being the property of the Crown, is real property, **and does not, in the prescribed manner, notify the Chief Executive thereof within a reasonable time after the person first becomes aware of that location is guilty of an offence against this Act** unless the person believes on reasonable grounds that the Chief Executive is aware of the location of that Aboriginal object."[4]

10 Hence, RCC may be guilty of an offence under s 89A of the NPWA, as RCC had knowledge of the location of at least 16 Aboriginal sites in the Project Area. This knowledge has been held for over 7 years, during which time RCC has failed to notify the Chief Executive of the NPWA.

11 NTSCORP further notes that RCC may be liable for compensation to Widjabul Wia-bal for:

(a) any destruction or damage to the sites, which has arisen in the time period since 2013; and

(b) any decision of RCC to develop or dispose of land within the Project Area in the future.

Next Steps

12 The Applicant requests that no decisions are made by RCC in relation to the Dunoon Dam Project Area – including any decisions about the disposal of the land by Council or determining whether or not the Project should proceed – without proper consultation with Widjabul Wia-bal.

13 The Applicant also requests that RCC commission a qualified archaeologist to prepare an Aboriginal Cultural Heritage Assessment for the Project Area. Further, RCC is to use a best practice approach of consultation with Widjabul Wia-bal.

14 Finally, the Applicant requests that this letter be passed on to and tabled at the next Rous County Council Councillor's meeting, for their consideration.

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[1] *Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW, Part 6 National Parks and Wildlife Act 1974,* State of NSW and Department of Environment, Climate Change and Water NSW (**"Archaeological Code"**), p.4, at [1.6].
[2] Archaeological Code, Requirement 5b; 6; 7; 8; 23; 24; 25; 26.
[3] Requirement 25, Archaeological Code.
[4] S 89A, *National Parks and Wildlife Act 1974* (NSW)

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15 Please contact the undersigned or Sarah Bartrim on (02) 9310 3188 if you have any questions or would like to discuss this matter further.

Yours sincerely,

Tilly Vaughan
Solicitor
NTSCORP Limited

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Transfer of Marom Creek Water Treatment Plant to Rous County Council

(D21-21837)

Business activity priority	Strategy and planning
Goal 2	Align strategic direction to core functions and sustainability

RECOMMENDATION that Council:

1. As part of its water security risk mitigation approach under the Future Water Project 2060, confirms that its:

   (a) **Preferred option** is to acquire the Marom Creek Water Treatment Plant, including ancillary infrastructure and assets, and the Ellis Road and Lindendale groundwater access licenses ('The Property'), owned by Ballina Shire Council.

   (b) **Second preferred option** is to develop a groundwater treatment plant for Rous' bores located at Alstonville.

   (c) **Third preferred option** is to develop a groundwater treatment plant for Rous' bores located at Woodburn.

2. Direct the General Manager to write to the General Manager of Ballina Shire Council requesting that Ballina Shire Council not progress any of the planned upgrade works to the Marom Creek Water Treatment Plant, until Ballina Shire Council has resolved its position in relation to Rous' **Preferred option** (1(a)).

3. In the event that The Property acquisition does not proceed, confirms that the General Manager is authorised to progress the **Second preferred option**.

4. Note that the preferred aquifer to source future groundwater supplies for the **Preferred and Second preferred** options is the Clarence Moreton Basin.

5. Authorise:

   (a) The General Manager to progress the **Preferred and Second options** concurrently and negotiate the purchase of The Property as described in the body of the report.

   (b) The Chair and General Manager to sign necessary documentation under seal to effect the purchase and transfer of The Property to Rous County Council.

6. With reference to the 16 December 2020 resolution [61/20] "*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",* note that this report satisfies the requirement to provide a further update on the progress of discussions with Ballina Shire Council.

Purpose

To provide information and advice to Rous County Council to inform its decision on the proposed acquisition of Marom Creek Water Treatment Plant and ancillary infrastructure and assets, from Ballina Shire Council.

Outcome

Confirm preferred option and subsequent options and conferral of relevant authorities to progress actions to a conclusion.

Background

Rous' Future Water Project 2060 ('FWP 2060') has, since its inception, recommended combining existing groundwater and water treatment assets in the Alstonville area and incorporating them permanently into Rous County Council's ('Rous') bulk water supply as fulltime regional water sources.

These assets include:

- Rous owned groundwater bores; and
- Ballina Shire Council owned Marom Creek Water Treatment Plant ('Marom Creek WTP') and associated assets including groundwater bores.

Ballina Shire Council, at its 27 August 2020 ordinary meeting, resolved to endorse the concurrent investigation of two options for the management and asset ownership of Marom Creek WTP [270820/17]:

1. Transfer of ownership to Rous.
2. Lease to Rous to increase the area of supply.

Information regarding discussions with Ballina Shire Council was reported to Rous' 16 December 2020 Council meeting.

Role of the Marom Creek Water Treatment Plant in the FWP 2060

There are four reasons why utilising the Marom Creek WTP permanently as part of Rous' fulltime regional water supply has always been, and remains, a recommendation in the FWP 2060:

1. Capability to boost the regional water supply's secure yield so that increasing demand can be met from 2024.

2. Close proximity to the existing assets accessing groundwater from the Alstonville aquifer, which, with appropriate treatment, have the capacity to boost the regional water supply's secure yield from 2024.

3. A quick and cost-effective water supply security option as it involves mostly upgrades and augmentations to existing infrastructure.

4. The acquisition of Marom Creek WTP will provide the security of supply needed from 2024 while extensive investigations are undertaken into the potential use of additional water supply options such as new groundwater, purified recycled water and desalination schemes.

It is important to note, Ballina Shire Council currently has an existing *Safe and Secure* grant to undertake upgrades at Marom Creek WTP. These works are to improve the asset, based on its current supply arrangements. These works are not based on its potential use as a regional resource with mixed raw water supplies.

Rous resolved at its 16 December 2020 meeting [61/20] not to proceed with further investigations into the Dunoon Dam. That decision has not impacted Rous' long held position on Marom Creek WTP.

A final decision by Ballina Shire Council on the proposed transfer of Marom Creek WTP is now required.

Report considered by Ballina Shire Council – FWP 2060 – Marom Creek WTP

At its Council meeting on 27 August 2020, Ballina Shire Council received a staff report on the impacts of the FWP 2060 on Council's ownership and operation of the Marom Creek WTP. Ballina Shire Council unanimously resolved as follows in relation to that report:

> *270820/17 RESOLVED (Cr Keith Williams/Cr Eoin Johnston)*
>
> *That Council advise Rous County Council that in response to the draft Future Water Project, Council endorses the concurrent investigation of the following two options for the management and asset ownership of the Marom Creek Water Treatment Plant:*
>
> • *A long-term deed of agreement where the asset continues to be owned by Ballina Shire Council and the supply is formally included in the management of the regional water supply and its secure yield.*
>
> • *An agreement for the transfer of ownership of the Marom Creek Water Treatment Plant to Rous County Council.*

If Marom Creek WTP is to be relied on as a permanent element of the regional water supply security solution, an 'own and operate' arrangement is the only model that is appropriate. It will enable Rous as the regional bulk water supplier to exercise exclusive operational control over the asset and invest in the facility without the risk of third-party intervention.

It is not recommended that Rous progress any arrangement with Ballina Shire Council other than a complete acquisition.

Rous is required to ensure it meets its obligations to supply water in bulk to the region's councils. Both Ballina Shire Council and Rous has transferred assets and licences previously, to ensure the mutual benefits of both organisations. A lease option adds unnecessary complexity without providing any additional regional benefit to the bulk water supply network, compared to a complete transfer.

A snapshot of Ballina Shire's drinking water supply

- On average over 3,675 megalitres or 35% of bulk water from Rous' supply is distributed each year by Ballina Shire Council to most of its local government area.

- Remaining villages are serviced by the Marom Creek water supply, which is owned and operated by Ballina Shire Council. This includes the Marom Creek WTP (located in Alstonville), which sources surface water from a weir on Marom Creek. The catchment area is unprotected, heavily developed and subject to extensive agricultural and horticultural uses.

- On average, around 150 megalitres of treated water from Marom Creek WTP is supplied directly by Ballina Shire Council each year to the areas of Wardell, Cabbage Tree Island and Meerschaum Vale.

- During dry periods, Ballina Shire Council can supplement the Marom Creek supply with groundwater from two bores in Alstonville (Ellis Road) and Wollongbar (Lindendale Road). However, these assets have not undertaken that function for nearly 20 years. It is highly likely that major refurbishment or renewal will be required.

Ballina Shire Council and Rous in partnership prioritising integrated regional water supply

- Ballina Shire Council and Rous share a history of working together to prioritise a strategically integrated regional water supply.

- In 1988 Ballina Shire Council connected most of its towns and villages to Rous' Rocky Creek Dam water supply rather than build its own dam.

- The Marom Creek water source originally supplied the towns of Wollongbar and Alstonville in addition to its current service area.

- In the early 1990's the Ballina Shire Council reservoir servicing Wollongbar and Alstonville was also connected to Rous' regional bulk water supply.

- Significant growth throughout the Ballina Shire and other constituent council areas saw Emigrant Creek Dam, Wilsons River source and Alstonville and Woodburn groundwater eventually included in Rous' regional water supply resources.

- Service Level Agreements between Rous and Ballina Shire Council provide mutual obligation requirements to supply water to the Marom Creek supply area during dry periods.

The Marom Creek water supply has historically performed well during drought conditions but both Ballina Shire Council and Rous recognise that it does not provide the same level of supply security or water quality compared to the regional supply.

Incorporating the Marom Creek Water Treatment Plant into the regional supply

Ballina Shire Council and Rous staff agree that the Marom Creek WTP is a significantly under-utilised asset. It could have a critical strategic role in producing more water for the region.

- **Current:** up to 0.55 megalitres per day to meet maximum demand from the Marom Creek WTP supply area.

- **Potential:** 3.5 megalitres per day as part of the Future Water Project (significant augmentation and water quality improvements would be required, when using this WTP as a regional water supply option, with mixed raw water sources).

As part of their *Safe and Secure* grant, Ballina Shire Council has issued a tender to the market for the upgrade of Marom Creek WTP. The purpose of the upgrade is, among other things, to improve water quality monitoring and safety standards.

As part of the FWP 2060 a drinking water quality risk assessment was completed by Rous. The assessment found that any future scheme will require both conventional water treatment and advanced processes to mitigate potential risks.

Part of the FWP 2060 stage 1 action is to utilise groundwater resources from the Clarence Moreton basin (preferred aquifer) and then the Alstonville aquifer (should it be required). Further groundwater investigations are required to inform the specification for the water treatment process required to treat extracted groundwater.

Further work is required to investigate and assess the impact of utilising the Clarence Moreton basin aquifer as an ongoing source of water. These works are integral to gain support from Ballina Shire Council for the recommended **Preferred option**.

Staff advice is that it is likely that the current treatment process at the Marom Creek WTP may not represent the best option and significant augmentation may be needed. Any decisions or actions associated with the upgrade of the Marom Creek WTP would be premature given that neither Rous nor Ballina Shire Council have resolved a final position on the proposed asset transfer.

Based on these issues, staff have requested that Ballina Shire Council staff do not formally engage any contractors until after our respective Councils have determined their final positions (refer Attachment 2).

Overview of key interactions from 2016 to date

Date	Interaction on the Marom Creek Water Treatment Plant
Jun-2016	Rous is invited to participate in the BaSC - 20 Year Asset Master Plan for Marom WTP
Aug 2016 to Nov 2017	Various meetings and workshops to discuss Marom Creek WTP and the Rous regional supply
Dec-2017	Rous liaise with NSW DPIE staff on yield assessments and licensing for Alstonville groundwater, including the Marom Creek WTP
May-2018	Rous review water security requirements, inclusive of the potential use of Marom Creek WTP.
Nov-2018	BaSC finalise the 20 Year Asset Master Plan for Marom WTP
Jan-2019	Rous completes initial investigations for a Groundwater scheme and Groundwater treatment plant in Alstonville
Jan-2019	BaSC request water supply for the stand down of Marom WTP during upgrade works planned
Jun-2019	Rous completes drilling and testing program in Alstonville
Jul-2019	BaSC and Rous hold informal discussions on the potential transfer of assets associated with Marom Creek WTP to be used as part of the Rous regional bulk water supply
Nov-2019	Rous provides an update to BaSC on the Marom Creek WTP assessment - Wollongbar/Alstonville supplied by this alternative source
Dec-2019	The FWP2060 coarse assessment recommends further consideration of the Marom Creek WTP option and integration into the potential Alstonville groundwater scheme
Dec-2019	Rous requests information from BaSC to better ascertain the benefits to the regional supply from the Marom Creek WTP
Jan-2020	BaSC supplies information to support Rous' assessments
Jan-2020	Rous formally writes to BaSC to request Marom Creek WTP as an option for integration into the regional supply
Apr-2020	BaSC advise of its support for the water produced from the Marom Creek WTP to be considered as an option in the FWP2060
Apr-2020	Rous reviews possible methodologies to assess the potential compensation amount to BaSC for the Marom Creek WTP and supporting assets
May-2020	Rous advise BaSC of its preferred short-term strategy - upgrades to the Marom WTP, along with groundwater sources in Alstonville
Jul-2020	Rous publicly exhibits the FWP2060 - inclusive of the Marom Creek WTP upgrades and groundwater scheme
Aug-2020	General correspondence in reference to the due diligence assessments associated with Marom Creek WTP
Aug-2020	BaSC endorses the investigations into asset ownership or lease options of the Marom Creek WTP
Sep-2020	FWP2060 public exhibition period closes
Sep-2020	Ongoing discussions of the process to consider the transfer of assets along with assets subject to the transfer
Oct-2020	Rous/BaSC undertake asset inspections of Marom Creek WTP and supporting assets
Oct-2020	Ongoing discussions to consider the process to transfer assets
Dec-2020	Rous considers the draft IWCM and discussions in relation to the Dunoon dam proposal
Mar-2021	Rous circulates a consultant brief to complete a valuation assessment of assets subject to the proposed asset transfer for comment
Mar-2021	Meeting with BaSC to discuss the scope of work for the valuation and supporting data

Date	Interaction on the Marom Creek Water Treatment Plant
Apr-2021	Rous staff provide a briefing session to BaSC Councillors
Apr-2021	BaSC recommends that current written down value be used as a basis to form an agreement (along with other possible compensation considerations)
Apr-2021	Informal discussions on BaSC tender for Marom Creek WTP and impacts to Rous' FWP2060 stage 1 option, including requesting that no action be taken until a decision on the transfer is made
June 2021	BaSC resolves to decline tenders for the improvements to the Marom Creek WTP and negotiate with the only tenderer
June 2021	Rous advise BaSC of its concerns about the potential redundancy of improvement works should the Marom Creek WTP be used as a regional water supply option (Attachment 2)

The role of Alstonville and Woodburn groundwater resources

Rous can currently source groundwater from the Alstonville aquifer via two bores in Alstonville (Lumley Park) and Wollongbar (Convery's Lane) to supplement supply during dry periods. In addition, supplementary supply for the Lower Richmond River area is available via a bore connected to the Woodburn aquifer.

The FWP 2060 recommends:

- *Activating Alstonville's groundwater resources fulltime as an additional primary supply*

  Comment: Rous is investigating whether groundwater of sufficient quality and quantity can be accessed from the Clarence Moreton basin (preferred option) or deeper within the Alstonville aquifer (alternate option, should it be required) to ensure existing domestic and agricultural users, surface water and groundwater dependent ecosystems are not adversely impacted.

- *Retaining the existing Woodburn supply as a dry period contingency option, given it is the most viable groundwater source available with a short lead time if required in a drought*

  Comment: New bores will need to be constructed and connected as part of the Woodburn area's existing groundwater supply to provide a greater level of resilience in the event of a drought.

  At this stage, developing the Woodburn groundwater supply into a fulltime regional source is not preferred, due to it being the most viable drought contingency and provides lower overall regional benefits than the preferred option.

Regardless, appropriate water treatment will be required if groundwater is to be used on a fulltime basis.

The two available water treatment options are:

1. Use the existing, nearby Marom Creek WTP; or

2. Rous develops a new groundwater treatment plant near its existing bores.

Irrespective of the above, it is imperative that Rous commences obtaining the necessary approvals for a new treatment plant, which is required by 2024. It is recommended that both options be concurrently investigated and advanced, until a formal agreement with Ballina Shire Council has been obtained. This will ensure that Rous can meet its regional water security obligations.

Should Rous be unable to secure the transfer of the Marom Creek WTP (**Preferred option**) and subsequently determine that a new groundwater treatment plant in Alstonville (**Second preferred option**) is not viable, further actions will be necessary:

1. Rous must revamp its existing groundwater bores in Alstonville and Wollongbar to provide a greater level of resilience in the event of a drought.

2. Rous needs to determine whether developing the existing Woodburn groundwater supply into a fulltime regional water source is a worthwhile option.

The FWP 2060 has identified potential capital savings to the region from utilising the Marom Creek WTP of approximately $6.8million. Rous will be required to complete more assessments including catchment inspections and analysis, and further groundwater investigations, before a more precise estimate of cost savings will be known. Nevertheless, the integration of surface and groundwater sources provides a greater level of operational resilience, compared to a groundwater only supply, which is difficult to value in dollar terms.

Preferred option:
Acquire the Marom Creek WTP including ancillary infrastructure and assets

- **What**

Transfer ownership and operation of the Marom Creek WTP to Rous.

- **Water security benefit**

A combined groundwater and surface water source option that supplies the communities of Wollongbar and Alstonville along with the areas of Meerschaum Vale and Wardell is the most prospective short-term option. It provides certainty and the most beneficial regional water security and cost outcome.

- **Secure yield assessment**

1050 megalitres per annum (ML/a) (to the regional supply network)

- **$ cost**

Using the Written Down Value (replacement cost less accumulated depreciation) method, Marom Creek WTP, weir and land including existing groundwater bores is currently valued at $3.1million, with associated supporting assets being an additional $3.5million.

The preferred method is to use the ‘Written Down Value’ (replacement cost less accumulated depreciation) to determine the contribution amount payable to Ballina Shire Council for the proposed transfer to Rous.

This approach would include a schedule of rates, agreed terms and overarching framework to facilitate agreement on the final contribution amount.

While the treatment plant, weir and groundwater bores form the centrepiece of the Marom Creek water supply, a series of associated assets may also need to be dealt with as part of the proposed transfer, such as:

- Whites Lane Reservoir and Meerschaum Vale balance tank.
- Around 19.2 kilometres of pipelines.

It is proposed that a business case for these associated assets, subject to the transfer, be completed. These works will include field verification, asset condition and inventory assessments as well as scheme designs. This business case will consider alternatives, such as a new clear water tank and backwash pumps located at the Marom Creek WTP site, in lieu of service water pressure from the Whites Lane Reservoir. These works will not reconsider the 'Written Down Value' of these assets, but rather for Rous to complete its due diligence as part of the asset transfer and have the necessary information it requires to advance the development of this option.

Once completed, further discussions around the bulk sell points would occur between the two Councils as negotiations continue.

For more information refer to the 'Finance' comment.

- **Risk**

Ballina Shire Council commences with planned improvement works.

Ballina Shire Council has advised that they do not consider ownership to be an impediment to the use of the Marom Creek WTP as part of the regional supply. However, given the capital value of the works proposed and the differing levels of risk tolerance between the two Councils, it is recommended that only a full transfer of required assets, along with licences, rights and other powers should be considered.

Ballina Shire Council has obtained the *Safe and Secure* grant for the Marom Creek WTP upgrade. Initial enquiries by Rous indicate that if the asset was transferred, the grant would be able to be transferred.

Alternative options to the preferred option – as identified in the FWP 2060

The following two options are alternatives to the preferred option of Rous acquiring Marom Creek WTP and ancillary infrastructure and assets.

Second preferred option:
Develop a groundwater treatment plant for Rous' bores located at Alstonville

- **What**

A new Rous owned and operated water treatment plant close to an existing bore.

- **Water security benefit**

Dependent on Rous' ability to secure sufficient groundwater licences. The Clarence Moreton basin is the preferred option, given additional licences are available. If that did not happen, Rous could potentially purchase existing groundwater licences and seek to access groundwater resources from the lower areas of the Alstonville aquifer. The secure yield of the Alstonville groundwater option has been based on a treated water capacity of 4 megalitres per day (ML/d) supplying Ballina Shire areas of Wollongbar and Alstonville.

- **Secure yield assessment**

1050 ML/a, based on obtaining the required groundwater licences from NRAR.

- **$ cost**

The Alstonville groundwater option will require the replacement of existing bores and a new water treatment plant.

The total initial capital cost for this option is estimated at $39.8million.

- **Risk**

Rous has completed a drinking water quality risk assessment that identified significant potential risks related to drinking water quality for Rous and Ballina Shire Council owned bores from this groundwater source. This assessment determined that a WTP inclusive of conventional water treatment and advance processes will be required.

Alstonville aquifer has a licence embargo in place for any new licences to access groundwater. Rous' current licence limit is 680 ML/a meaning there is a need to acquire more water licences. This could be from the Clarence Moreton basin (preferred option) where licences are available. Alternatively, Rous could purchase additional existing licences to meet our long-term water supply needs from within the Alstonville aquifer. However, the long-term sustainable extraction limits and water qualities are not known at this stage. Rous is progressing works to better understand the potential suitability of this aquifer, with the results not expected to be known until the latter part of 2021. The current and future demand for water in the areas to be serviced by this Alstonville scheme option is more suitable compared to the option of moving to the Woodburn groundwater scheme.

Given that this option will result in two water treatment plants located within approximately 8kms of each other, it is likely that this option will raise "overall community value" concerns with the regulator. Significant delays in the approval process for this option is a distinct possibility.
The current estimated long-term average annual demand from the Alstonville and Wollongbar areas is 1205 ML/a.

Third preferred option:
Develop a groundwater treatment plant for Rous' bores located at Woodburn

- **What**

If investigations find that Alstonville groundwater is not a viable option, the Woodburn groundwater scheme could be reinstated in the short-term. This would include expansion of the existing bore field and relocation of existing licences impacted by the Pacific Highway alignment.

- **Water security benefit**

When compared to the preferred scheme of the Marom Creek WTP and Alstonville groundwater, the Woodburn scheme has a lower yield, yet similar overall costs. The Woodburn bore supply is also included as a dry period supply in the current operating regime, meaning an alternative dry period source would need to be identified. This may be the revamping of Rous' existing groundwater bores in Alstonville and Wollongbar to provide the required resilience in the event of a drought.

- **Secure yield assessment**

750 ML/a or approximately 70% of the preferred Alstonville scheme (based on a treated water capacity of 5 ML/d supplying the Richmond Valley areas of Broadwater, Evans Head and Woodburn).

- **$ cost**

The Woodburn groundwater option requires both new groundwater bores and a water treatment plant.

The total initial capital cost for this option is estimated at $36.5million.

- **Risk**

Current and future demand for water in the areas to be supplied by the Woodburn scheme is limited. Whilst there are several future urban development areas designated within the supply area, there are risks that these areas will not be developed further, and potential future demands may be lower than expected. The current estimated long-term average annual demand is 1132ML/a.

Governance

The governance considerations that will need to be taken into account will depend on the final options progressed. A body of work to identify and define those requirements will need to be completed in due course.

Finance

The Long-Term Financial Plan (LTFP) includes significant capital allocations to secure and augment Marom Creek WTP and associated groundwater assets. As outlined in this report, this is the **Preferred option**. It has an estimated capital cost of $38M over four years.

There are additional capital allocations for acquisition of land for the identified groundwater options in the FWP 2060.

Should the **Preferred option** not be progressed for whatever reason then Rous will proceed to the **Second** and **Third preferred options** as required.

The FWP 2060 has identified a cost differential of $6.8M between the options, excluding land acquisition or transfer costs.

It is understood that the **Second preferred option** on the Alstonville Plateau does not have any access to surface water and therefore will require purchasing of additional groundwater allocations to achieve similar water volumes. These additional costs are not included in the LTFP at this time.

The LTFP will be updated once the outcome of the preferred options is determined.

Conclusion

Transferring ownership and improvements to the Marom Creek WTP, along with modifications to the existing groundwater supply network provides the most advantageous water security and cost outcomes for the regional supply, constituent councils and the community. Both Ballina Shire Council and Rous agree that the Marom Creek WTP can play a critical strategic role in securing regional water reliability.

Ballina Shire Council is seeking to undertake improvements to its Marom Creek WTP. These improvements are to address issues concerning water quality and monitoring of the WTP performance. While these works are modest and an appropriate action for Ballina Shire Council's ongoing utilisation of the asset, they do not represent a positive long-term investment should the facility be transferred to Rous. Currently Rous is not able to determine what the optimum treatment processes are required at Marom Creek WTP based on the mixed raw water sources proposed in the FWP2060 actions. As a result, it is preferred that Ballina Shire Council defer progressing any planned upgrade works until a definite decision is made on the proposed transfer.

It is recommended Council authorise the General Manager to negotiate the final agreement and secure the transfer of Marom Creek WTP and associated water supply assets once the final bulk sell points have been determined.

Phillip Rudd
General Manager

Attachments

1. Ballina Shire Councillor briefing note - dated 7 July 2021
2. RCC to BSC correspondence - tender for Marom Creek - dated 29 June 2021

Attachment 1

Briefing note to Ballina Shire Council:

FWP2060 Stage 1 - Marom Creek WTP and Alstonville aquifer project update

7 July 2021

(D21-22082)

The following is a recap of the information provided at the Councillor briefing session 19 April 2021.

Stage 1 of the FWP 2060 relates to Maron Creek WTP and Alstonville aquifer.

With the support of Ballina Shire Council (BSC), Rous County Council (RCC) is seeking to acquire ownership and control over bulk water supply assets currently held by BSC, on behalf of the region, and implement an extensive upgrade to the Marom Creek WTP to maximise yields from existing groundwater licences held by both RCC and BSC on the Alstonville Plateau, and surface waters contained in the site's weir pool.

This recommendation has not changed from the previous versions of the FWP2060.

The 2014 Future Water Strategy, which had regional support, recommended that existing groundwater supply infrastructure could be optimised to use allocated licenced volumes to their full potential. RCC is seeking to use existing town water entitlements, where appropriate (Stage 1) and begin to investigate accessing water from the underlying aquifer, known as the Clarence Morton Basin (stage 2). Stage 2 is required to ascertain if additional groundwater sources are available and to alleviate perceived pressures on competing licence holders.

RCCs plans includes treatment of bulk water resources from the Clarence Moreton Basin (preferred option), Alstonville aquifer (if required) and adjacent surface waters (weir), however the ultimate water treatment process required is currently unknown. Challenges associated with the treatment of mixed water sources, means in all probability, that the current treatment process employed at the Marom Creek WTP will be unable to meet the required water quality standards. Rous' initial assessments indicate that the majority of the current treatment assets would need to be written off or impaired and replaced with an appropriate treatment technology.

This stage of the plan is expected to cost approximately $38M and can be completed by 2025.

RCC recommends that BSC does not enter into contract with any tenderers for upgrade works at Marom Creek WTP until both councils have resolved their respective final positions on the transfer of assets.

RCC's has one poorly performing bore where issues have been encountered during its operation, including impacts on surrounding groundwater licence holders. Whereas the remaining RCC bore has no impacts on other users or the environment whatsoever.

RCC constructed several pilot bores which drill through the basalt aquifer into the underlining basin, known as the Clarence Moreton Basin. Water quality and yields were considered appropriate for town water purposes, but further assessments are needed.

Rous County Council's short-term action is to undertake detailed hydrogeological assessments of the aquifer at a greater depth.

This action will provide the necessary evidence to dispel community concerns and understand long-term sustainable extraction limits.

Project progress update post Councillor briefing session held 19 April 2021

Actions completed

1. RCC has completed a literature review on the Clarence Morton Basin Groundwater Source.
2. Liaison with NSW Department of Planning Industry and Environment (NSW DPIE) Water Utilities branch and Groundwater Management and Science group concerning the issues associated with the underlying formation of the Alstonville Aquifer, being the Clarence Morton Basin Groundwater Source. Based on information received, RCC has decided to assess the potential long-term sustainable extraction limits from water bearing layers found in the Clarence Morton Basin aquifer.
3. Workshops to seek input into bore design and construction methodology of RCC replacement Water Supply Bore at Convery's Lane, Wollongbar.
4. Design and construction specifications for the replacement town water supply bore for Convery's Lane, Wollongbar.
5. 'In-principal' support from the NSW DPIE Groundwater Management and Science group for the final construction methodology and design.

Actions planned (3 - 6 months)

1. Completion of detailed cost estimation for the bore construction, hydrogeological assessments, and monitoring.
2. Obtain approvals to amended water supply bore approval and obtain Water Access Licencing for testing purposes.
3. Commence consultation with key stakeholders.
4. Finalise environmental approvals.
5. Commence the procurement for services to the bore construction and undertaken testing and monitoring.

Concurrent actions to the above

Negotiate with Ballina Shire Council on the elements of the Stage 1 of the revised draft FWP 2060 once direction from RCC has been obtained.

Subject to above

1. Draft the instrument of agreement.
2. Business Case for the associated assets subject to the transfer of the Marom Creek WTP.

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29 June 2021

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Dear Paul

Marom Creek WTP asset transfer as a regional water source

In reference to the Marom Creek Water Treatment Plant (WTP) upgrade and conversations with John Truman, Rous County Council (Rous) is requesting that Ballina Shire Council (BaSC) does not enter into contracts with any tenderers for these works until both Councils have resolved their respective final positions on the transfer of assets.

Rous, in conjunction with our consultant, has completed a drinking water quality risk assessment that identified significant potential risks related to the drinking water quality for the potential water sources to be used. This assessment determined that a WTP with conventional water treatment and advanced processes to mitigate potential risks will be required. As Rous is also seeking to access groundwater resources from both the Alstonville aquifer and the Clarence Moreton basin, the ultimate conventional water treatment process required is not known. However, it is likely that the current treatment process at the Marom Creek WTP may not represent the best option and significant augmentation may be needed.

Rous has also received advice that it should consider the most recent National Health and Medical Research Council (NHMRC) guidelines on microbial health-based targets (HBT) for treatment train design, given the level of augmentation and new supply zones that are proposed.

Therefore, Rous is requesting that no formal engagement occur until after our respective Councils have determined their final positions on the transfer of assets.

The extent of the potential transfer of assets has been discussed between our respective staff on many occasions. Rous' preferred option is to combine the Marom Creek weir pool with both the current and potential groundwater sources and treat these water sources at the Marom Creek WTP site. The Marom Creek WTP, weir and Ellis Road and Lindendale bores along with their respective groundwater access licences, forms the centrepiece of the preferred option. However, a series of associated assets may also need to be dealt with as part of the proposed transfer, including:

- Whites Lane reservoir
- Wardell pipeline
- Wollongbar pipeline #
- Russellton Industrial Estate pipeline #

Rous acknowledges that the most recent advice from BaSC did not include these assets within the potential transfer.

I refer to the attached plan.

Rous believes that using the current fair value (or written down value) method is the only approach to determining the compensation amount payable to BaSC for the proposed transfer of assets. Rous would prefer to progress with an agreement based on the centrepiece assets, with an overarching agreement that includes a framework to facilitate an outcome on the associated assets.

Rous is proposing to complete a business case for the associated assets subject to the transfer occurring, along with field verification, and asset condition and inventory assessments. Rous acknowledges that the current service water supply to the Marom Creek WTP is via the Whites Lane reservoir. This business case will consider engineering options, such as a new clear water tank and backwash pumps located at the Marom Creek WTP site, in lieu of service water pressure from the Whites Lane reservoir.

Given the level of investment involved in integrating the Marom Creek WTP into the Rous regional bulk water supply, inclusive of connecting current and future groundwater bores, Rous' preference would be to take ownership of the Marom Creek WTP and its supporting infrastructure to secure the level of investment that is needed. Any consideration of a lease option is unlikely to garner the necessary support from Rous councillors. Therefore, Rous does not wish to progress with this option. Should ownership over Marom Creek WTP not be agreed upon by BaSC, Rous will consider our alternative options.

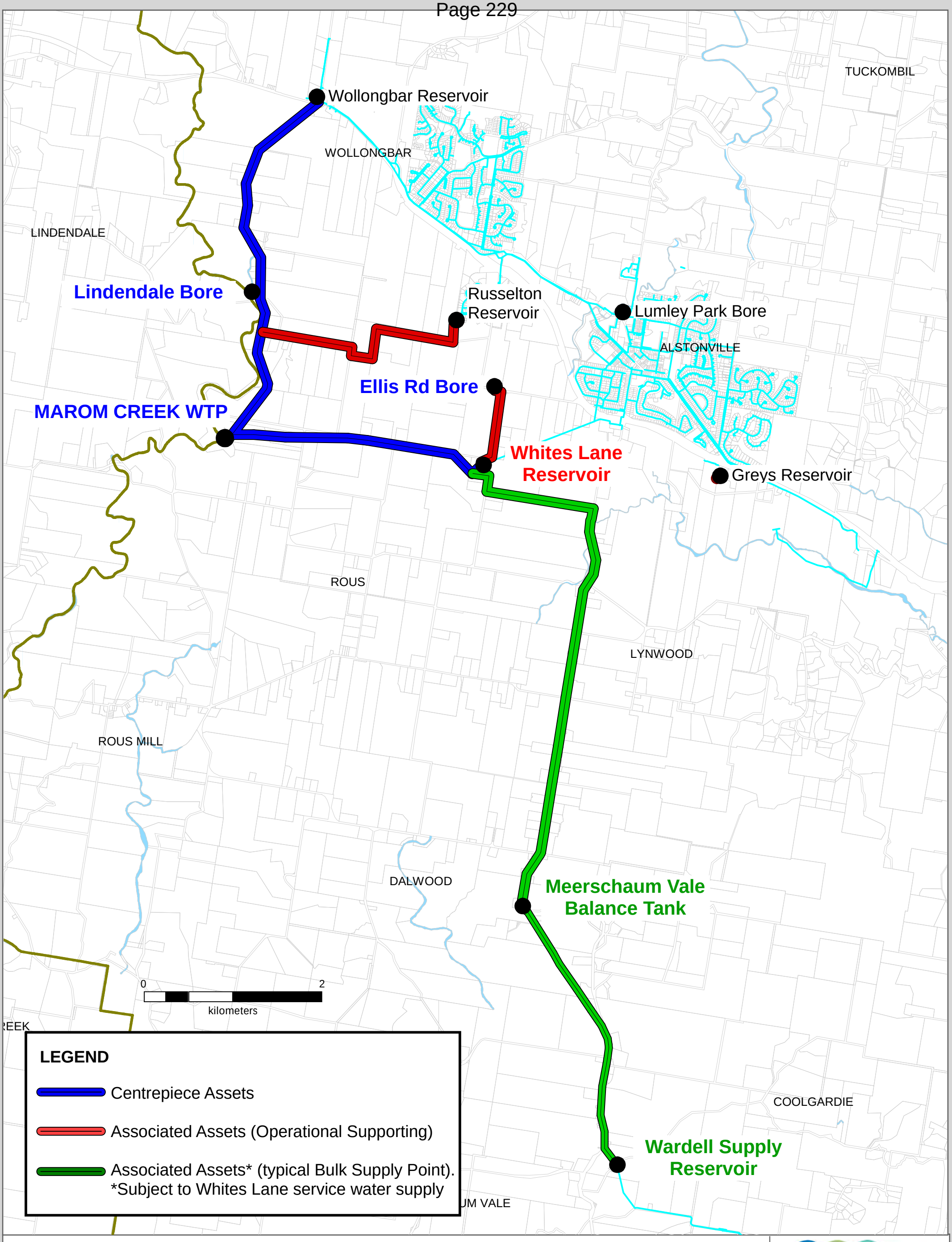
Rous would like to seek your 'in-principle' support for the abovementioned approach. I would appreciate your advice by 9 July 2021 to allow this to be considered as part of a Council report to our extraordinary July meeting. I look forward to your advice concerning this matter.

Should you wish to discuss these matters further, please contact me 6623 3810.

Yours faithfully

Phillip Rudd
General Manager

Enclosed: Marom Creek WTP possible transfer assets list.



Attachment 1 - BSC Marom Creek Water Supply Assets

THE INFORMATION ON THIS MAP MAY NOT BE ACCURATE.

Disclaimer: The material contained on this map is made available on the understanding that Rous County Council is not hereby engaged in rendering professional advice. While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of the information prior to using it.

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