Notice of Meeting

Water and Sewer Advisory Committee Meeting

A Water and Sewer Advisory Committee Meeting of Byron Shire Council will be held as follows:

Venue	**Conference Room, Station Street, Mullumbimby**
Date	**Thursday, 17 April 2025**
Time	**11:30 AM**

Phil Holloway
Director Infrastructure Services

I2025/490
Distributed 10/04/25

BYRON SHIRE COUNCIL

CONFLICT OF INTERESTS

What is a "Conflict of Interests" - A conflict of interests can be of two types:

Pecuniary - an interest that a person has in a matter because of a reasonable likelihood or expectation of appreciable financial gain or loss to the person or another person with whom the person is associated.

Non-pecuniary – a private or personal interest that a Council official has that does not amount to a pecuniary interest as defined in the Code of Conduct for Councillors (eg. A friendship, membership of an association, society or trade union or involvement or interest in an activity and may include an interest of a financial nature).

Remoteness – a person does not have a pecuniary interest in a matter if the interest is so remote or insignificant that it could not reasonably be regarded as likely to influence any decision the person might make in relation to a matter or if the interest is of a kind specified in the Code of Conduct for Councillors.

Who has a Pecuniary Interest? - a person has a pecuniary interest in a matter if the pecuniary interest is the interest of the person, or another person with whom the person is associated (see below).

Relatives, Partners - a person is taken to have a pecuniary interest in a matter if:

- The person's spouse or de facto partner or a relative of the person has a pecuniary interest in the matter, or
- The person, or a nominee, partners or employer of the person, is a member of a company or other body that has a pecuniary interest in the matter.

N.B. "Relative", in relation to a person means any of the following:

(a) the parent, grandparent, brother, sister, uncle, aunt, nephew, niece, lineal descends or adopted child of the person or of the person's spouse;

(b) the spouse or de facto partners of the person or of a person referred to in paragraph (a)

No Interest in the Matter - however, a person is not taken to have a pecuniary interest in a matter:

- If the person is unaware of the relevant pecuniary interest of the spouse, de facto partner, relative or company or other body, or
- Just because the person is a member of, or is employed by, the Council.
- Just because the person is a member of, or a delegate of the Council to, a company or other body that has a pecuniary interest in the matter provided that the person has no beneficial interest in any shares of the company or body.

Disclosure and participation in meetings

- A Councillor or a member of a Council Committee who has a pecuniary interest in any matter with which the Council is concerned and who is present at a meeting of the Council or Committee at which the matter is being considered must disclose the nature of the interest to the meeting as soon as practicable.
- The Councillor or member must not be present at, or in sight of, the meeting of the Council or Committee:

    (a) at any time during which the matter is being considered or discussed by the Council or Committee, or

(b) at any time during which the Council or Committee is voting on any question in relation to the matter.

No Knowledge - a person does not breach this Clause if the person did not know and could not reasonably be expected to have known that the matter under consideration at the meeting was a matter in which he or she had a pecuniary interest.

Non-pecuniary Interests - Must be disclosed in meetings.

There are a broad range of options available for managing conflicts & the option chosen will depend on an assessment of the circumstances of the matter, the nature of the interest and the significance of the issue being dealt with. Non-pecuniary conflicts of interests must be dealt with in at least one of the following ways:

- It may be appropriate that no action be taken where the potential for conflict is minimal. However, Councillors should consider providing an explanation of why they consider a conflict does not exist.
- Limit involvement if practical (eg. Participate in discussion but not in decision making or vice-versa). Care needs to be taken when exercising this option.
- Remove the source of the conflict (eg. Relinquishing or divesting the personal interest that creates the conflict)
- Have no involvement by absenting yourself from and not taking part in any debate or voting on the issue as of the provisions in the Code of Conduct (particularly if you have a significant non-pecuniary interest)

Committee members are reminded that they should declare and manage all conflicts of interest in respect of any matter on this Agenda, in accordance with the Code of Conduct.

RECORDING OF VOTING ON PLANNING MATTERS

Clause 375A of the Local Government Act 1993 – Recording of voting on planning matters

(1) In this section, **planning decision** means a decision made in the exercise of a function of a council under the Environmental Planning and Assessment Act 1979:

(a) including a decision relating to a development application, an environmental planning instrument, a development control plan or a development contribution plan under that Act, but
(b) not including the making of an order under that Act.

(2) The general manager is required to keep a register containing, for each planning decision made at a meeting of the council or a council committee, the names of the councillors who supported the decision and the names of any councillors who opposed (or are taken to have opposed) the decision.

(3) For the purpose of maintaining the register, a division is required to be called whenever a motion for a planning decision is put at a meeting of the council or a council committee.

(4) Each decision recorded in the register is to be described in the register or identified in a manner that enables the description to be obtained from another publicly available document and is to include the information required by the regulations.

(5) This section extends to a meeting that is closed to the public.

OATH AND AFFIRMATION FOR COUNCILLORS

Councillors are reminded of the oath of office or affirmation of office made at or before their first meeting of the council in accordance with Clause 233A of the Local Government Act 1993. This includes undertaking the duties of the office of councillor in the best interests of the people of Byron Shire and the Byron Shire Council and faithfully and impartially carrying out the functions, powers, authorities and discretions vested under the Act or any other Act to the best of one's ability and judgment.

BYRON SHIRE COUNCIL

BUSINESS OF MEETING

MINUTES FROM PREVIOUS MEETINGS

Report No. 3.1 Adoption of minutes from Previous Meeting

Directorate: Infrastructure Services

File No: I2025/480

RECOMMENDATION:

That the minutes of the Water and Sewer Advisory Committee Meeting held on 19 July 2024 be confirmed.

Attachments:

1 Minutes 19/07/2024 Water and Sewer Advisory Committee Extraordinary, I2024/1042 , page 10

Report

The attachment to this report provides the minutes of the Water and Sewer Advisory Committee Meeting of 19 July 2024 .

Report to Council

The minutes were reported to Council on

Comments

In accordance with the Committee Recommendations, Council resolved the following:

24-421 Resolved that Council does not adopt the following Recommendation:

Report No. 4.1 Mullumbimby Water Supply Strategy Public Consultation Report

Committee Recommendation 4.1.1

That Council:

1. Publicly thanks the community for its participation in making more than 433 Your-Say submissions during June 2024 on Mullumbimby's future water supply;

2. Acknowledges that 89% of 411 valid Your-Say respondents oppose abandoning the Wilsons Creek source (Lavertys Gap), while 6% are neutral and 5% support;

3. Notes that Hydrosphere's report "Mullumbimby Water Supply Strategy" of December 2021 does not investigate Option 2 (adding off-stream storage and retaining the Wilsons Creek source) to the extent suggested in Council's Resolution 23-120 and that it assesses Option 3 (Rous only) without Dunoon Dam which is now included in Rous's forward water source planning;

4. Notes the following extract from the North Coast Enabling Regional

Adaptation, North Coast Region Report (NSW Office of Environment and Heritage, 2019) which states on page 15:

"Under a transformed system for infrastructure [,] water systems are smaller, localised and decentralised with multiple redundancies providing tailored and integrated solutions"

5. Proceeds with the investigations previously outlined in Parts 7 and 8 of Resolution 23-120 with some additions in 8b and 8c, namely:

6. Investigates a strategy for Mullumbimby's long term water supply based on the following concept:

   a) Lavertys Gap as the source during flows in excess of environmental requirements;

   b) water stored off-stream between the source and Mullumbimby;

   c) water treated at a new location between the storage and Mullumbimby;

   d) water delivered to Mullumbimby and possibly beyond; and

   e) maximising demand management, including the harvesting of roof water.

7. Includes in this investigation:

   a) the topography of the terrain between Lavertys Gap and Mullumbimby, to identify potential dam sites;

   b) the hydrology of Wilsons Creek and its capacity to supply, including

      (i) seasonality,

      (ii) establishing environmental flows for future EPA licensing;

   c) the impact of climate change on supply and on demand (using up-to-date CC data and methodologies in the pilot phase for local water supply through DPE, and applied in Regional Water Strategies);

   d) infrastructure needs including offtake, storage, treatment and linkages to the town's reservoirs;

   e) environmental assessments for the creation and operation of that infrastructure, including greenhouse gas emissions;

   f) assessment of the weir at Lavertys Gap including

      (i) structural integrity;

(ii) means of creating fish passage; and

(iii) how this proposal enhances its heritage and preservation; and

g) economic assessment.

8. Notes the successful upgrade to Kyogle's water supply which included off stream storage and creation of fish passage on the existing weir in the Richmond River.

9. Supports Council consulting with landowners of properties currently supplied from the pressure line between the Water Treatment Plant at Lavertys Gap and the reservoir near Azalea Street, by:

a) Listening to their wishes, and

b) Considering outcomes including a reticulation pipeline returning from Azalea Street reservoir to those properties.

Minutes of Meeting

Extraordinary Water and Sewer Advisory Committee Meeting

Venue	**Conference Room, Station Street, Mullumbimby**
Date	**Friday, 19 July 2024**
Time	**10:00 AM**

BYRON SHIRE COUNCIL

BYRON SHIRE COUNCIL

EXTRAORDINARY WATER AND SEWER ADVISORY COMMITTEE MEETING
MINUTES 19 JULY 2024

Minutes of the Extraordinary Water and Sewer Advisory Committee Meeting held on Friday, 19 July 2024

File No: I2024/1042

PRESENT:

Councillors:	Cr C Coorey	Present
	Cr M Lyon	Present
	Cr S Ndiaye	Present
	Cr D Dey	Present
	Cr A Pugh	Present
Staff:	Phil Holloway (Acting General Manager)	Present
	Cameron Clark (Manager Utilities)	Present
	Annie Lewis (Media Communications Coordinator)	Present
	Chloe Woods (Minute taker)	Present
Community	Elia Hauge	Present
	David Fligelman	Apology
	Ben Fawcett	Present
	Bruce Clarke	Present
Visitors	Peter Trute	Present

Cr Sarah Ndiaye (Chair) opened the meeting at 10:13am and acknowledged that the meeting was being held on Bundjalung Country.

ATTENDANCE VIA AUDIO-VISUAL LINK:

Cr Arsen Pugh attended via Audio-Visual Link.

APOLOGIES:

Apologies were received from David Fligelman.

DECLARATIONS OF INTEREST – PECUNIARY AND NON-PECUNIARY

Ben Fawcett declared non-pecuniary interest in Report No. 4.1. The nature of the interest being that Ben Fawcett's residence is less than 1km from Lavertys Gap Weir and 500m

from the water treatment plant. Ben Fawcett elected to remain in the Meeting and will participate in discussion and the vote.

Elia Hauge declared a pecuniary/non-pecuniary interest in Report No. 4.1. The nature of the interest being that In Elia's role as an engineer at Greg Alderson Associates, Elia is working on a project for NSW Public Works that involves remediation design for a Rous Water pipeline. Elia Hauge elected to remain in the Meeting and will participate in discussion and the vote.

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

Report No. 3.1 **Adoption of Minutes from Previous Meetings**
File No: I2024/984

Committee Recommendation:

That the minutes of the Water and Sewer Advisory Committee Meeting held on 30 May 2024 be confirmed. (Fawcett/Clarke)

The recommendation was put to the vote and declared carried.

STAFF REPORTS - INFRASTRUCTURE SERVICES

Cr Ndiaye left the meeting at 11:04am and returned at 11:05 am.

Report No. 4.1 **Mullumbimby Water Supply Strategy Public Consultation Report**
File No: I2024/1032

Committee Recommendation:

That Council:

1. **Publicly thanks the community for its participation in making more than 433 Your-Say submissions during June 2024 on Mullumbimby's future water supply;**

2. **Acknowledges that 89% of 411 valid Your-Say respondents oppose abandoning the Wilsons Creek source (Lavertys Gap), while 6% are neutral and 5% support;**

3. **Notes that Hydrosphere's report "Mullumbimby Water Supply Strategy" of December 2021 does not investigate Option 2 (adding off-stream storage and retaining the Wilsons Creek source) to the extent suggested in Council's**

Resolution 23-120 and that it assesses Option 3 (Rous only) without Dunoon Dam which is now included in Rous's forward water source planning;

4. Notes the following extract from the North Coast Enabling Regional Adaptation, North Coast Region Report (NSW Office of Environment and Heritage, 2019) which states on page 15:

"Under a transformed system for infrastructure [,] water systems are smaller, localised and decentralised with multiple redundancies providing tailored and integrated solutions"

5. Proceeds with the investigations previously outlined in Parts 7 and 8 of Resolution 23-120 with some additions in 8b and 8c, namely:

7. Investigates a strategy for Mullumbimby's long term water supply based on the following concept:
- ***a) Lavertys Gap as the source during flows in excess of environmental requirements;***
- ***b) water stored off-stream between the source and Mullumbimby;***
- ***c) water treated at a new location between the storage and Mullumbimby;***
- ***d) water delivered to Mullumbimby and possibly beyond; and***
- ***e) maximising demand management, including the harvesting of roof water.***

8. Includes in this investigation:
- ***a) the topography of the terrain between Lavertys Gap and Mullumbimby, to identify potential dam sites;***
- ***b) the hydrology of Wilsons Creek and its capacity to supply, including (i) seasonality,***
  (ii) establishing environmental flows for future EPA licensing;
- ***c) the impact of climate change on supply and on demand (using up-to-date CC data and methodologies in the pilot phase for local water supply through DPE, and applied in Regional Water Strategies);***
- ***d) infrastructure needs including offtake, storage, treatment and linkages to the town's reservoirs;***
- ***e) environmental assessments for the creation and operation of that infrastructure, including greenhouse gas emissions;***
- ***f) assessment of the weir at Lavertys Gap including***
  (i) structural integrity;
  (ii) means of creating fish passage; and
  (iii) how this proposal enhances its heritage and preservation; and
- ***g) economic assessment;***

6. Notes the successful upgrade to Kyogle's water supply which included off stream storage and creation of fish passage on the existing weir in the Richmond River.

7. Supports Council consulting with landowners of properties currently supplied from the pressure line between the Water Treatment Plant at Lavertys Gap and the reservoir near Azalea Street, by

a. Listening to their wishes, and

b. Considering outcomes including a reticulation pipeline returning from Azalea Street reservoir to those properties. (Dey/Clarke)

Cr Coorey and Cameron Clark left the meeting at 11:29am and did not return.

The recommendation (Dey/Clarke) was put to the vote and declared carried.
Cr Lyon voted against the motion.
Cr Coorey was not present for the vote.

There being no further business the meeting concluded at 12:43pm.

STAFF REPORTS - CORPORATE AND COMMUNITY SERVICES

Report No. 4.1 Integrated Planning and Reporting

Directorate: Corporate and Community Services

Report Author: Amber Evans Crane, Corporate Planning and Improvement Coordinator

File No: I2025/481

Summary:

This report provides an overview of Council's Integrated Planning and Reporting Framework and invites discussion on priority areas for inclusion in Council's delivery program.

RECOMMENDATION:

That the Water and Sewer Advisory Committee:

1. **Notes Council's Integrated Planning and Reporting Framework;**
2. **Notes Council's priorities as identified by Councillors for the 2025 – 2029 and Delivery Program**

Background to Integrative Planning and Reporting (IP&R)

The Integrated Planning and Reporting Framework in NSW requires all councils to adopt a suite of strategic plans. These long-term plans provide transparency and make it possible for Council to plan in a manner which ensures that community needs and priorities are responded to well into the future. Council also has a suite of strategies, plans and policies which help inform operations and decision making, and these policies are adhered to in alignment with the Integrated Planning and Reporting Framework.

The central IP&R documents are outlined in more detail:

10 Year Community Strategic Plan

Leading the Council's planning hierarchy, the Community Strategic Plan (CSP) captures the community's vision, aspirations, and expectations for the future. It identifies key social, economic, and environmental priorities and long term strategies to achieve these goals over the next 10 years.

The CSP outlines the vision, community objectives and supporting strategies which will guide Council's long-term decision making. Robust engagement with the community about their desires and expectations has guided the long-term future planning to meet the needs and aspirations of the community.

10 Year Resourcing Strategy

The resourcing strategy addresses the sustainable long term financial, asset management, and workforce planning requirements. This is the point where Council assists the community by sorting out who is responsible for what, in terms of the issues identified in the Community Strategic Plan.

4 Year Delivery Program

The delivery program translates the community strategic plan goals into actions. It is Council's commitment to the community, outlining what it intends to do toward achieving the goals of the community strategic plan during its term of office. The Delivery Program is the single point of reference for all principal activities undertaken by Council. All plans, projects, activities, and funding allocations must be directly linked to the four-year delivery program.

Annual Operational Plan

The Delivery Program is supported by an annual Operational Plan which details the individual projects and activities that will be undertaken each year to achieve the commitments of the Delivery Program. The Operational Plan is supported by a detailed budget and a statement of revenue policy, which also sets the fees and charges for that year.

Advisory Committee Input into IP&R

The key IP&R documents described in the Background section are in the process of review as is the requirement following a local government election.

The current Community Strategic Plan (CSP) 2032 has been reviewed and the next iteration, the CSP 2035, was placed on public exhibition at the 28 November 2024 Ordinary Council meeting with submissions open until 9 February 2025. The revised CSP will be presented back to Council for adoption in May 2025. The draft can be found on Council's website at www.byron.nsw.gov.au/communityplan.

Adjacent to this, the Delivery Program 2025 – 2029 and Operational Plan 2025/26 are being developed. Both documents will be presented to Council in May 2025 and placed on public exhibition for public feedback.

The four-year priorities recently identified by Councillors for inclusion in the Delivery Plan 2025-2029 that relate to the Committee include:

- Water Supply
- Wastewater Management
- Storm-water
- Water Sensitive Urban Design
- Water Security

Community Strategic Plan and Operational Plan

CSP Objective	CSP Strategy	DP Action	Code	OP Activity
1: Effective Leadership	1.1: Enhance trust and accountability through open and transparent leadership	1.1.4: Performance Measurement and Reporting - Embed a robust performance management system through the development of an outcomes measurement framework	1.1.4.4	Prepare the 2025-2029 Delivery Program

Statutory Considerations

Integrated Planning and Reporting is governed by:

- 'Local Government Act 1993'.
- 'Local Government (General) Regulation 2021'.
- Integrated Planning and Reporting Guidelines for Local Government in NSW': outlines the statutory planning and reporting requirements that councils, county councils and joint organisations must meet

STAFF REPORTS - INFRASTRUCTURE SERVICES

Report No. 4.2 Mullumbimby water supply strategy - High-level project plan

Directorate: Infrastructure Services

Report Author: Pablo Orams, Integrated Water Management Officer

File No: I2025/395

Summary:

This report provides the WSAC with a high-level project design for the delivery of evidence-based recommendations for Council to decide on a long-term water supply strategy for Mullumbimby. It includes sections that describe a conceptual project framework, project risks and assumptions, relationships with other projects and a draft estimated project plan.

Staff will use feedback from the WSAC to refine this project design and improve its effectiveness at achieving its fundamental purpose: securing Mullumbimby's long-term water supply.

RECOMMENDATION:

1. That the Water and Sewer Advisory Committee notes the proposed project design

2. That the Committee provides feedback to staff on how to improve the project design, in alignment with: -

a) The aim of the project i.e. provide evidence-based recommendations for Council to decide on a long-term water supply strategy for Mullumbimby

b) The need to provide best-value to ratepayers via sustainable and efficient water services provision

Attachments:

1 Action Memo Item - Deferral of decision to pursue a connection to Rous Council 24/10/2024, I2024/1475 , page 30⇩

2 Mullumbimby water supply strategy Rev 3 Final Sep2024 - Hydrosphere, E2025/8160 , page 32⇩

3 Action Memo Item - Mullumbimby Water Supply Strategy Council 15/08/2024, I2024/1185 , page 266⇩

4 Additional information for the WSAC 17 April 2025 meeting - Mullumbimby Water Supply Strategy project, E2025/38430 , page 268⇩

5 Report

Purpose

This report provides a high-level project design for the delivery of evidence-based recommendations for Council to decide on a future water supply strategy for Mullumbimby.

The project in question responds to Council **Resolution 24-477** (see **Attachment 1**)

10 Staff request the Committee to provide feedback and advice for ensuring the project design is fit-for-purpose.

Note: Council's Executive Management team have transferred responsibility for the delivery of this project to the Assets & Major Projects Team.

Background

15 Mullumbimby's water supply is sourced from the Lavertys Gap weir, situated in the upper reaches of Wilson's Creek. The weir feeds the Mullumbimby Water Treatment Plant (WTP), which then supplies potable water to the town's water network.

Various elements of this scheme were commissioned between the 1920s and 1940s.

It also included a small hydroelectric plant, but was decommissioned in 1989.

20 Due to its location, condition and design, the Lavertys Gap weir / Mullumbimby WTP scheme is vulnerable to droughts and extreme weather events, and in the face of Mullumbimby's future development estimates, it is predicted the scheme will not be able to meet Mullumbimby's water demand beyond 2028.

In situations when the Lavertys Gap weir / Mullumbimby WTP scheme fails (e.g. during
25 droughts or wet weather) Council can operate a supplementary water source through the Rous Emergency Water Supply Line. This scheme connects Mullumbimby to the Rous regional water network, with current capacity to cover approximately half of the town's water demand. The emergency line was built in response to the 2002-2003 drought. Following the 2022 floods, Council secured State Government funding to upgrade the
30 emergency's line capacity to be able to cover all of Mullumbimby's reticulated water demand.

In recognition of these issues, since 2019 Council staff have produced a substantial body of work aimed at informing a long-term water supply strategy for Mullumbimby (see **Attachment 2**). Various water supply options were assessed, with the resulting
35 recommendation being to permanently connect Mullumbimby to the Rous regional water supply via the existing emergency supply line. This recommendation was adopted by Council in August 2024 (**Res. 24-411, Attachment 3**).

However, in October 2024, Council decided to defer the decision for an additional two years to allow for further investigations and community consultation while addressing the ongoing risks to the Lavertys Gap weir / Mullumbimby WTP scheme (**Res. 24-477, Attachment 1**). This latest Resolution is the catalyst for the project described in this report.

Project design

Staff are undergoing project design to enable an evidence-based and transparent decision-making process to secure long-term water security for Mullumbimby. Lessons learnt are being distilled from the previous round of work and the deliberation process that resulted on Council's **Resolution 24-477** (**Attachment 1**). Staff are also concerned with the ongoing structural, performance and compliance shortfalls of the Lavertys Gap weir / Mullumbimby WTP scheme, which are further compounded by the rising risk of extreme weather events and Council's financial constraints and capital investment priorities across the Shire's water supply systems.

Thus, considering the complexity of the above issues, it is of paramount importance that Council staff and decision makers agree on why this project is needed, what it is aiming to achieve, and how it will do so, as well as recognising the constraints and risks that influence it.

The sections below articulate a proposed project design to facilitate this agreement.

Project conceptual framework

Figure 1 below presents the proposed project at a conceptual level. It establishes the desired impact (i.e. guarantee sustainable, long-term water supply security for the town of Mullumbimby), and works backwards to describe the project outcomes, outputs, actions and resources that will support that impact. Project drivers and contextual issues are also described.

Figure 1 – Project conceptual framework

PROJECT DRIVERS AND CONTEXT

- Lavertys Gap / Mullumbimby WTP water scheme can't garantee Mullumbimby's long-term water security

- Short-term risks to Mullumbimby's water security due to structural, performance and compliance shortfalls in Lavertys Gap / Mullumbimby WTP

- Future development

- Unpredictable extreme weather events

- Council's competing capital investment priorities

PROJECT IMPACT

Guarantee sustainable, long-term water supply security for the town of Mullumbimby

PROJECT OUTCOME

Provide Council with evidence-based recommendations for deciding on a long-term water supply strategy for Mullumbimby

PROJECT OUTPUT 1

Revised and updated options investigation *"including off stream storage and a hybrid solution with Lavertys Gap and Rous"*

PROJECT OUTPUT 2

Decision making framework informed by *"direct community input"* (MCA) and robust financial modelling (BCA, NPV)

PROJECT ACTIONS

- Consolidation of lessons learnt from previous work

- Project risks assessment

- Revise and update options investigation

- Community engagement (e.g. via workshops) to inform Multi- Criteria Analysis (MCA) objectives, criteria and weightings

PROJECT ACTIONS

- Benefit-Cost Assessment (BCA) of options shortlisted via MCA

- Net-present Value (NPV) financial modelling to measure impact of shortlisted options on Council and ratepayers

PROJECT ACTIONS

- Ongoing reporting on actions to maintain local water security until final Council decision is made

- Ongoing engagement/comms to support transparency and shared understanding across stakeholders

- Community consultation via phone surveys

PROJECT RESOURCES (INTERNAL)

- Project management

- Stakeholder engagement

- Financial analysis

- Input from Utilities staff when required

- Media and comms

- Other departments' input (ET, Finance, Planning)

PROJECT RESOURCES (EXTERNAL)

- Lead consultant (policy/strategy, technical, financial)

- Facilitation and engagment consultant

- Local technical advisor

Project assumptions

- Previous investigations (see **Attachment 2**) will be reviewed and used as a key input for this project.

- Off-stream storage option: while this option was already explored in previous investigations, additional comment and high-level/desktop assessments will be provided regarding:

  - possible sites for an off-stream storage
  - hydrology, water quality and catchment impacts
  - environmental flows considerations
  - considerations regarding landholder consultation and land acquisition

- Hybrid water supply option: this new option assumes the combined operation of the Lavertys Gap water source and the Rous regional water supply (via the upgraded Rous Emergency Supply Line), offering enhanced water security and operational flexibility. This may involve the downsizing and/or relocation of the Mullumbimby WTP to reduce risks associated with extreme weather, treatment performance and regulatory compliance.

- Mullumbimby's future water demand estimates will be revised and updated in alignment with the latest growth forecasts (i.e. Byron Shire Residential Strategy 2041).

- **Item 4.c.** of **Res. 24-477** (**Attachment 1**) requests that the reinstatement of hydroelectric facility be explored as part of this investigation. High-level commentary can and will be provided around this issue. It is expected however that given the site's heritage significance (and related constraints), water licence considerations, governance arrangements, and Council's service provision and capital investment priorities, this option will not feature in this study.

- Decision making framework: The process for shortlisting options and ultimately recommending a water supply solution to Council will be multi-staged:

  - Stage 1: Options shortlisting through **Multi-Criteria Analysis (MCA)** based on community-designed objectives, criteria and criteria-weightings. Community input will be facilitated via a series of workshops.

- Stage 2: Shortlisted options will then go through a **Benefit-Cost Assessment (BCA)** to assess their economic viability (i.e. benefit/cost ratio). The assessment will follow BCA guidelines from NSW Treasury.

- Stage 3: **Net-Present Value (NPV)** of shortlisted options over a 30-year timeframe will provide the basis for understanding the financial impact on Council, and ultimately, the ratepayer.

  Other metrics may be defined to assist Councillors on their final decision, and could include estimated rate increases, dollars per kilolitre of water supplied ($/kL), etc.

Project risks

Staff considers important risks impacting the delivery of this project to be clearly defined and understood across stakeholders. While a comprehensive risk assessment is proposed to be done early on the project timeline, an initial description of some key project risks is provided below. Staff hopes to use this as a springboard to further unveil project risks in collaboration with the WSAC, and support the upcoming risk assessment process.

- The capital costs of some options to be investigated may exceed Council's and the community's capacity to fund it (via rate increases). This risks the long-term condition of water provision assets and levels of service to the community.
- Unpredictable weather events, the high-risk nature of Wilsons Creek catchment, and the end-of-life condition of the Lavertys Gap weir / Mullumbimby WTP scheme hinder Council's capacity to maintain water security and comply with relevant regulation until a final decision is made and implemented.
- Recent revised growth forecasts for Mullumbimby are likely to increase future water demand estimates, changing water supply options' capacity modelling.
- The State Heritage listing of Mullumbimby Hydro-electric Power Station Complex. This includes the weir but not the treatment plant. There will be additional approvals required to modify or upgrade the weir.
- Community's willingness to pay for proposed options is yet to be understood.
- Misinformation / disinformation in the community throughout this project may impact efforts to drive evidence-based decision making.

Project interdependencies

Achieving a decision on a long-term water supply strategy for Mullumbimby and safeguarding short-term water provision may be influenced or constrained by other Council activities/projects, including:

- **Rous Emergency Water Supply Line upgrade project**: This is currently ongoing, with completion expected by September 2025. Regardless of what long-term water

supply strategy Council decides on, completion of this upgrade is critical to enable that strategy, either as the main water supply moving forward, or as the redundancy required to allow for the implementation of other long-term solutions. It will also offer interim water supply security in case the Lavertys Gap weir / Mullumbimby WTP scheme fails before a long-term strategy is adopted.

- **Negotiation of Level of Service Agreement (LSA) with Rous**: As requested in **item 3** of **Res. 24-477** (**Attachment 1**), Council's executive team, with support from Utilities staff, are in negotiations with Rous to facilitate a reduction of the emergency water supply volumetric charges. This important to help reduce the financial impact on Council if Lavertys Gap weir / Mullumbimby WTP fails and/or reliance on the Rous Emergency Supply Line increases in the short term.

- **Lavertys Gap weir condition assessment, monitoring and repairs project**: Council's Utilities Department, with the support of NSW Public Works, is undertaking actions to address bank erosion issues that put at risk the weir's structural integrity, and consequently, its storage capacity. The key focus is on condition monitoring until final remediation works can be done. These are only possible once the upgraded Rous Emergency Water Supply Line is operational. Wet weather events can hinder these efforts.

- **Mullumbimby WTP short-term improvements**: Following advice from NSW Health, Council staff are investigating operational controls and treatment process upgrades to manage non-compliance risks at Mullumbimby WTP. These risks relate to the high-risk nature of the Wilson's Creek catchment and the design and end-of-life condition of the WTP, and might trigger boil water alerts if advised by the regulator.

- **Securing water supply for Wilson Creek residents**: There are 13 properties in Wilsons Creek directly connected to the Mullumbimby WTP trunk main. These connections are not compliant with Council's current Water Supply Operations Standards and land zoning rules, but it is understood this is a legacy issue going back to the establishment of the Mullumbimby WTP. The properties have become reliant on the potable water supply for rural water security, with a high level of water consumption.

  It is expected that potable supply to the above-mentioned properties will need to continue (**item 6, Res. 24-411, Attachment 3**). In the short term, supply from the WTP is at risk due to the issues described in the above sections, and Council will need to find alternative water sources if required (e.g. trucking water to the WTP's clear water tank). In the long-term, if Council decides to favour the Rous supply, upgrades to water conveyance and storage systems will be required to enable supply to the Wilsons Creek residents.

Project draft plan

A high-level draft implementation plan is provided below. This plan will be refined following consultation with the WSAC.

PROJECT COMPONENT	ACTIVITY	2025 Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2026 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Project scope refinement	Internal engagement	■																				
	WSAC engagement	■																				
	Stakeholder engagement and comms strategy design	■	■																			
	Project risk assessment		■																			
	Endorsed project plan		■	■																		
Procurement of external expertise	Including lead consultant, facilitation/engagement consultant and local technical advisor			■	■																	
Updated options investigation	Review of previous work				■	■																
	Update with latest information				■	■	■															
	Additional investigations as per Res. 24-477					■	■	■														
	Progress / draft investigation report							■			■			■			■					
	Feedback and review								■	■	■	■	■	■	■	■	■					
Multi-Criteria Analysis (MCA) process	DRAFT MCA objectives / criteria definition					■																
	Internal review						■															
	WSAC review							■														
	Community workshops - planning								■	■												
	Community workshop 1 (objectives and criteria)										■											
	Community workshop 2 (MCA weightings definition)											■										
	Community workshop 3 (MCA application to options)												■									
	Documentation and reporting of engagement process results													■	■							
Benefit-Cost Assessment (BCA) and financial modelling	Detailed collection and refinement of data inputs for BCA														■							
	Application of BCA methodology to shortlisted options from MCA process														■	■						
	Financial modelling to define impact of shortlisted options on Council and ratepayers															■	■					
Comms and consultation	Internal reporting on status of short-term water security risks			■			■			■			■			■			■			
	Media releases			■			■			■			■			■			■			
	Phone surveys design								■													
	Phone surveys delivery									■												
Final council decision	Final report to Council																■	■				
	Council meeting for final decision																		■			

Strategic Considerations

Community Strategic Plan and Operational Plan

CSP Objective	CSP Strategy	DP Action	Code	OP Activity
5: Connected Infrastructure	5.5: Provide continuous and sustainable water and sewerage management	5.5.1: Water supply - Provide a continuous water supply that is maintained in accordance with NSW Health guidelines	5.5.1.20	Report to Council on the future water strategy for Mullumbimby

Financial Considerations

A project budget will be put forward following refinement of the above project design.

5 Consultation and Engagement

This report is part of the internal engagement and consultation required to refine the above project design. A detailed stakeholder consultation and engagement strategy is to be developed.

Additional Information

10 Attachment 4 provides a summary of progress done with regards to the action items of Council **Resolution 24-477**

Byron Shire Council

FOR ACTION

Report No 9.1 - Deferral of decision to pursue a connection to Rous

TO: Clark, Cameron - Manager Utilities

COPY TO:

DATE: 28 October 2024

MEETING: Council Meeting of 24 October 2024

RESOLUTION NUMBER: 24-477

Action is required for this item as per the Council Resolution outlined below.

Resolved that:

1. The decision to pursue a permanent connection to Rous be deferred for up to two years.
2. Council continues with the emergency connection to Rous as planned and investigates operational regimes to minimise the risk of water quality incidents, as has been done for the existing emergency line.
3. Council seeks to renegotiate an interim agreement for a reduced cost for emergency supply during this period with Rous.
4. That a staged investigation into integrated water supply options be continued, including off stream storage and a hybrid solution with Lavertys Gap and Rous, and:
   a. the investigation includes an options workshop with community, and direct community input to multi-criteria weightings to compare options;
   b. regular progress reports be provided to the Council during this investigation period; and
   c. investigations into the possible reinstatement of the hydroelectric plant be explored.

(Ndiaye/Hauge)

SPECIFIC ACTIONS REQUIRED:

Byron Shire Council

This action sheet has been automatically produced by the administrator using **InfoCouncil**, the agenda and minutes database.

Click the 

button on the InfoCouncil Toolbar to update the outstanding actions.

For completed actions: Please update the notes and update the finalisation date.

For ongoing actions: Please update the notes and the expected completion date.

Please continue to update the comments until the matter has been finalised.

Please note:

- The notes that you record against *Actions* in InfoCouncil are reported to Council and are therefore **public and should not be used for internal comments**
- When a resolution has multiple parts (i.e. 1., 2., 3.) **each update should address each of the points**, with the corresponding number
- The default *target date* is 1 month from the meeting – you can **change the target date** and provide a reason (again… this will be public)
- Only mark as complete once **ALL parts are complete**
- Once you have marked complete, your **Director** will receive an email requesting authorisation for the action be marked as complete. Directors can either:
    a. **Approve completion** – This marks it as complete and notifies the action owner; OR
    b. **Return the action** – This can be selected where the action notes provided by the officer are insufficient or if the action shouldn't have been marked complete yet. The officer will have the action returned to them and it will stay incomplete. If the action is returned to you, you will need to action any feedback from your Director and redo the steps to mark the action as complete when appropriate.
- If for some reason the resolution cannot be completed (e.g. budget, legislation, or competing priorities) you can reallocate the action to the user called '**No Action, Closed'** and provide a detailed reason. This will be reported to Council to endorse the closure of the resolution.
- Reference **CM9 doc numbers** in notes whenever possible
- You can add notes at any time, but at a minimum **all actions should be updated before the end of the quarter** (30 Sept, 31 December, 31 March, 30 June).

Further information can be found on the Intranet and in the Resolution Reporting Guidelines.

Mullumbimby Water Supply Strategy

Final, updated September 2024

Disclaimer:

This report has been prepared on behalf of and for the exclusive use of Byron Shire Council and is subject to and issued in accordance with the agreement between Byron Shire Council and Hydrosphere Consulting. Hydrosphere Consulting accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

Acknowledgement of Country

Hydrosphere Consulting recognises the traditional owners of the land discussed in this report, the Bundjalung of Byron Bay, Arakwal people, the Widjabal people, the Minjungbul people and the wider Bundjalung Nation.

Cover photo: Lavertys Gap weir, September 2018

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20-020 MULLUMBIMBY WATER SUPPLY STRATEGY

REV	DESCRIPTION	AUTHORS	REVIEW	APPROVAL	DATE
0	Draft for Council review	R. Campbell, J. Fullerton, K. Menzies	K. Pratt, M. Howland	M. Howland	17 June 2021
1	Final draft	R. Campbell	M. Howland	M. Howland	17 Dec 2021
2	Minor edits for public exhibtion	R. Campbell	M. Howland	M. Howland	21 May 2024
3	Updated with new data, revised cost estimates and Council resolution	R. Campbell	M. Howland	M. Howland	25 Sept 2024

EXECUTIVE SUMMARY

Introduction

Mullumbimby's drinking water supply is sourced from the upper reaches of Wilsons Creek. Water is extracted from Lavertys Gap weir on Wilsons Creek where it flows by gravity through an open channel, via a tunnel to the Mullumbimby water treatment plant (WTP) as shown on Figure 1. The channel and tunnel were the original raw water transfer system to the Mullumbimby Hydroelectric Power Station (now decommissioned). There is an emergency supply pipeline from the Rous County Council (RCC) bulk supply system with agreement to supply up to 0.5 ML/d to the lower areas of the Mullumbimby distribution system. In 2021, the Mullumbimby water supply serviced approximately 1,620 residential properties (3,600 people) and 270 non-residential properties. Approximately 13 customers along Wilsons Creek Road are connected to the trunk main from the WTP.

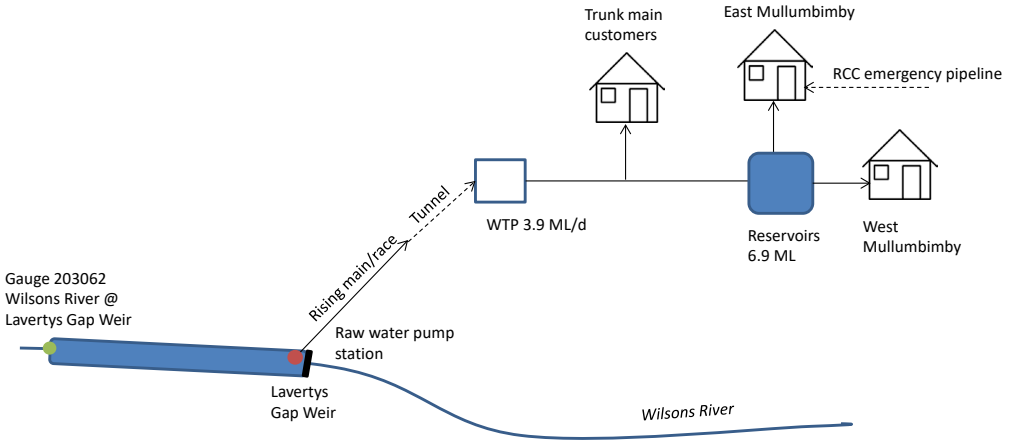

Figure 1: Mullumbimby water supply schematic diagram

Byron Shire Council (BSC) engaged Hydrosphere Consulting to prepare a long-term strategy for Mullumbimby water supply. The key issue to be addressed is water supply security (servicing existing customers and future development over the long-term). The current demand for water is similar to the secure yield at Lavertys Gap weir and if the worst drought on record were to repeat, the current supply would not meet demand. BSC has prepared growth management strategies for urban land, rural areas and business/industrial land which include future development that will increase the demand for potable water. This strategy also considers the following issues:

- Asset condition and performance - the raw water channel (constructed in the 1920s) has exceeded its useful life. The likelihood of failure is considered very high and on the basis that structural failure of the channel would cause extended interruption to the water supply, upgrading the raw water transfer system is a high priority while the weir supply continues to be used. In addition, due to the age of the Mullumbimby WTP (originally constructed in 1940), the WTP requires replacement in the next five to ten years. In addition, WTP upgrades are required to ensure removal of pathogens in the short-term.

- Drought management and emergency response - restrictions are currently introduced based on the water level and inflows in Lavertys Gap weir. Restrictions were imposed in Mullumbimby during the droughts of 2002/03, 2006/07 and 2019/20. The emergency supply from the RCC regional supply was used for 30 days during summer 2019/20 and two weeks during the 2022 floods.
- Heritage considerations and management obligations - Lavertys Gap weir and the channel (as part of the Mullumbimby hydro-electric power complex) are listed on the NSW State Heritage Register. In addition, the WTP has heritage significance at a local level.

This report assesses the security of the existing water supply system based on its secure yield and current demand. Options to increase the supply and reduce potable water demand were identified and analysed and scenarios have been developed using combinations of the options to achieve the required secure yield in 2050. An integrated water cycle management (IWCM) approach was used to compare options and scenarios and identify the preferred supply augmentation scenario to meet the predicted 2050 demand.

A draft of this report was prepared in 2021, updated for public exhibition in May 2024 and updated following the public exhibition with ne data and Council's resolution in September 2024.

Security of Current Water Supply

'Secure yield' is defined as the highest annual water demand that can be supplied from a water supply headworks system whilst water restrictions are not too severe, not too frequent, nor of excessive duration. A model has been developed using GoldSim 12.1 (Monte Carlo simulation software) to simulate the Mullumbimby water supply and assess the secure yield for various Global Climate Models using the methodology prescribed by the draft *Guidelines on Assuring Future Urban Water Security* (NSW Office of Water, 2013). Water security is achieved if the secure yield of a water supply is at least equal to the unrestricted dry year annual demand.

The historical demand for potable water in a 'dry year' (a year with low rainfall) and an 'average year' (a year with average rainfall) were calculated using the data on existing customers and demand. The predicted residential, business and industrial development was used to estimate the additional number of future connected properties in Mullumbimby and the total demand over the next 30 years. Reduced water losses are predicted as a result of pressure reduction measures to be implemented as part of Council's water loss management program.

Mullumbimby's demand for water is increasing with development and population growth. The current (2020) and 2050 dry year unrestricted demand are compared to the secure yield in Table 1. The RCC emergency supply pipeline improves the water supply security although it is not intended to operate any more than an emergency supply. Assuming that water loss reduction measures are implemented and the emergency supply is available, the supply will be secure until 2027 (Figure 2). After this time, the existing system cannot meet forecast demand without the potential for more frequent, longer and severe water restrictions. The supply deficit at 2050 (excluding the emergency supply) will be 377 ML/a.

Table 1: Comparison of demand and secure yield

Component (ML/a)	2020	2050
Dry year unrestricted demand (including water loss reduction)	483	754
Secure yield - weir supply	440	377
RCC emergency supply	183	183
Total system yield	623	560
Supply deficit (excluding emergency supply)	+43	377

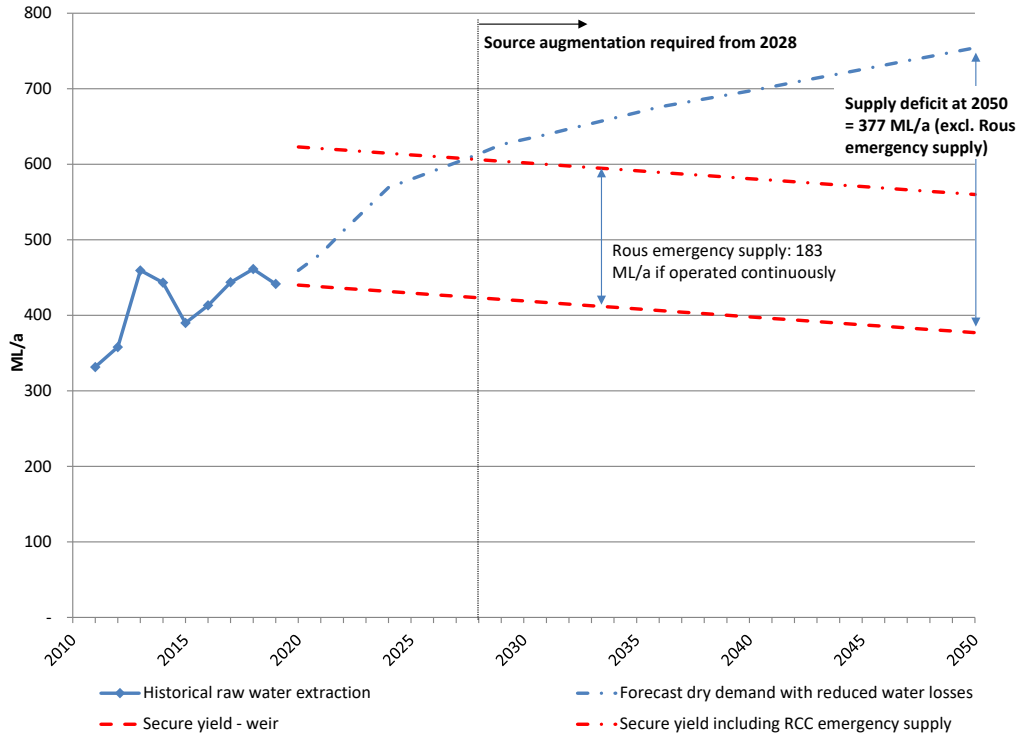

Figure 2: Comparison of forecast raw water demand and secure yield

A secure water supply is critical to ensure the Mullumbimby community's health and quality of life as well as a sustainable environment and continued economic prosperity. As the water supply authority, Council has a duty under the *Local Government Act 1993* and *Water Management Act 2000* to ensure that there is enough water available to meet the long-term needs of Mullumbimby. Based on the current demand and secure yield forecasts, investment in new water sources cannot be continuously deferred and after 2027 new sources of water will be required to meet the town's long-term water needs.

Demand-Side Options

Implementation of demand-side options (demand management, urban effluent reuse and private supplies) will form part of the long-term strategy through the implementation of parallel initiatives including the NSW government BASIX program, BSC's recycled water strategy (currently being reviewed and updated), the Regional Demand Management Plan (RDMP, including residential and non-residential water saving programs and community engagement and education) and BSC's water loss reduction measures. Increased drought restrictions are not proposed as part of the long-term strategy but may be required until water security is resolved.

Water Supply Options and Supply 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 further assessed and discussed in detail in this report:

Option 1. Base case (for comparison with augmentation options).

Option 2. Raising Lavertys Gap weir.

Option 3. Off-stream storage.

Option 4. A: Permanent connection to the RCC bulk water supply.

B: Emergency connection to regional supply

Option 5. Groundwater.

Following a detailed assessment of these options, Option 2 (raising Lavertys Gap weir) was not recommended for further consideration due to the minimal yield benefit, high costs and significant impacts on terrestrial biodiversity as well as downstream users and the environment.

Four scenarios have been developed from combinations of the remaining options that would achieve the required secure yield over the long term (754 ML/a, an increase of 377 ML/a at 2050). All scenarios include the following common components:

- Continued use of the weir supply and Mullumbimby WTP until the preferred source augmentation strategy is implemented.
- Short- term WTP upgrades to ensure consistent supply of microbially safe water until the preferred source augmentation strategy is implemented.
- Extension of the RCC emergency bulk water supply connection to service all Mullumbimby water supply customers to be used as a secure emergency response measure when required to supplement the weir supply (Option 4B).
- An increase in the Lavertys Gap weir licence extraction limit (likely to be required from 2023 unless an alternative source is implemented).
- Review and update of the drought management plan based on the performance of the supply and drought management regime during the recent drought.
- Implementation of the demand management measures in the RDMP.

- Water loss reduction measures.
- Continued investigation of the long-term impacts of climate change on the secure yield of the weir supply.
- Resolution of the heritage management requirements for the weir, channel and WTP.
- Development of water supply options for the trunk main customers.
- Continued identification and implementation of urban effluent reuse opportunities (future demand will be reduced with potable water savings and yield deficit will be reduced accordingly).

No local options have been identified for Mullumbimby that do not require major infrastructure solutions. The potentially feasible water supply augmentation scenarios are (Table 2):

- Scenario S1: Base case: Improvements to the existing raw water transfer system, a new WTP and full emergency connection to the regional supply. This scenario would provide secure yield until 2027. Beyond 2027, restrictions may become more frequent and/or more severe.
- Scenario S2: Off-stream storage: Improvements to the existing raw water transfer system, full emergency connection to the regional supply, construction of a 200 ML off-stream storage and new WTP. High stream flows would be transferred to fill the off-stream storage. Water from the storage will be treated at the new WTP and transferred to the township.
- Scenario S3: Permanent connection to RCC regional supply: In this scenario, Mullumbimby would form part of the RCC regional supply network with bulk treated water transferred to the Azalea Street reservoirs.
- Scenario S4: Supplementary groundwater: Improvements to the existing raw water transfer system, a new WTP, full emergency connection to the regional supply, construction of new bores to the south-west of Mullumbimby with raw water transferred either to the weir or the new WTP for treatment and distribution to the township.

Table 2: Water supply scenarios

Scenario	S1	S2	S3	S4
Upgrade raw water transfer system from weir[1]	✓	✓		✓
WTP relocation and replacement	✓	✓		✓
Fishway		✓		
Option 1 – Base case	✓			
Option 3 - Off-stream storage		✓		
Option 4A - RCC (permanent)			✓	
Option 4B - RCC (emergency extension)	✓	✓	✓	✓
Option 5 - Groundwater				✓

1. The preferred option to upgrade the raw water transfer system from the weir (for S1, S2 and S4) is a new pumped pressure pipeline following an alternative alignment that is independent of the channel.

Environmental Impacts

All surface water options considered for Mullumbimby (Wilsons Creek extraction for S1 and S2 and Rocky Creek extraction for S3) rely on existing infrastructure and extraction from the Richmond River system. Although there are significant initial impacts associated with dam and weir construction, the ecology within the storage area and downstream eventually adapts to the changed flow regime with subsequent loss of habitat for many native species. The terrestrial environments impacted by the existing surface water supplies have been modified through increased water level in the storages and land clearing to varying extents. All proposed supply augmentations for each scenario will require infrastructure development that is not expected to significantly impact on the terrestrial environment. Scenarios relying on groundwater supplies (S4 – potentially a local fractured rock groundwater supply and S3 – proposed future regional groundwater supplies) have the potential to impact on groundwater dependent ecosystems. However, these impacts are expected to be adequately managed through site selection and extraction regimes. Similarly, any impacts on the terrestrial environment due to establishment of groundwater sources are expected to be adequately managed through site selection.

The dominant environmental impacts are largely related to the existing water supply arrangements and are not expected to be altered with ongoing use of these supplies. The impacts of proposed system augmentation to achieve secure yield requirements (the new WTP for S1, S2 and S4, an off-stream storage in S2 and groundwater in S3 and S4) are expected to be adequately managed.

Recommended Scenario

Community consultation was not undertaken during the initial drafting of this report. Instead, the predicted community acceptance was compared based on the expected frequency, duration and severity of restrictions, the extent of investment, infrastructure modifications, energy requirements and service delivery required for each scenario. The combination of these factors was expected to influence community opinion on the scenarios. As the environmental impacts of the four scenarios are expected to be adequately managed, assessment of the scenarios focused on security of supply and economic considerations. The water supply scenarios are compared in Table 3 on the basis of security of supply and costs. A triple-bottom-line (TBL) assessment was used to compare the scenarios (Table 4 and Table 5).

Table 3: Comparison of supply scenarios

Scenario	Security of supply	30-year capital cost (2025$)[1,2]	30-year operation and maintenance cost (2025$)[1]
S1: Base case: Improvements to the existing raw water transfer system, a new WTP and full emergency connection to the regional supply and new WTP.	Secure until 2027. Beyond 2027, restrictions may become more frequent and/or more severe.	$19,763,000 (weir supply, WTP, emergency supply)	$41,049,000 (asset operation and maintenance, ongoing purchase of emergency water)

Scenario	Security of supply	30-year capital cost (2025$)[1,2]	30-year operation and maintenance cost (2025$)[1]
S2: Off-stream storage: Improvements to the existing raw water transfer system, full emergency connection to the regional supply, construction of a 200 ML off-stream storage and new WTP.	A 200 ML storage is expected to provide a secure supply until approximately 2060.	$79,913,000 (weir supply, WTP, emergency supply, 200 ML storage, fishway)	$45,074,000 (asset operation and maintenance, purchase of emergency water until storage is constructed)
S3: Permanent connection to RCC regional supply: Mullumbimby would form part of the RCC regional supply network with bulk treated water transferred to the Azalea Street reservoirs.	The secure yield would be determined by the RCC bulk supply system, as with the remainder of Byron Shire.	$1,500,000 (emergency supply, pipeline duplication)	$89,782,000 (asset operation and maintenance, ongoing bulk purchase of water)
S4: Supplementary groundwater: Improvements to the existing raw water transfer system, new WTP, full emergency connection to the regional supply, construction of new bores to the south-west of Mullumbimby with raw water transferred either to the weir or the new WTP for treatment and distribution to the township.	A supplementary groundwater supply with a yield of 1.1 ML/d is expected to provide a secure supply until 2050. Higher groundwater yields would reduce reliance on the weir supply and increase the security of the groundwater option.	$31,205,000 (weir supply, groundwater bores, WTP, emergency supply)	$40,891,000 (asset operation and maintenance, purchase of emergency water until storage is constructed)

1. The cost estimates do not include current operating costs, staff costs, management of assets no longer required as part of the water supply system or costs of infrastructure modifications for heritage preservation as these are common to all scenarios.

2. The extension of the existing emergency trunk water main from the RCC regional supply to Azalea Street reservoir will be fully funded as a flood resilience project under the Disaster Recovery Fund (DRF) and nil initial capital cost has been included for each scenario.

Table 4: 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	Energy requirements	Operational energy consumption (comparative).
Social		
Community acceptance	Predicted community acceptance	The outcomes of community consultation were not available at the time of the TBL assessment.

Criteria	Description	Information used
Security of supply	Year of augmentation required (following implementation of the scenario)	Secure yield assessment of each option.
Economic		
Net present value (NPV)	NPV of capital and operating costs (30 years) at 5% discount rate.	Estimated capital and operating costs.
Life-cycle cost (30 years)	Total cost over 30 years	Estimated capital and operating costs.

A weighted score (higher is better) 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.

A summary of the TBL assessment (with equal weighting for each criterion) is provided in the following table. Changing the weightings does not change the outcomes of the multi-criteria analysis (MCA) ranking.

Table 5: Summary of MCA outcomes

Scenario	Weighted environmental score (/5)	Weighted social score (/5)	NPV ($ million, 30 years @ 5%)	Total score (per $ NPV)	Rank (based on MCA)
S1: Base Case	4.50	1.00	34.6	80	3
S2: Off-stream Storage	3.67	3.50	89.0	40	4
S3: Permanent connection to RCC regional supply	4.67	4.00	43.0	101	1
S4: Groundwater	3.67	3.25	43.9	72	2

Based on the TBL assessment, the most favourable scenario is S3: Permanent connection to the RCC regional supply (Figure 3). This scenario would have minimal environmental impact and the security of supply is only limited by the security of the RCC regional supply. Social acceptance of this scenario has not yet been determined but when other factors such as energy consumption, infrastructure modifications and required investment are considered, the regional supply has significant benefit over the local scenarios.

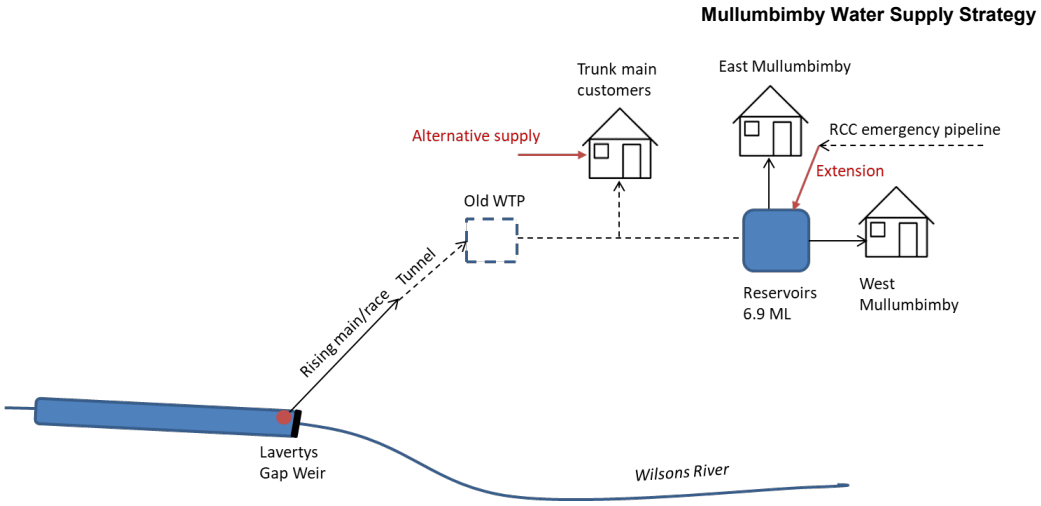

Figure 3: Recommended scenario S3: Permanent connection to RCC regional supply

The NPV of the regional scenario is the lowest of all scenarios. There are significant capital cost savings in avoiding the need to replace the Mullumbimby WTP and upgrade the weir supply in addition to constructing new infrastructure, however, the ongoing costs of a regional supply are higher than local scenarios.

The benefits of centralisation of water supplies and regional interconnection have been recognised in a previous study undertaken by the Northern Rivers Regional Organisation of Councils (now Joint Organisation) including improved financial outcomes through economies of scale, access to a wider range of options to improve efficiency, system resilience and operational flexibility. Financial benefits would result from regional opportunities for staging of water source development, increased flexibility in scheme development, reduced duplication of infrastructure and sharing of costs over a larger customer base. There is also the potential to reduce the risk of supply shortage in the region through supply diversity, supply redundancy, climate resilience and system flexibility. A regional scheme also allows access to a wider range of options to improve environmental and social outcomes than a local scheme. The benefits of regional supplies (compared to local supplies) are also recognised in the NSW Government's *Far North Coast Regional Water Strategy Implementation Plan* (2023), particularly Action 4.3 (Support regional-scale, adaptive decision-making for town water supplies in the Far North Coast) which includes connecting smaller systems in the Richmond/Brunswick catchments (Casino, Nimbin, Mullumbimby) to the RCC bulk water supply on a permanent basis as well as development of other regional supply sources such as desalination.

Consultation

Draft outcomes of this report were presented to Council staff and the Executive Team prior to presentation to the BSC Water and Sewer Advisory Committee in April 2021. The study was also discussed at subsequent meetings of the Committee in September 2022, June 2023 and a Council workshop in November 2023. Council resolved at its August 2023 meeting to undertake community consultation on the findings of the draft report prior to deciding on a course of action. In June 2024, Council conducted public consultation to gauge community opinion about the findings of a draft of this report and the recommended scenario.

During the public exhibition period, additional information was provided to Committee members and Councillors including revised cost estimates and the analysis of impact on water supply customer bills. This information has been incorporated into this report.

Council Resolution

At its Ordinary Meeting of 15 August 2024, Council resolved [24-411] to:

1. *Note the outcomes of the public consultation on Mullumbimby Future Water Strategy.*
2. *Note the revised NPV comparison analysis for the Water Supply Options for Scenarios 2 and 3.*
3. *Adopt Scenario 3 - permanent, full connection to the Rous regional water supply.*
4. *Maintain its extraction licence at Lavertys Gap.*
5. *Request staff to investigate and report back to Council options for Lavertys Gap water treatment infrastructure and associated land use.*
6. *Commits to continuing to reticulate current volumes of potable water to properties already connected between the Laverty's Gap Water Treatment Plant and Azalea Street reservoirs.*

Implementation Plan

The Mullumbimby Water Supply Strategy includes a diversified portfolio of actions to meet the community's water needs based on connection to the RCC regional supply:

- Priority actions: improved drought resilience and treatment performance:
    - Pipeline extension to Azalea Street reservoirs to service the whole town from the RCC regional supply.
    - Drought management and emergency response planning.
    - Consultation with RCC, trunk main customers, Essential Energy and government agencies regarding the preferred strategy and implementation requirements.
    - Asset management planning for existing water supply assets that are not required as part of the regional scheme.
    - Heritage investigations to provide guidance on long-term maintenance and management of the weir, channel and WTP.
- Ongoing actions:
    - Reducing potable water demand including water loss management and the increased use of recycled water.
    - Financial planning to implement funding strategies.

The expected delivery of the recommended scenario (capital and operating cost estimates and timing) is shown in Table 5. The cost estimates do not include staff time or existing strategic planning or operational expenditure which are not influenced by the preferred water supply strategy for Mullumbimby. The implementation plan assumes that the permanent connection to the regional supply will be available from 2025. Future costs related to redundant assets (e.g. WTP, weir, channel) such as re-purposing, relocation or decommissioning have not yet been identified.

Strategic planning actions such as financial planning and demand management would be undertaken for all BSC water supplies as part of existing budgets and have not been included here. Effluent reuse opportunities are currently unknown and costs have not yet been estimated. These actions are part of Council's shire-wide water supply strategic planning and delivery and would be included in all future water supply scenarios.

Table 6: Mullumbimby water supply strategy implementation - cost estimates

Delivery Program year		DP 3	DP 4	DP 1	DP 2	DP 3	DP 4	DP 1	DP 4	DP 1	DP 2
Action/cost estimate (2025 $'000)	**Ten-year cost**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**2028/29**	**2029/30**	**2030/31**	**2029/30**	**2030/31**	**2031/32**
Pipeline extension to Azalea Street reservoirs[1]	*DRF*	DRF									
Emergency water supply - purchase of water (allowance)	*137*	137									
Regional water supply - purchase of water	*18,618*		1,480	1,613	1,759	1,921	2,077	2,246	2,430	2,507	2,585
Pipeline operation/ maintenance	*292*		32	32	32	32	32	32	32	32	32
Servicing trunk main customers	*500*	500									
Asset management planning	*200*	100	100								
Drought management plan review	*20*	20									
Consultation	*100*	50	50								
Heritage management	*100*	50	50								
Totals	***19,963***	**857**	**1,712**	**1,645**	**1,791**	**1,953**	**2,109**	**2,278**	**2,462**	**2,539**	**2,617**

1. DRF – Disaster Recovery Fund

Planning and approvals	Construction	Operation

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1. INTRODUCTION

Council engaged Hydrosphere Consulting to prepare a long-term strategy for Mullumbimby water supply to ensure that it can meet future water demand. Previous investigations have included:

- *Mullumbimby Long Term Water Supply Scheme Strategy* (JWP, 2005).
- *Mullumbimby Water Treatment Plant Refurbishment* (HydroScience Consulting, 2008).
- *Mullumbimby Water Treatment Plan Concept Design Report* (HydroScience Consulting, 2009).
- *Mullumbimby Drought Management Plan* (HydroScience Consulting, 2016).
- *Draft Byron Shire Council Water Supply and Sewerage Strategic Plan: 2017 Review* (Hydrosphere Consulting, 2017).
- *Mullumbimby Water Supply, Lavertys Gap Weir - Secure Yield Assessment* (Hydrosphere Consulting, 2019).

Detailed investigations into the WTP upgrade requirements (CWT, 2020), heritage management requirements (Hill *et al*., 2021), the condition and performance of the raw water supply channel (Willow + Sparrow, 2020a) and development of hydraulic options for transfer of raw water to the existing WTP (Willow + Sparrow, 2020b) have also informed the development of this strategy. Concurrently, Council is investigating the potential for effluent reuse options to supplement the Mullumbimby water supply (open space irrigation and urban dual reticulation). The outcomes of these investigations to date have also been incorporated into this Strategy.

The need for a long-term water supply strategy for Mullumbimby is based on the following findings from previous studies:

- The current demand for water is similar to the secure yield at Lavertys Gap weir and if the worst drought on record were to repeat, the current supply would not meet demand.
- Mullumbimby's demand for water is increasing with development and population growth.
- The Mullumbimby WTP requires upgrades to ensure consistent supply of microbially safe water in the short-term and is ageing and requires replacement.
- The raw water supply channel is in poor condition and is at risk of failure.

In addition, the prolonged drought conditions experienced during summer 2019/20 resulted in a significant draw-down of the weir and the need to impose high level restrictions in Mullumbimby. Drawdown of the weir also occurred between November and December 2020 although restrictions were not required due to high rainfall in mid-December 2020. Due to flooding in February/ March 2022, Mullumbimby's water supply was offline and staff were unable to access the WTP. Water restrictions were put in place and Mullumbimby relied on the emergency connection for two weeks.

The scope of this Water Supply Strategy includes:

- Review of existing raw water supply and WTP performance and asset condition.
- Demand analysis and forecast (2020 to 2050).

- Assessment of the security of the current supply.
- Investigation of water supply augmentation options:
    - Raising Lavertys Gap weir.
    - Off-stream storage.
    - Permanent connection to Rous regional supply.
    - Stormwater reuse.
    - Desalination.
    - Groundwater.
    - Indirect potable reuse of treated wastewater.
- Consideration of potable water demand reduction options:
    - Regional demand management actions (monitoring, reporting, water loss reduction, non-residential customer programs, smart metering, rebates and education).
    - Increased drought restrictions.
    - Urban effluent reuse.
    - Private water supplies (rainwater tanks, bore water etc.).
    - Rous regional emergency bulk water supply.
- Coarse assessment of long-term supply options.
- Detailed assessment (social, environmental and financial) of short-listed supply options.
- Development, assessment and comparison of long-term water supply scenarios.
- Identification of a recommended scenario.
- Incorporation of consultation outcomes, Council resolution and finalisation of the strategy.
- Development of an implementation plan.

2. EXISTING WATER SUPPLY SYSTEM

Mullumbimby's drinking water supply is sourced from the upper reaches of Wilsons Creek, a tributary of the Richmond River. Water is extracted from Lavertys Gap weir on Wilsons Creek where it flows by gravity through a 'race' (open channel), via a tunnel (583 m) to the WTP as shown on Figure 4. The channel and tunnel were the original raw water transfer system to the WTP and the Mullumbimby Hydroelectric Power Station (now decommissioned). The main features of the Mullumbimby water supply system are shown on Figure 4 and Figure 5.

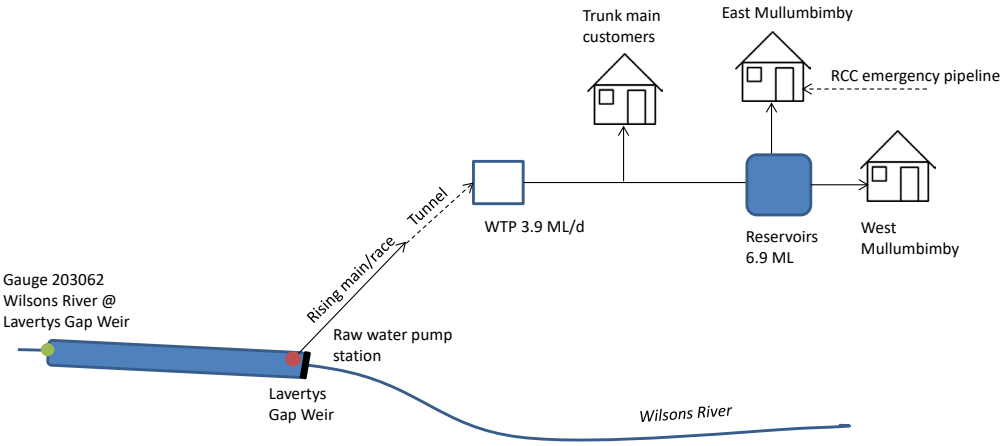

Figure 4: Mullumbimby water supply schematic diagram

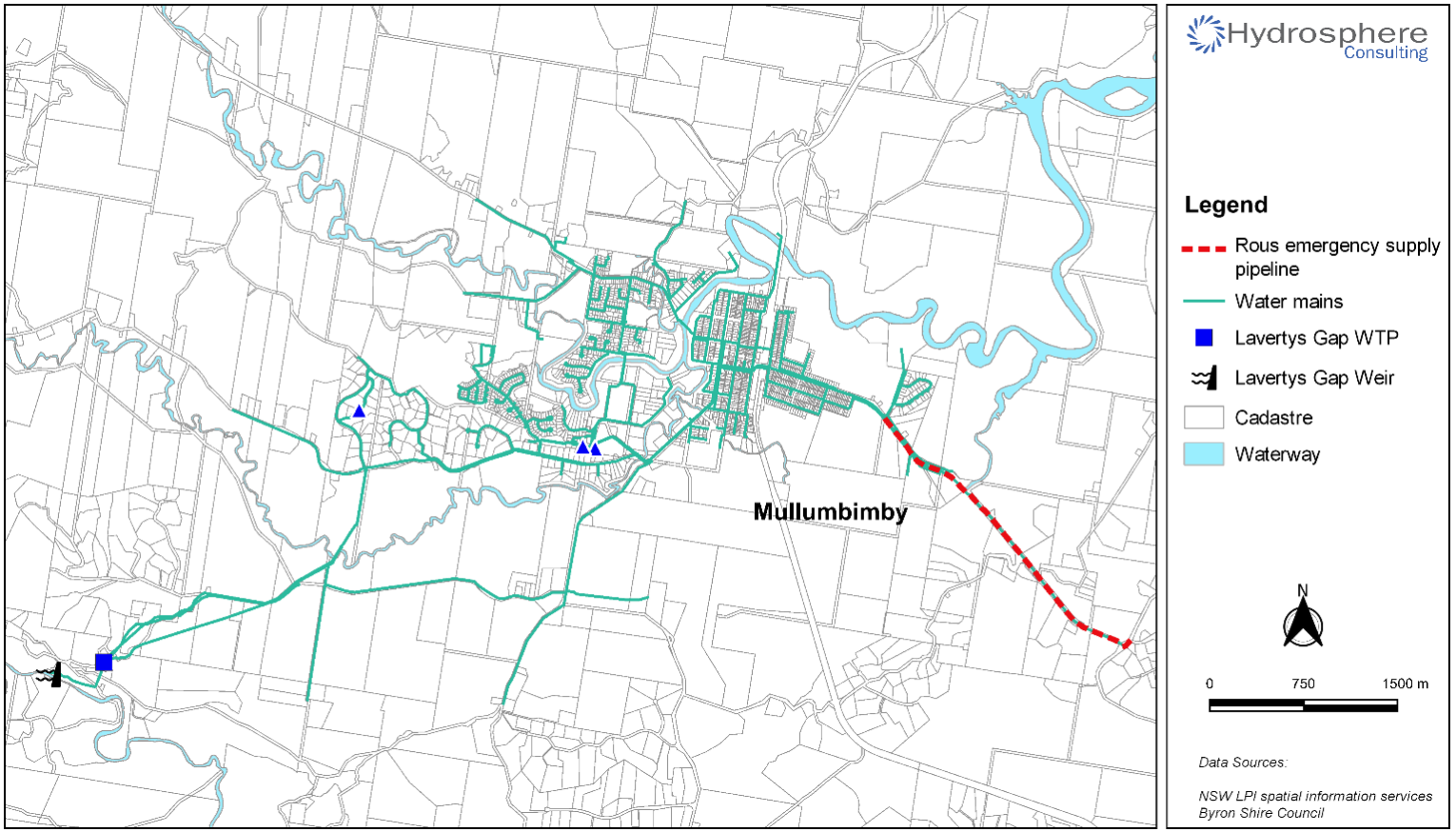

Figure 5: Mullumbimby water supply

2.1 Raw Water Supply

The Lavertys Gap weir catchment and storage are shown on Figure 7. Council has a works approval (30CA304433) and water access licences (23085 and 22968, Table 6) for extraction of water from the Bangalow Area water source (Lavertys Gap weir) in accordance with the *Water Sharing Plan for the Richmond River Area Unregulated, Regulated and Alluvial Water Sources, 2010*.

Table 7: Water access licences

Water Access Licence	Purpose	Category	Water Sharing Plan	Licence entitlement p.a.	Additional requirements/comments
23085	Town water supply	Local Water Utility	*Richmond River Area Unregulated, Regulated and Alluvial Water Sources 2010*	535 ML	Restrictions on taking water do not apply to water taken under this access licence if the water is taken while the Alstonville Sewage Treatment Plant is discharging water on a daily basis.[1]
22968	Industrial	Unregulated river		10 ML	

1. The Alstonville sewage treatment plant discharges to Maguires Creek (outside the Wilsons River catchment).

A stream flow gauge was installed at the head of the weir pool (203062 Wilsons River @ Lavertys Gap weir) in March 2016 and is used to monitor flow and water level upstream of the weir. BSC also monitors the depth of water within the storage (at the weir) with SCADA.

Inflow to the weir storage is generally high and the weir frequently overflows to Wilsons Creek. Daily data recorded at the upstream (203062) gauge are shown in Figure 6 and a summary of inflow to the weir is provided in Table 7. During spring/ summer 2019/20, inflows to the weir were significantly reduced due to drought conditions (shaded red in Table 7). The weir has a full supply volume (FSV) of 72.663 ML at a full supply level (FSL) of 116.16 mAHD. The water level in the weir reduced to approximately 1.4 m below the FSL in December 2019 with a volume of 36.6 ML (50% capacity). The storage response during summer 2019/20 is discussed further in Section 7.3.3.

During February/ March 2022, inflows to the weir were significant increased due to flooding (shaded green in Table 7). The maximum daily flow (28/2/22) was 8,612 ML/d (4.8 times higher than the previous maximum flow in 2020).

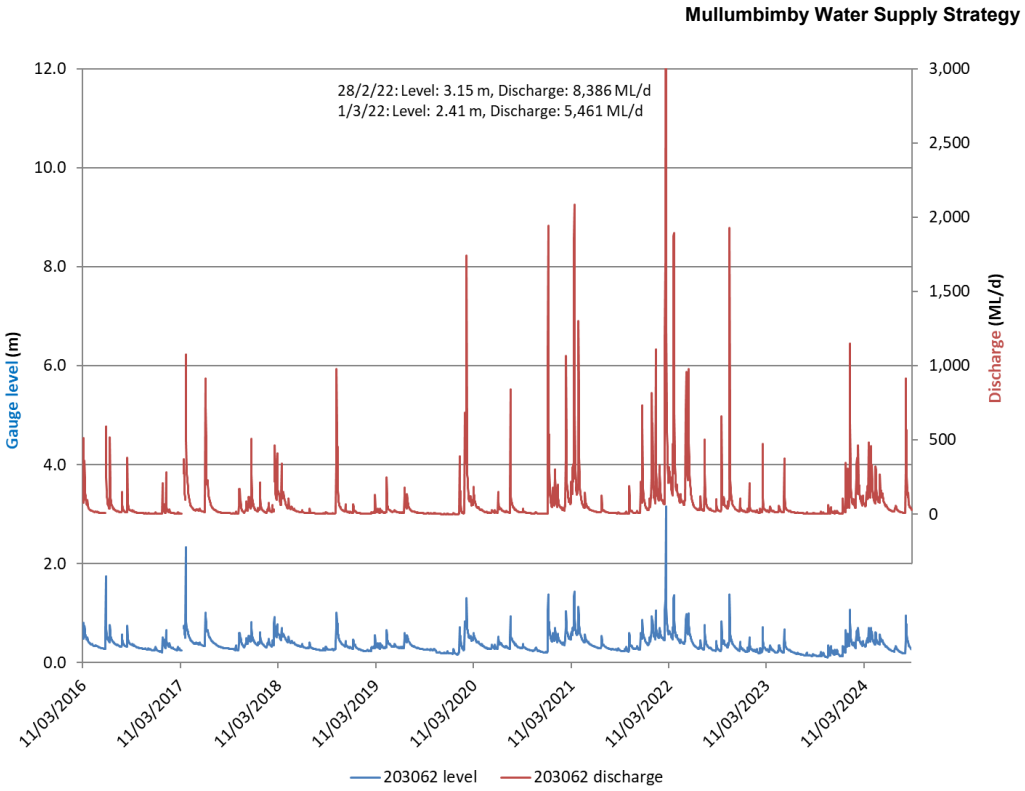

Figure 6: Stream gauge 203062 (Wilsons River @ Lavertys Gap weir) discharge and level

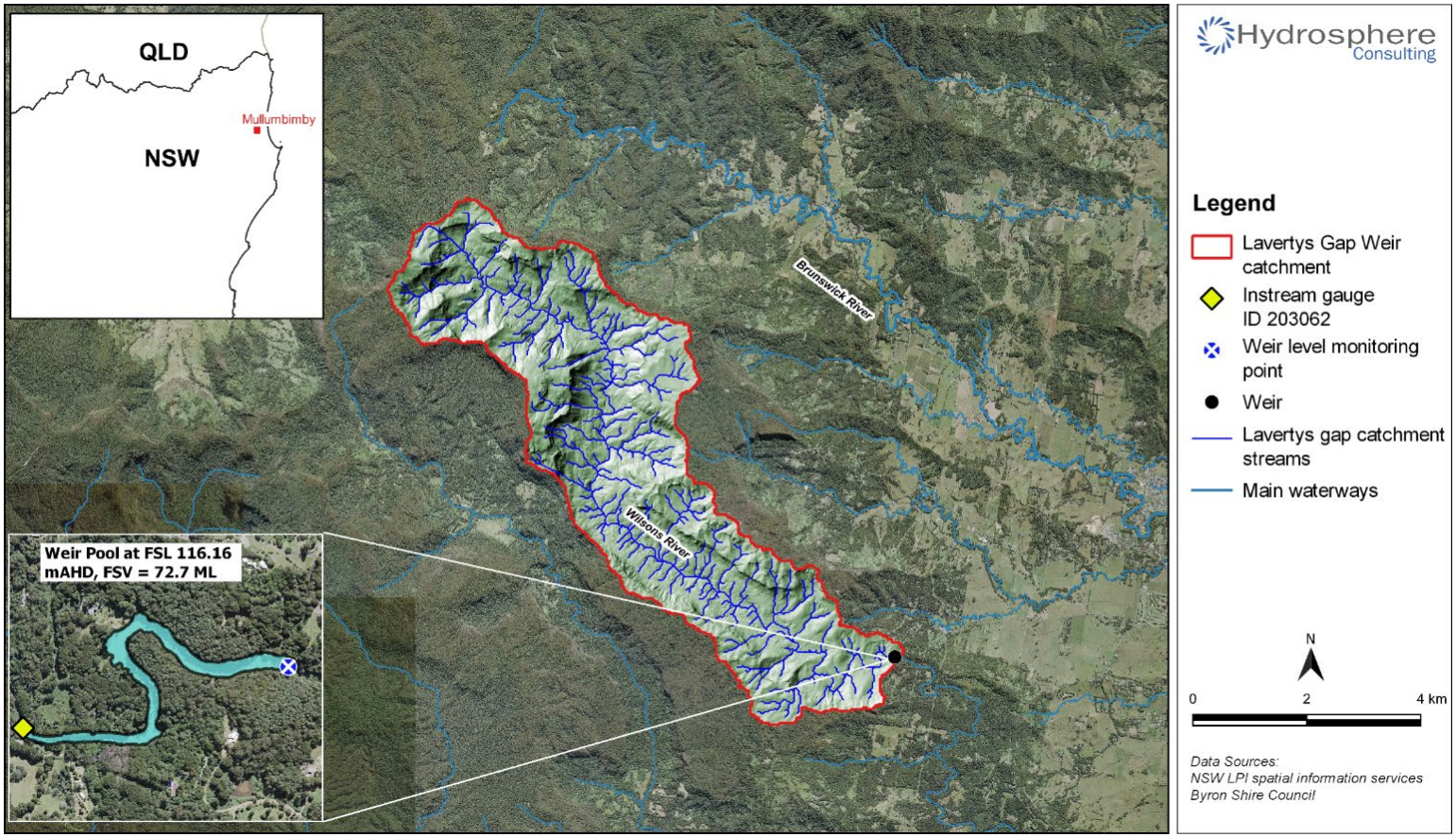

Figure 7: Lavertys Gap weir storage and catchment

Table 8: Weir inflow data (March 2016 - May 2021)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum daily inflow (ML/d)												
2016			51.5	15.1	6.1	0.0	12.3	11.8	10.6	5.5	3.6	1.5
2017	1.0	3.6	0.0	30.9	19.5	15.3	15.2	7.6	4.4	3.3	10.8	18.6
2018	10.6	13.4	62.0	34.2	14.0	8.5	5.4	3.3	3.8	3.2	12.8	7.8
2019	3.3	2.7	7.6	9.8	12.4	9.3	16.2	7.7	4.9	1.0	0.6	0.5
2020	0.4	4.4	40.1	13.1	8.9	10.4	10.4	13.9	8.2	4.1	1.2	1.1
2021	41.4	25.1	70.8	43.5	22.4	11.4	10.2	5.6	3.2	2.8	6.8	26.3
2022	53.6	68.1	128.2	77.9	63.2	29.2	24.0	19.2	17.6	36.7	18.1	14.5
2023	14.1	9.9	14.2	11.5	13.1	9.2	5.1	4.2	3.1	1.7	4.7	3.5
2024	41.7	42.4	51.4	73.1	55.2	16.8	11.2	9.6				
Minimum recorded	0.4	2.7	0.0	9.8	6.1	0.0	5.1	3.3	3.1	1.0	0.6	0.5
Mean daily inflow (ML/d)												
2016			153.0	24.1	9.9	107.2	24.2	46.2	19.6	7.9	5.0	3.7
2017	42.1	6.9	49.0	155.3	27.9	182.2	34.5	10.1	6.2	43.5	48.6	70.8
2018	34.9	61.1	152.9	64.6	25.8	11.9	9.7	4.4	5.8	154.1	24.4	19.1
2019	5.4	5.6	25.6	35.9	19.7	28.0	44.1	11.1	6.0	4.5	1.0	1.5
2020	29.2	314.6	76.0	23.0	14.7	31.6	62.2	32.6	13.9	6.8	3.5	247.6
2021	108.5	164.5	362.4	234.9	47.6	16.0	26.4	8.3	5.3	25.1	38.4	112.9
2022	254.1	599.4	646.5	170.4	350.9	61.8	78.5	29.8	91.9	175.6	41.4	28.1
2023	32.2	40.5	27.8	20.4	44.4	15.4	7.7	5.3	5.3	7.5	13.8	15.5
2024	175.5	154.2	127.4	176.1	107.2	31.2	26.0	134.4	34.7			
Average recorded	85.2	168.4	180.1	100.5	72.0	53.9	34.8	31.4	21.0	53.1	22.0	62.4
Max daily inflow (ML/d)												
2016			525	46	17	609	44	388	33	10	7	12
2017	289	13	381	1,105	38	937	79	15	8	177	118	522
2018	221	477	418	124	50	28	38	9	13	1,005	68	70
2019	10	15	133	254	30	183	141	17	8	8	2	8
2020	401	1,788	188	37	30	154	862	78	36	14	9	1,995
2021	311	1,094	2,139	1,338	150	22	128	11	11	194	222	752
2022	1,142	8,612	5,608	687	1,004	155	518	52	676	1,979	95	108

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023	213	485	54	57	388	25	13	12	17	62	48	107
2024	1,181	476	498	472	273	64	61	937	39			
Maximum recorded	1,181	8,612	5,608	1,338	1,004	937	862	937	676	1,979	222	1,995
Total daily inflow (ML)												
2016			3,213	724	308	3,217	751	1,433	587	245	149	115
2017	1,306	193	1,520	4,659	866	5,465	1,071	313	187	1,350	1,458	2,194
2018	1,082	1,711	4,741	1,939	799	357	301	137	174	4,777	733	591
2019	168	158	795	1,077	611	839	1,368	343	179	141	30	48
2020	906	9,125	2,356	689	454	948	1,928	1,010	416	210	105	7,674
2021	3,363	4,606	11,235	7,046	1,475	479	820	257	158	779	1,151	3,501
2022	7,876	16,784	20,040	5,111	10,877	1,853	2,433	924	2,758	5,443	1,243	873
2023	997	1,135	863	611	1,377	461	238	165	158	231	414	482
2024	5,441	4,472	3,949	5,283	3,322	935	805	4,166	139			
Total inflow (ML)												
2017	20,581											
2018	17,344											
2019	5,756											
2020	25,823											
2021	34,868											
2022	76,214											
2023	7,133											

During spring/summer 2019/20, inflows to the weir were significantly reduced due to drought conditions (shaded red). During February/March 2022, inflows to the weir were significantly increased due to flood conditions (shaded green).

Photos of the weir, catchment and storage at various water levels are provided in Plate 1.

The raw water supply arrangement is shown on Figure 8. Water flowing through the channel to the WTP can also leak from the channel and flow back into Wilsons Creek downstream of the weir. Council switches to pump feed (via pump and rising main installed in the channel /tunnel) generally when the water level falls below the FSL to minimise the loss of water and ensure continued supply.

1. Upstream catchment

2. Weir storage at FSV (18 September 2018)

3. Weir at FSV and spilling (18 September 2018)

4. Wilsons Creek downstream of weir (18 September 2018)

5. Weir level (19 December 2019) approximately 115 m AHD (1.2 m below FSV). Photo - N. Ulrick

6. Weir overtopping following heavy rainfall (7 February 2020)

Plate 1: Lavertys Gap weir storage levels

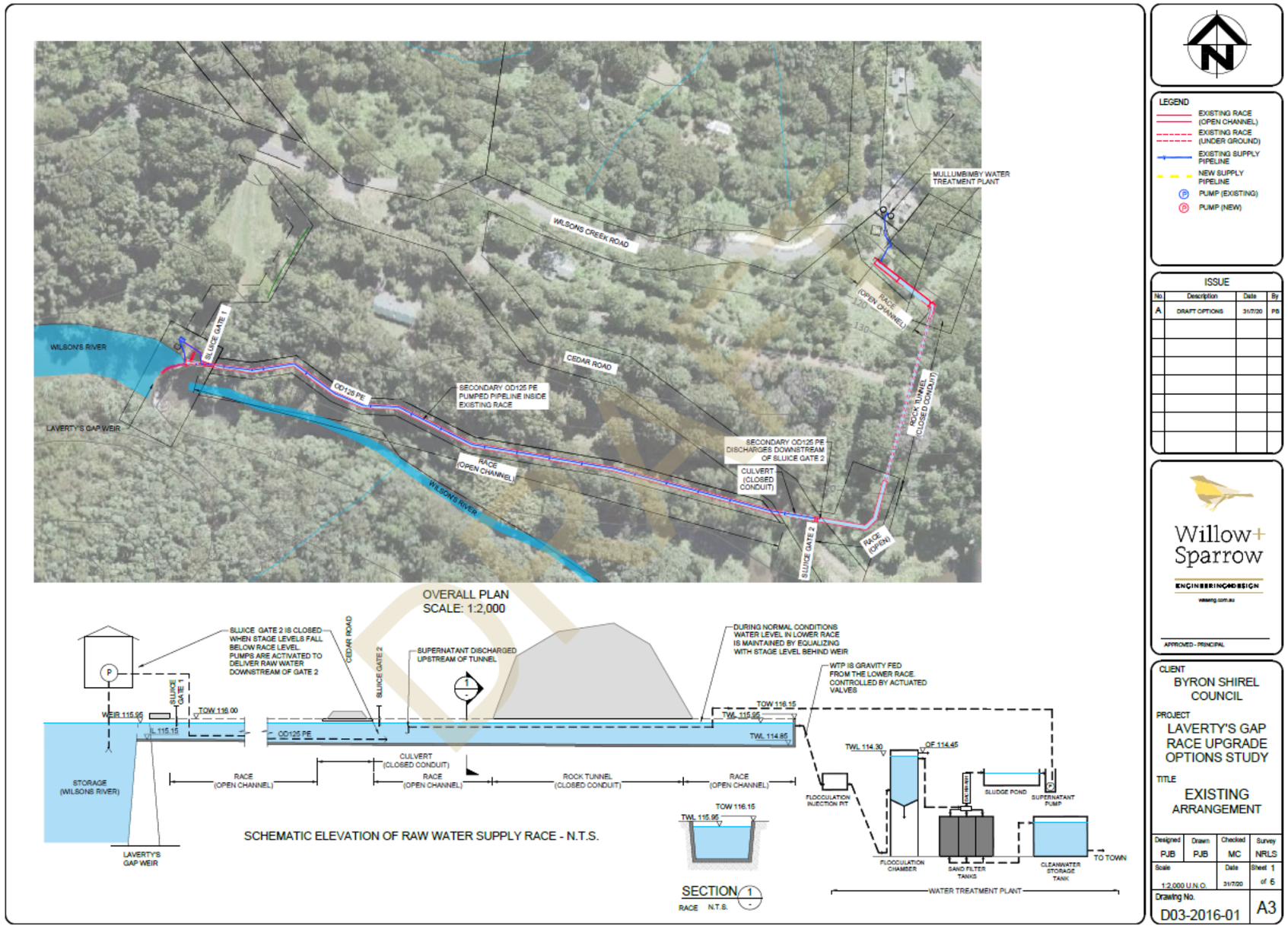

Figure 8: Existing raw water supply arrangement

Source: Willow + Sparrow (2020b)

2.2 Treatment

The Mullumbimby WTP is a conventional sand filtration plant with coagulation and flocculation (Figure 9). The original WTP was constructed in 1939 and augmented in 1962 and 1966. A backwash recovery system was completed in 2002 to stop the previous practise of disposing of the filter backwash water to Yankee Creek, a tributary of the Brunswick River. This backwash recovery system now collects all filter backwash water in a holding tank to allow the settlement of solids. The supernatant is returned to the inlet of the WTP via the raw water channel and the settled solids are removed weekly and sent to one of Council's sewage treatment plants (HydroScience Consulting, 2008).

The capacity of the plant is 3.9 ML/d. Raw water gravitates to the WTP (45 L/s) where the flow is split between two filtration units. Filtered water from either unit flows to the clear water tanks. Chlorine is dosed into the common filter outlet pipework upstream of the clear water tanks. Filtered water gravitates from the clear water tanks to the town storage reservoirs at Left Bank Road and Azalea Street then reticulated to consumers.

2.3 Trunk Main Customers

Approximately 13 customers along Wilsons Creek Road are connected to the trunk main from the WTP (Figure 10).

Concerns regarding the future water supply for these individual customers were raised by these customers during the public exhibition of the draft Mullumbimby Water Supply Strategy. Some of these customers attended the public meetings and raised concerns with Council staff and the consultants, and some provided written submissions to Council on this issue. The affected properties include farms, domestic residences and an electricity substation facility along the section of Wilsons Creek Road. It is understood from the information provided by these customers that the use of potable water varies but includes drinking water, stock watering and firefighting. The general feedback was that these customers wish to remain connected to the potable water supply.

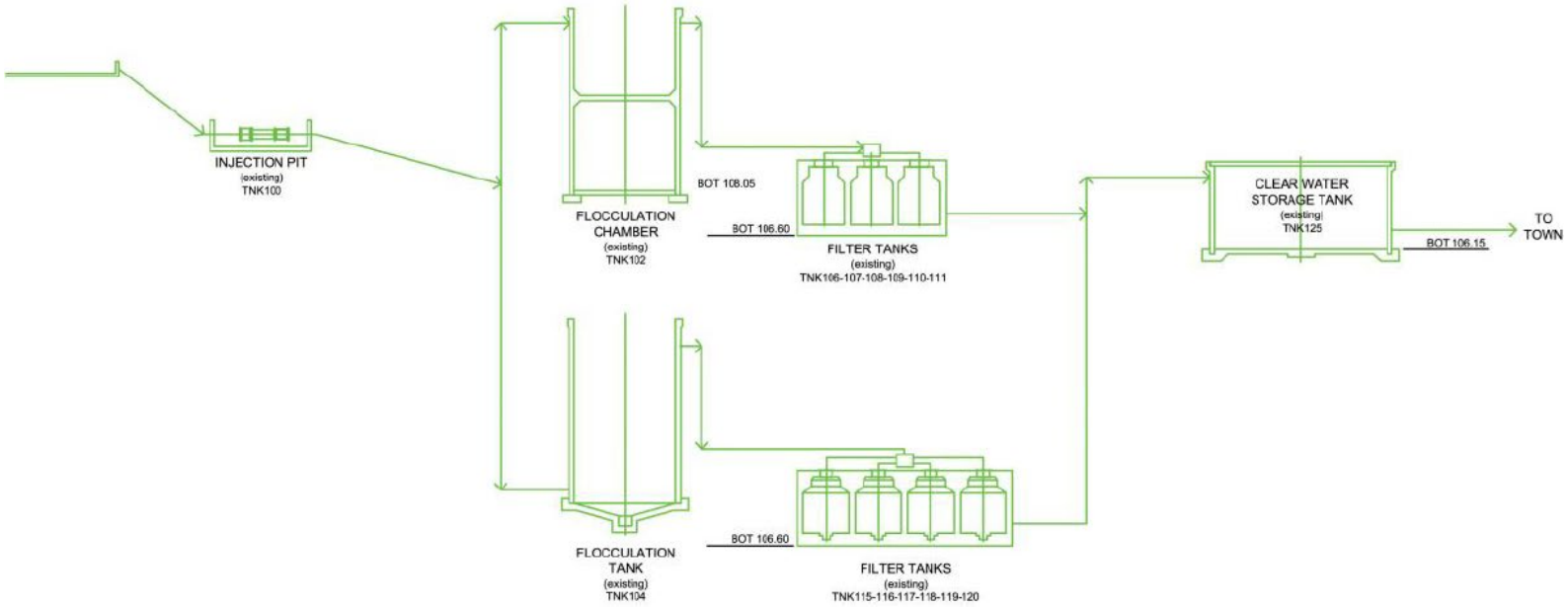

Figure 9: Mullumbimby WTP process diagram

Source: HydroScience (2012)

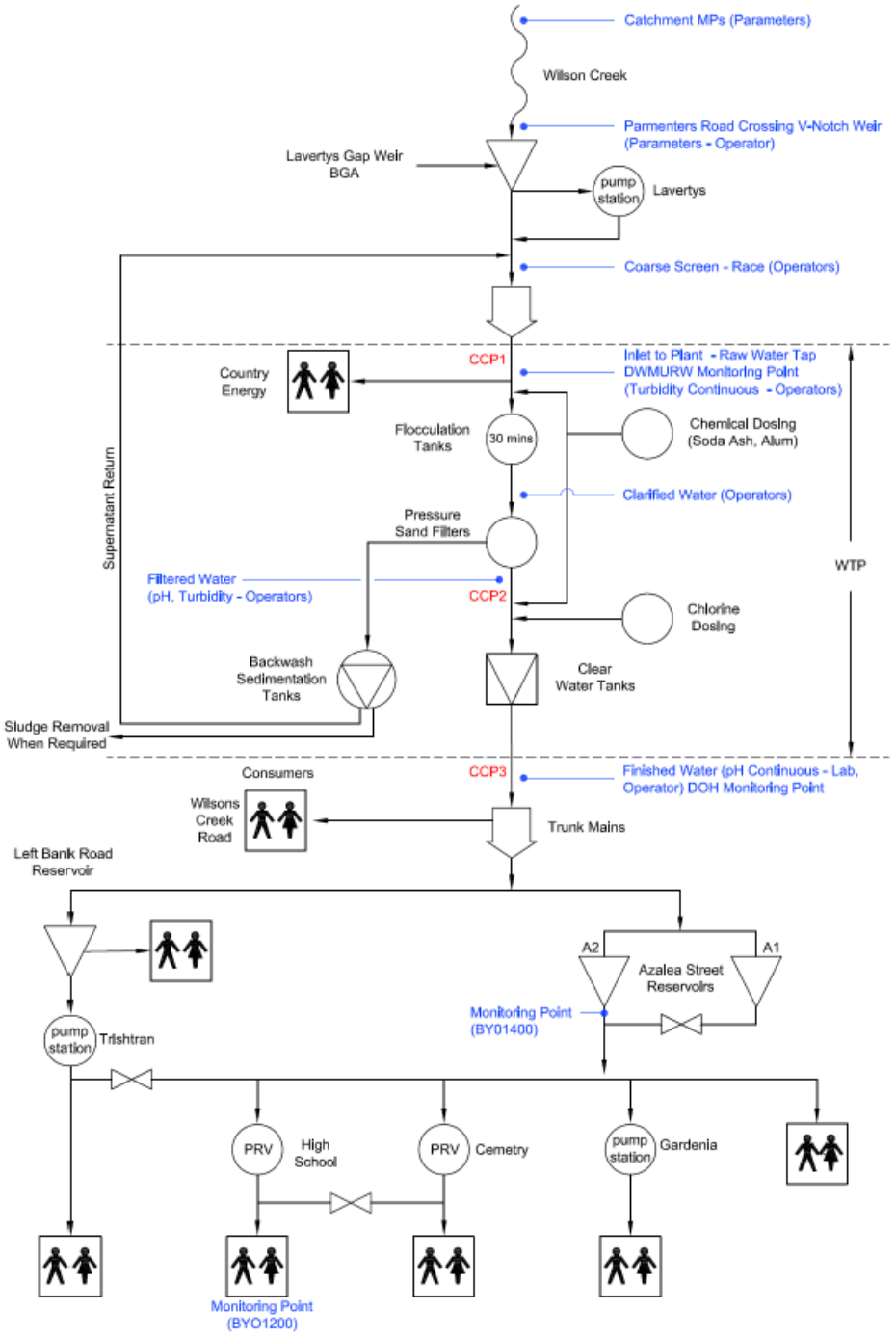

Figure 10: Mullumbimby water supply schematic

Source: HydroScience (2012)

3. DROUGHT MANAGEMENT

In accordance with the *Mullumbimby Drought Management Plan* (HydroScience, 2014), Mullumbimby residents have restrictions (7 levels) introduced based on the water level and inflows in Lavertys Gap weir (refer Table 16, Section 7.3.2). Supply-side actions include investigation of emergency supplies including the Rous County Council (RCC) regional supply and potential alternative sources such as groundwater, effluent reuse, desalination, other surface water options.

Restrictions were imposed in Mullumbimby during the droughts of 2002/03, 2006/07 and 2019/20 (level 1 from 7/11/19 - 10/11/19 (4 days), level 3 from 11/11/19 - 23/12/19 (42 days), level 4 from 24/12/19 to 22/1/20 (30 days), level 2 from 22/1/20 to 13/2/20 (22 days)). Restrictions were also introduced during the floods of 2022 (level 4 for 14 days) when the WTP was unable to treat water.

RCC is the regional bulk supplier for the Lismore, Ballina, Richmond Valley and Byron Local Government Areas (excluding Mullumbimby). An emergency supply pipeline (3.2 km, DN250 PVC) from the RCC bulk supply at St Helena reservoir (at the intersection of Tandys Lane and Gulgan Road to the intersection of James Street and Mullumbimby Road, Mullumbimby) was constructed in 2002/03. The emergency pipeline can only supply water to lower elevation areas (East Mullumbimby). The Service Level Agreement between BSC and RCC allows for a maximum rate of 0.5 ML/d through this main. The cost of water supplied (Special Approved Connection) is $5.43 per kL in 2024/25 (RCC, 2024a).

During summer 2019/20, the emergency supply was used to supplement town water supply from the Mullumbimby WTP for the first time (average 0.43 ML/d for 30 days). Due to flooding in February/ March 2022, the WTP was unable to treat water, the RCC emergency supply connection was activated for two weeks and used more than 13.3 ML.

RCC is currently augmenting the St Helena supply main to the northern areas of Byron Shire (600/375 mm) and RCC expects this to increase the available supply capacity to Mullumbimby up to 3.2 ML/d subject to detailed modelling and amendment to the Service Level Agreement.

RCC imposes restrictions for all customers in Byron Shire supplied with bulk water by RCC in accordance with the *Rous Regional Drought Management Strategy* (Hydrosphere Consulting, 2016) which documents a regional restriction regime that applies to all customers served by the RCC regional water supply. The local water supplies managed by councils in the region (including Mullumbimby) may adopt triggers for the introduction of water restrictions developed for their specific water sources/storages.

4. DEMAND MANAGEMENT

Demand management initiatives have been successful in the region at reducing water demand. The *Rous Regional Demand Management Plan: 2023 - 2026* (RDMP) (Hydrosphere, 2022a) provides details on demand management strategies adopted within the Ballina, Byron, Lismore and Richmond Valley Council areas. The actions in the RDMP will be coordinated by RCC on behalf of the constituent councils. The actions apply to the Rous regional water supply areas and also support BSC in the delivery of Mullumbimby's water supply.

Table 8 outlines demand management actions to be implemented across the regional supply area and the tasks that BSC is responsible for where relevant to Mullumbimby. It is envisaged that RCC will update the RDMP in 2026 and incorporate Mullumbimby as part of a regional supply scenario.

Table 9: RDMP (2023-2026) actions and tasks

Action	Tasks to be undertaken by Byron Shire Council	Expected outcomes
Residential customer Behaviour change pilot program	Initial program design with RCC and other constituent councils, identifying target groups, meter reading and data provision.	The pilot program will inform the design of the future residential customer assistance program.
Non-residential customer pilot program	Initial program design with RCC and other constituent councils, identifying target groups, meter reading and data provision.	The pilot program will inform the design of the future non-residential customer assistance program.
Audit of council facilities and operations	Identify and provide access to BSC facilities, meter reading and data provision.	Audit outcomes and water savings programs are expected to be applicable to BSC facilities in Mullumbimby.
Standard definitions of connection types	Guidelines and policy were developed by RCC and the constituent councils in early 2024.	These guidelines will apply to all BSC customers
Standard metering policy	Guidelines and policy were developed by RCC and the constituent councils in early 2024.	These guidelines will apply to all BSC customers
Reporting of customer data and consumption	Annual reporting for all BSC customers and demand in accordance with improved customer management system, bulk flow metering and reporting procedure	Data available for ongoing review of demand forecasts.
Education and engagement tools	Provide links to tools provided by RCC	These tools will apply to all BSC customers. Water education information will be available on BSC's website.
Monitoring of RDMP action status	Provide data as required by RDMP actions, provide feedback on implementation of related activities (e.g. water loss management and smart metering), share knowledge and lessons learned	Lessons learned are expected to be applicable to BSC customers in Mullumbimby.

Action	Tasks to be undertaken by Byron Shire Council	Expected outcomes
Water loss management	Each constituent council will implement a water loss management program building on existing programs and infrastructure already installed.	BSC will provide sufficient resources to implement its water loss management programs and set targets based on best-practice indicators and timeframes for water loss reduction.
Smart metering	Provide input to RCC to assist with the development of a smart metering program.	Smart water meters were trialled in the Byron Shire from November 2020 as part of a 12-month pilot project. Approximately 400 smart water metering devices were installed on residential and commercial properties in East Mullumbimby and selected bulk recycled water clients in Byron Bay. BSC 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.
Recycled water	Develop opportunities to replace potable water with treated sewage effluent and encourage the use of recycled water.	Mullumbimby reuse opportunities are being investigated by Council (refer Section 12.7.1).
Water supply pricing	BSC will continue to set a pricing structure that encourages demand reduction and supports the initiatives in the RDMP.	Pricing encourages demand management and provides full cost recovery.

5. BACKGROUND TO THIS STRATEGY

The scope and relevant key findings of past studies are summarised in Table 9, providing background information on the Mullumbimby water supply.

Table 10: Background information

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Richmond-Brunswick Regional Water Supply Study Discussion Paper	Public Works Department	December 1984	Prior to the connection of the Ballina Shire to the regional water supply, this investigation was undertaken to determine whether an integrated Richmond - Brunswick regional water supply scheme offers advantages over independent development by RCC and Ballina Shire Council.	The options considered for RCC proceeding alone included a scheme involving raising of Rocky Creek Dam by 4 m and construction of a 37,200 ML dam on Wilsons Creek near Goonengerry Road (downstream of Lavertys Gap weir and including the weir inundation area). The options for a combined regional scheme (which were preferred on a cost basis) did not include a new dam on Wilsons Creek. This report assumed that the regional scheme would eventually be extended to supply bulk water to augment (but not replace) the supply to Mullumbimby from Lavertys Gap weir. At the time it was recognised that the maintenance of the weir supply relies heavily on streamflow persistence and the demands were approaching the available yield (assessed as 400 ML/a). It was assumed that the Lavertys Gap system would eventually be supplemented by a regional bulk supply point at Brunswick Heads. The report also considered surface water sources and dam sites in the Brunswick River Basin. The streams in the Brunswick River basin have small catchments and are tidal over much of their length and were not considered as potential storage sites. The Brunswick River above the tidal limit at Mullumbimby is wide with extensive Quaternary alluvial deposits and potential dam sites were only identified upstream of Main Arm but not considered in detail in the report due to the large distance to population centres.

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Mullumbimby Long-Term Water Supply Strategy	JWP	March 2005	Presents demand forecasts and examines possible water supply options for Mullumbimby.	In 2001, the NSW Department of Land and Water Conservation (now Department of Climate Change, Energy, the Environment and Water, DCCEEW) foreshadowed that if Mullumbimby water supply was to remain independent of the regional supply, the introduction of environmental flows will be required at the time of augmentation, or in 10 years i.e. by 2011. JWP (2005) reported that Lavertys Gap weir may be a low priority weir for requiring environmental flows due to the age of the weir, where the environment may have adjusted to the post-weir flow conditions and the large quantities of water that overflow the weir most of the time. There has been no other discussion of environmental flow requirements with regulatory agencies since then. JWP (2005) determined that the total storage required to maintain a typical environmental flow condition and supply an average demand of 450 ML/a (reduced to 80% when the storage is below 55%) and with 10% inactive storage is 432 ML. The “typical” environmental flow condition assessed was: • When inflow is < Q_{95} all inflow is passed (Q_{95} is a flow condition which occurs 5% of the time (i.e. 95% of the time the river flows exceed this condition). • When inflow is between Q_{95} and Q_{80}, 80% of the flow is passed. • When inflow is > Q_{80} at least the Q80 is passed. A more stringent condition of not abstracting any water when inflow is below Q_{80} was also considered. The strategy recommended maintaining Mullumbimby’s current water supply (Lavertys Gap weir) and supplementing the supply with the regional supply requiring a permanent connection to the regional supply network.

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Mullumbimby Water Treatment Plant Refurbishment	HydroScience	March 2008	Investigation of WTP and refurbishment and/or upgrade requirements.	While the plant generally meets water quality criteria, there are operational and safety issues that require upgrade. While the plant can be refurbished to overcome the current deficiencies, the age of the plant and the outdated technology mean that the plant is not likely to have a 30-year life. Money spent on refurbishment is a short-term investment, as a new plant will be required in the medium term. Membranes are a modern technology that provide added benefits, and the preferred treatment technology despite the higher cost. The preferred location of the new plant was considered to be the existing site. Other locations were investigated, including near the weir, but the existing location was considered the most advantageous. A 5.0 ML/d membrane filtration plant was estimated to cost $2.3 million (2008$).
Byron Shire Council Integrated Water Cycle Management (IWCM) Plan	MWH	June 2009	Provides actions to provide a secure water supply to Mullumbimby to meet future water demand. This plan was reviewed in 2017.	The Integrated Water Cycle Management (IWCM) Plan recommended: • The installation of a dual reticulation system for new residential developments in Mullumbimby. • Harvesting stormwater flows to satisfy any environmental flow requirements that may be introduced for Lavertys Gap weir. • Implement further demand management initiatives. • Implement the Mullumbimby Long-Term Water Supply Strategy (JWP, 2005).
Mullumbimby Water Treatment Plant Concept Design Report	HydroScience	December 2009	Confirmation of the required design criteria and development of a concept design for the Mullumbimby WTP.	Structural analysis identified that with proper treatment the existing structures will remain serviceable into the future. The existing plant performs well and in terms of process and structural condition it can remain serviceable for some time. Consequently, the conclusion of the concept design report is that the construction of a new plant may be deferred by approximately ten years (to 2019). Continuing to operate the existing plant poses higher risk than construction of a new plant. In order to reduce the risk, the report recommended that some immediate works be implemented in order to prolong the plant's life to 2020.

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Northern Rivers Region Organisation of Councils (NOROC) Bulk Water Supply Study	Hydrosphere Consulting	October 2013	An investigation into interconnected water supply options for the local government areas within the Northern Rivers region.	The interconnection of major water supplies in the region could improve water supply security on a local and regional scale. This study considered large-scale decentralised desalination and increased surface water storage as potential water source options. The scenarios assessed in the study considered abandoning Lavertys Gap weir with connection of Mullumbimby to the regional supply.
Mullumbimby Drought Management Plan	HydroScience Consulting	July 2014	Drought restriction policy for Lavertys Gap weir water supply.	The report presents a drought restriction policy for Mullumbimby and recommends considering the following alternate supply options during emergency situations: • Connecting the emergency pipeline and developing an operational agreement. • Extracting water from the Brunswick River. • New groundwater sources. • Effluent reuse. • A temporary mobile desalination plant. • Water carting.
Byron Shire Council Water Supply and Sewerage Strategic Plan (2017 Review)	Hydrosphere Consulting	September 2017	Analysis of Mullumbimby's water supply and water supply demand forecasts.	The report predicted annual growth in water demand to be higher than previously estimated in the 2009 IWCM Plan. The review identifies a need for augmenting the Mullumbimby water supply following a detailed analysis to confirm demand forecast, a secure yield assessment and a revised drought management plan.
Mullumbimby Mini-Hydro Prefeasibility Assessment	Entura	July 2018	A prefeasibility study which considers the reinstatement of a hydro-electric power plant at the Lavertys Gap weir.	The study concludes that there is potential to reinstate the mini-hydro scheme subject to obtaining a suitable water licence to allow water to be transferred from the Wilson's Creek catchment to the Yankee Creek catchment. The operation of the plant would increase the amount of water being extracted from the weir.

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Lavertys Gap weir secure yield assessment	Hydrosphere Consulting	May 2019	Secure yield estimates of Lavertys Gap weir based on hydrographic survey considering historic climate and climate change scenarios with and without upstream irrigation.	The report recommends Council investigate options for augmenting Mullumbimby's water supply as secure yield may not be sufficient to meet current demand and future demand with reduced stream flows due to climate change.
Mullumbimby WTP Assessment and Options Investigation	CWT	October 2020	Process audit and assessment of options to upgrade the WTP.	The Mullumbimby WTP is maintained and operated well, however due to its age it requires replacement in the next 5-10 years (2025-2030). The preferred approach for this is to construct a new WTP. Further investigations should be carried out to determine the requirements, treatment process and site of the new WTP. Whilst a new WTP is being designed and constructed, Mullumbimby WTP should be maintained and operated to consistently deliver microbially safe water. The report includes recommendations for improvements to general operation, flocculation, filtration, supernatant return, chemical dosing, chlorine dosing, clear water storage and chlorine contact time, treated water distribution and information management.
Hydraulic Options Study - Mullumbimby Raw Water Supply Race, Lavertys Gap NSW	Willow + Sparrow	October 2020	Hydraulic study to investigate options for the upgrade of the water supply channel.	The study recommends the channel is retained and a secondary pumped main is installed along a new alignment and operated in conjunction with the channel.
Mullumbimby raw water supply race structural & heritage assessment	Bill Jordan and Associates	October 2020	Preliminary heritage study of the raw water supply channel.	The study concludes that the channel should be conserved by keeping it in use to the maximum extent possible. The work required should be achievable by staging it in accordance with a schedule of priorities prepared in accordance with the extent of damage. The recommended sequence of work is to remove damaging vegetation, identify leaks and their size and prepare a priority schedule of rock filling and grouting and contract in stages as required.

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Mullumbimby Water Supply Race, Mullumbimby NSW: Statement of Heritage Impact	Hill, T. and M. Finlayson	May 2021	Statement of heritage impact for raw water supply upgrade options.	The options (Willow + Sparrow, 2020b) for an alternate pipeline which either substantially or completely removes the water supply from the water channel have the least physical impact on the channel. An additional option should be considered which involves sole use of the alternate pipeline for the supply of water to the treatment plant. The removal of the water supply infrastructure would have a positive benefit on the heritage values of the site and would provide an opportunity for a holistic planning process for the weir, water channel, treatment plant and generator sheds.
Mullumbimby trunk water supply assessment	Planit Consulting	February 2022	Identification of water supply pipeline upgrades to service Mullumbimby from the RCC regional supply for current and future timeframes	Upgrade requirements were identified based on required flow rates to supply the Mullumbimby reservoir with water from the RCC regional supply at the Pacific Highway.
Far North Coast Regional Water Strategy and *Implementation Plan*	Department of Planning and Environment	June 2023	Suite of catchment-based strategies for the Richmond, Tweed and Brunswick River catchments developed using an evidence-based and risk-based approach informed by community consultation	The regional water strategy (DPE, 2023a) is a region-wide strategic plan which sets regional strategic direction to achieve water security across multiple councils within the far north coast. Key challenges include declining catchment and river health, competition for low flows, water security, flooding. The benefits of regional supplies (compared to local supplies) are recognised in the Regional Water Strategy Implementation Plan (DPE, 2023b), particularly Action 4.3 (Support regional-scale, adaptive decision-making for town water supplies in the Far North Coast) which includes connecting smaller systems in the Richmond/Brunswick catchments (Casino, Nimbin, Mullumbimby) to the RCC bulk water supply on a permanent basis as well as development of other regional supply sources such as desalination.
Trunk main detailed design	Planit Consulting	June 2024	Detailed design drawings	Detailed design drawings based on trunk water supply assessment.

Title	Author	Date	Scope	Outcomes/findings relevant to this strategy
Mullumbimby Water Supply Strategy - Public consultation report. Public engagement activity and community feedback on scenarios identified for Mullumbimby's future water supply	Trute, P	July 2024	Public engagement activity and community feedback on scenarios identified for Mullumbimby's future water supply.	Refer detailed analysis provided in the report.
Wilsons Creek Water Supply Options Assessment	Willow + Sparrow	September 2024	Draft options assessment for potable water supply to 13 trunk main customers.	Draft options will be reviewed in consultation with BSC and trunk main customers.

6. ASSET CONDITION AND PERFORMANCE

Information on the condition of the raw water supply and treatment assets is provided in the following sections.

6.1 Lavertys Gap Weir

A geotechnical assessment undertaken as part of the 2005 strategy (SMEC, 2003) identified some weak founding conditions at the right abutment and some potential leakage from the weir. A visual inspection of the weir was also undertaken in May 2007 (HydroScience Consulting, 2008). No visual structural defects were identified, although the channel wall was damaged in a several places, resulting in water spills.

6.2 Raw Water Channel

The raw water supply channel is a gravity feed system that is an open channel and tunnel constructed in the 1920s to supply town water to Mullumbimby and supply water to the Mullumbimby hydro-electric scheme. The hydro-power station was decommissioned in 1990 and the weir and channel have been retained and currently operate only for town water supply.

Various studies have discussed the condition of the channel (JWP, 2005; HydroScience Consulting, 2008; Entura, 2018). Most recently, the condition of the channel was inspected on 5 February 2020 (Willow + Sparrow, 2020a). Findings of the condition assessment were:

- The existing structural condition is very poor and considered inadequate for current demand. There is extensive cracking in containment walls. Scouring around walls and subsidence was observed in numerous locations where there is no buttress or cantilever support against bending moments.
- Water loss is very high and leaking is prevalent. It is unlikely the volume of loss would significantly impact on yield when the weir is overtopping, because the water leaking from the channel which would ordinarily flow across the weir and generally drain back into the creek. However, during periods of low flows in the creek and when the water level in the weir is below the weir crest, the leaking would reduce yield and the water loss would be proportionally high. The channel invert level is 860 mm below the weir crest so that water enters the channel from the weir pool when the water level in the weir pool is above this invert level.
- Slips and geotechnical failures were observed. There are numerous slips where earth supporting the channel wall has slipped/subsided and compromised the structural integrity of the channel wall. Extensive sinkhole formations were observed behind the channel wall which is most likely caused by leaking water scouring behind the wall, creating cavities behind the wall.

Photographs from the condition assessment are included in Plate 2.

1. Subsidence and scour has exposed edges of buttress support.

2. Scouring has removed buttressing.

3. Major cracking.

4. Structure has crumbled.

5. Localised slip/subsidence resulting in movement of channel wall.

6. Sinkhole formation behind channel wall.

Plate 2: Condition of raw water channel - February 2020

Source: Willow + Sparrow (2020a)

The asset in its current condition has exceeded its useful life. The likelihood of failure is considered very high, and on the basis that structural failure of the channel would cause extended interruption to water supply, Willow + Sparrow (2020a) recommended that upgrading the channel be a high priority.

6.3 Water Treatment Plant

The Mullumbimby WTP is a sand filtration plant constructed in 1940 with major augmentation in 1962. It is situated on a steep site in the hills south-west of Mullumbimby.

HydroScience Consulting (2008) identified occupational health and safety hazards at the WTP as well as required upgrades to the existing WTP structure, mechanical and electrical systems. In 2008, the plant generally met the requirements of the ADWG but major upgrades to the plant were expected to be required due to its age. Subsequent investigations by HydroScience (2009) concluded that the structures have the potential to remain serviceable with rehabilitation and ongoing maintenance until a new plant is constructed (by approximately 2020). Regular (5-10 years) inspections and reviews to confirm ongoing serviceability and the need for any additional work would be required.

CWT (2020) provided a review of WTP condition and performance. The review found that:

- Treated water quality generally meets the ADWG limits however, there are several parameters with recorded deviations (turbidity, pH and total aluminium).

- Reticulated water is typically within ADWG values, however free and total chlorine are generally lower during warmer months with very low chlorine residual in summer 2019/20 coinciding with water restrictions and drought conditions.
- The existing treatment processes at Mullumbimby WTP are insufficient to achieve the required log credits for all pathogen groups (bacteria, viruses and protozoa).
- Upgrades to the filtration system and optimisation of the whole of WTP operation will be required to achieve the maximum log credits available for treatment processes. Additional process(es) such as ultraviolet disinfection (UV) or clarification will be required to address shortfalls for all pathogen groups and provide a treatment buffer.

6.4 Heritage Considerations

The hydro-electric power complex, including the weir and channel is listed on the NSW State Heritage Register (listing number 01926). The *Heritage Act 1977* refers to regulations for setting out the requirements for maintenance and the *Heritage Regulation 2012* details “Minimum standards of maintenance and repair”. Bill Jordan and Associates (2020) documented the work required to conserve the heritage status of the channel (removal of damaging vegetation, identification of leaks and their size and preparation of a priority schedule of rock filling and grouting). Some repairs are exempt from approval under the *Heritage Act 1977.*

An investigation of heritage significance (Ellsmore, D., 2007 *in* HydroScience Consulting, 2008) found that the WTP has heritage significance at a local level. The original plant that was built in 1940, consisting of one flocculation tank, one filter tank, plant room and clear water storage tank is the part of highest significance at the site. The heritage advice suggests that the original components constructed in the 1940s must be conserved to retain heritage value. Based on this advice, any new plant constructed on the existing site or refurbishment of the existing plant will need to retain the original plant components.

A Statement of Heritage Impact (SoHI) was prepared for the proposed options for upgrade of the raw water supply to the Mullumbimby WTP which form part of the Mullumbimby Hydro-Electric Power Station heritage site and are listed on the NSW State Heritage Register (Hill *et al*., 2021). This is discussed further in Section 12.7.2.

7. SECURE YIELD

7.1 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 now 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.

- 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 climate changed data for each GCM for this period. The 15 GCMs are listed in Table 10.

Table 11: GCMs used in the secure yield assessment

GCM No.	GCM	Modelling Group	Country
1	CCCMA T47	Canadian Climate Centre	Canada
2	CCCMA T63	Canadian Climate Centre	Canada
3	CNRM	Meteo-France	France
4	CSIRO-MK3.0	CSIRO	Australia
5	GFDL 2.0	Geophysical Fluid Dynamics Lab	USA
6	GISS-AOM	NASA/Goddard Institute for Space Studies	USA
7	IAP	LASG/Institute of Atmospheric Physics	China
8	INMCM	Institute of Numerical Mathematics	Russia
9	IPSL	Institute Pierre Simon Laplace	France
10	MIROC-M	Centre for Climate Research	Japan
11	MIUB	Meteorological Institute of the University of Bonn,	Germany
		Meteorological Institute of KMA	Korea
12	MPI-ECHAMS	Max Planck Institute for Meteorology, DKRZ	Japan
13	MRI	Meteorological Research Institute	Japan
14	NCAR-CCSM	National Center for Atmospheric Research	USA
15	NCAR-PCMI	National Center for Atmospheric Research	USA

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 with the 5/10/10 design rule.

Whilst the 15 GCMs represent a range of plausible climate futures for a 1ºC warming scenario, 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 guidelines (NSW Office of Water, 2013) require consideration of:

- 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.

7.2 Previous Secure Yield Studies

JWP (2005) reported the secure yield of the Mullumbimby water supply based on previous surveys of the storage, available streamflow data and various assumptions regarding environmental flow requirements. The report also assesses various options for increasing the secure yield of the water supply while considering environmental flow requirements.

A revised secure yield assessment (Hydrosphere Consulting, 2019; NSW Urban Water Services, 2018) provides secure yield estimates for the climate experienced over the last 120 years and with projected 1°C climate warming. The purpose-built system behaviour model developed by NSW Urban Water Services assesses the secure yield of the Mullumbimby water supply headworks system for the period January 1890 to October 2018 (129 years). Due to the limited amount of recorded streamflow data and the lack of upstream irrigation data, a range of secure yield estimates were obtained.

Inflow to the WTP from the weir has ranged from 332 ML/a to 461 ML/a between 2006 and 2018 with the highest demand in that period experienced in 2017/18. The secure yield assessment results suggest that the weir could supply the average demand (approximately 430 ML/a) during a repeat of the worst drought on record. However, with the predicted reduction in streamflow due to climate change and the predicted increase in demand due to population growth, the secure yield assessment suggests the weir supply would not meet future demand.

7.3 Updated Secure Yield Assessment

The secure yield estimates have been updated as part of the development of this strategy. A model has been developed using GoldSim 12.1 (Monte Carlo simulation software) to simulate the Mullumbimby water supply (streamflow, weir characteristics, WTP extraction/demand etc.) to assess current performance (such as secure yield and weir water level) and evaluate the effectiveness of augmentation options.

7.3.1 Model development

The model simulates the water balance within Lavertys Gap weir (Figure 11).

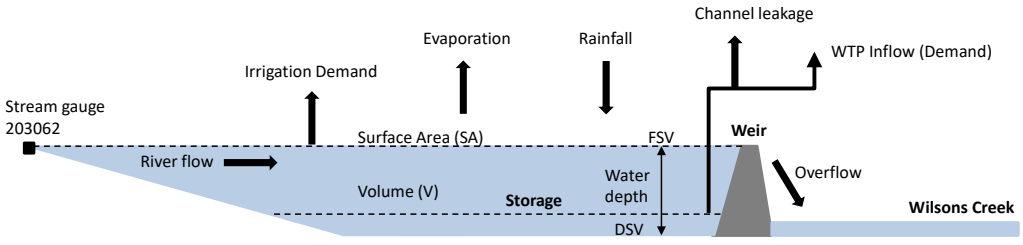

Figure 11: Weir water balance model

The water depth at the weir (and hence storage volume) is a function of:

- Weir inputs:

- River flow (modelled or measured at stream gauge 203062).
- Rainfall over weir surface.

- Weir outputs:
  - Evaporation.
  - Irrigation demand.
  - WTP inflow (demand).
  - Channel leakage.
  - Weir overflow.

The storage response can be modelled as two different simulation types (Table 11). A third simulation type (response of the storage to a future drought) can be built into the model but is not included in this assessment.

Table 12: Simulation settings

Simulation type	Aim	Demand	Simulation duration	Realisations (model runs)
Secure yield	Determine the highest annual demand than can be supplied from the water supply sources based on the system operating rules.	The total annual demand is held constant throughout the simulation period to assess whether the water supply security rules can be met for that demand.	Available duration of climate sequences (refer Section 7.3.2).	1
Validation	Confirm that the model replicates actual recorded behaviour of the storage.	Actual daily demand.	Available duration of recorded weir level data for validation.	1

7.3.2 Initial model inputs

Existing weir characteristics

Recent hydrographic survey of the weir (Hydrosphere Consulting, 2019) provided data on the water surface area, volume and height relationship for the existing weir (Table 12, Figure 12 and Figure 13).

Table 13: Weir storage details

Full Supply Volume (FSV)	72.663 ML
Surface Area (SA) at FSV	27,085 m^2
Weir height at FSV (crest)	116.16 m AHD
Seepage	Assumed none
Environmental release	None required
Licence entitlement	545 ML/a

Channel invert	115.3 m AHD
Dead storage volume (DSV)	10.455 ML

Source: Hydrosphere Consulting (2019)

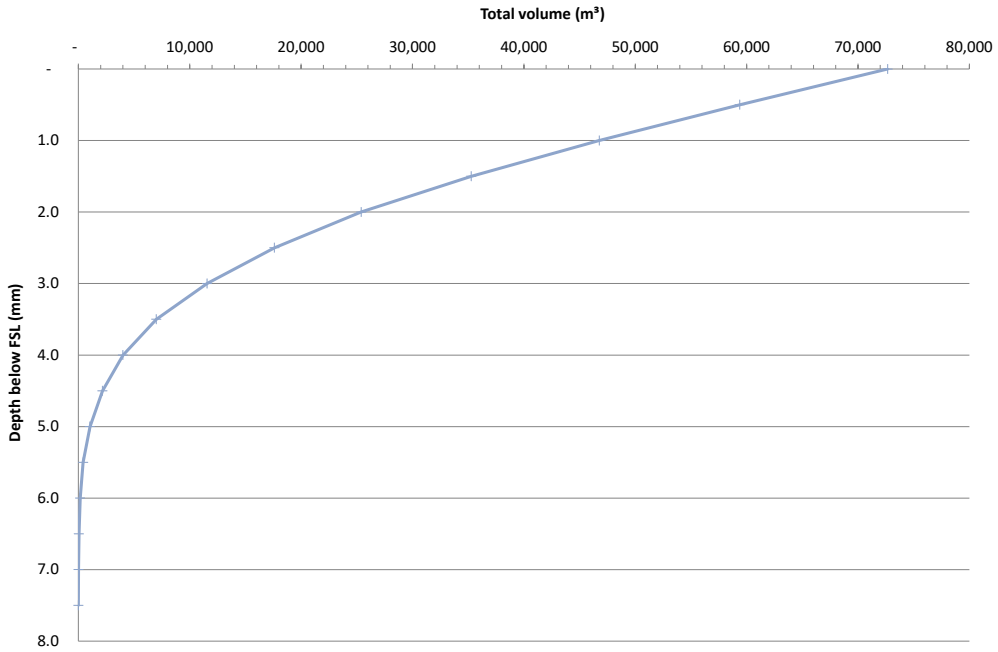

Figure 12: Volume of weir storage

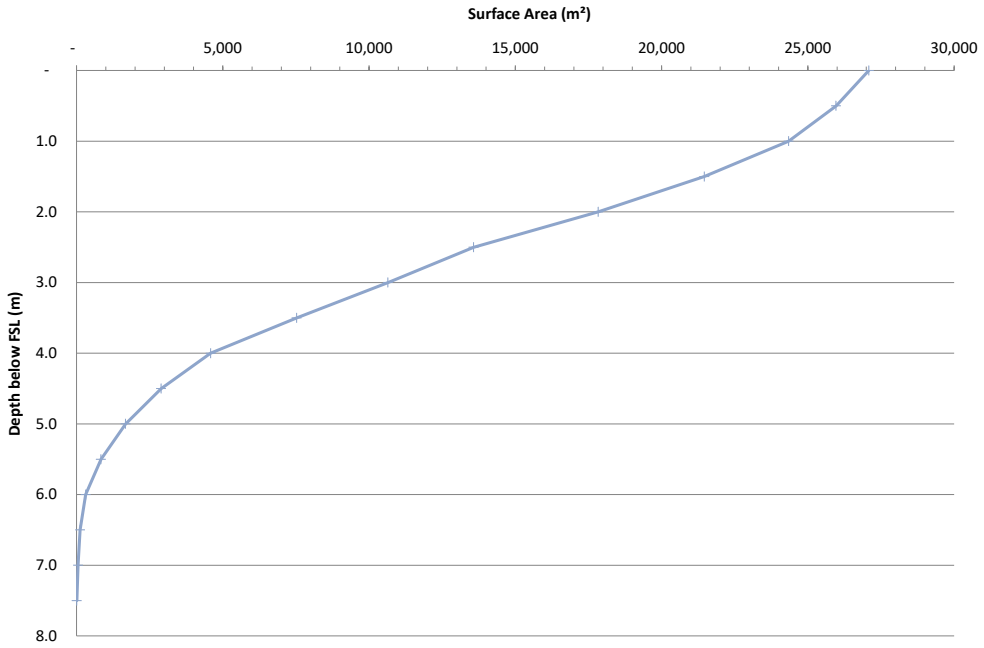

Figure 13: Surface area of weir

Meteorological data

Daily rainfall and daily evapotranspiration data were obtained from the SILO Data Drill for three grid points as given in Table 13 to represent the weir catchment (Figure 14).

Table 14: SILO grid points

Point	Latitude	Longitude
1	-28.60	153.40
2	-28.55	153.45
3	-28.60	153.45

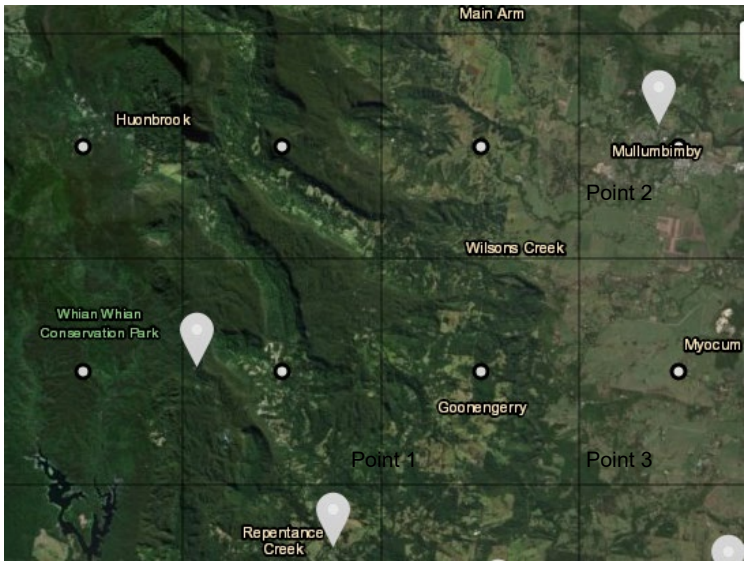

Figure 14: SILO point data grid points

Source: Queensland Government (2019)

Hydrological sequences

Daily streamflow data has been provided by NSW Urban Water Services from the yield modelling undertaken in 2018 (NSW Urban Water Services, 2018) for 1/1/1890 to 9/3/2016. Two sets of data were used in the modelling:

- Set 1 - based on gauging station 203062 (upstream of weir) and Sacramento model - rainfall runoff model.
- Set 2 - based on gauging station 203062 (upstream of weir) and Australian Water Balance Model (AWBM) - rainfall runoff model.

Flow data from gauging station 203062 (Wilsons River at Lavertys Gap weir) has been recorded since 9/3/2016. The gauging station has a catchment area of 26 km^2. Flow recorded at the gauging station has been adjusted by the ratio of weir to gauge catchment areas to estimate the total weir inflow.

Water supply demand

The model applies a daily demand based on a monthly demand factor (reflecting seasonal variation) and the annual demand (Table 14).

Table 15: Monthly demand factors

Month	Factor
January	1.042
February	0.985
March	0.971
April	0.918

Month	Factor
May	0.936
June	0.914
July	0.935
August	0.997
September	1.038
October	1.080
November	1.082
December	1.103
Average	1.000

Restriction regime

The model simulates restrictions implemented based on both the level of water in the storage (below full supply level, FSL) and inflows to the weir. The restriction regime is based on the Mullumbimby Drought Management Plan (HydroScience, 2014). A trigger to lift restrictions based on water level has also been included (Table 15).

Table 16: Restriction regime

Restriction level	Water level trigger (m AHD)	Depth below FSL (m)	Inflow trigger (ML/d)	Volume (ML)	% Volume introduced	% Volume lifted	Target demand (ML/d)	% reduction in demand
0	116.16	-	-	72.663	100%	-	1.18	-
1	115.86	0.3	1.0	64.696	89%	94%	1.12	-5%
2	115.56	0.6	1.0	56.862	78%	83%	1.00	-15%
3	115.26	0.9	1.0	49.293	68%	73%	0.89	-25%
4	114.96	1.2	0.5	42.172	58%	63%	0.83	-30%
5	114.66	1.5	0.5	35.275	49%	54%	0.79	-33%
6	114.36	1.8	0.5	29.345	40%	45%	0.76	-36%
7	113.96	2.2	0.0	22.276	31%	36%	0.52	-56%

Channel leakage

In normal operation, water flows into the channel from the weir storage and flows by gravity to the WTP. When the water level in the storage is above the channel invert, water from the weir flows into the channel (Plate 3). Due to the condition of the channel, water leaks from the channel walls at various locations and flows into Wilsons Creek downstream of the weir. The volume of water leakage from the channel is unknown but due to the poor condition of the channel and the extent of leakage, Council believes that the leakage can be significant.

A raw water pump and pipeline within the channel are generally used when the water level at the weir is below the level of the weir crest. The old penstock at the inlet of the channel was not effective at preventing inflow to the channel and while the pump was in operation and water still flowed by gravity through the channel resulting in continued leakage. From mid-November to the end of December 2019, the water level dropped below the invert of the channel (Plate 4) and hence there was no loss to the channel.

Council replaced the penstock on 14 January 2020 (Plate 5) and no leakage into the channel would have occurred after that time.

1. Channel inlet (submerged)

2. Water in channel

3. Water in channel and leakage from bend

Plate 3: Channel inlet and leakage (September 2018)

1. Channel inlet (exposed at low weir level)

2. Old penstock

3. Dry channel at weir

4. Dry channel looking downstream

Plate 4: Exposed channel inlet (December 2019)

Photos - N. Ulrick

1. New penstock (old penstock in background)
2. New penstock and realigned pump pipework

Plate 5: New penstock (January 2020)

Photos - N. Ulrick

Irrigation demand

Land owners adjacent to the weir storage can potentially extract water from the weir (Plate 6) although there are no data available on extraction volumes. The 2018 yield study (NSW Urban Water Services, 2018) assumed allowances for irrigation from the assumptions used in a previous (1998) yield study (Table 16). The model initially applies these allowances as daily equivalent demand in the respective month.

Table 17: Irrigation allowance (ML)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3.4	1.5	0.9	1.1	1.0	1.1	0.9	1.5	2.4	2.9	3.0	3.1	22.8

Source: NSW Urban Water Services (2018)

1. Riparian landowner

2. Landowner irrigation pump

3. Landowner irrigation pump

Plate 6: Potential upstream irrigation from weir storage (September 2018)

7.3.3 Storage Response in Summer 2019/20

BSC has monitored the water level (SCADA) in the weir since February 2014 although data are incomplete and considered erroneous prior to December 2016 (Figure 15). Rainfall, weir inflow and weir level since 2017 are shown in Figure 16.

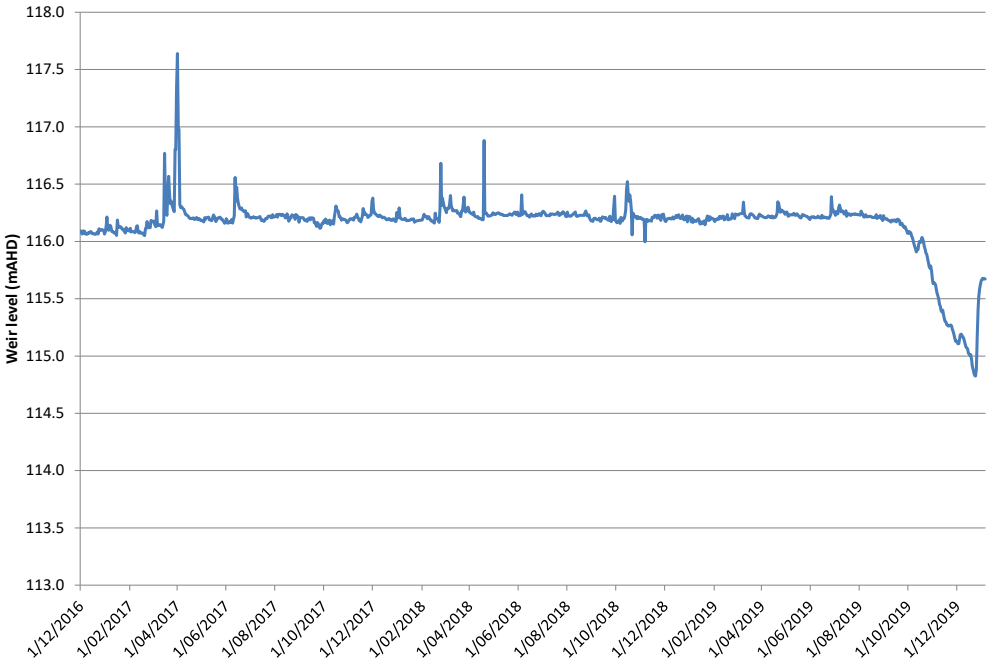

Figure 15: Weir level monitored by Council SCADA system (December 2016 - January 2020)

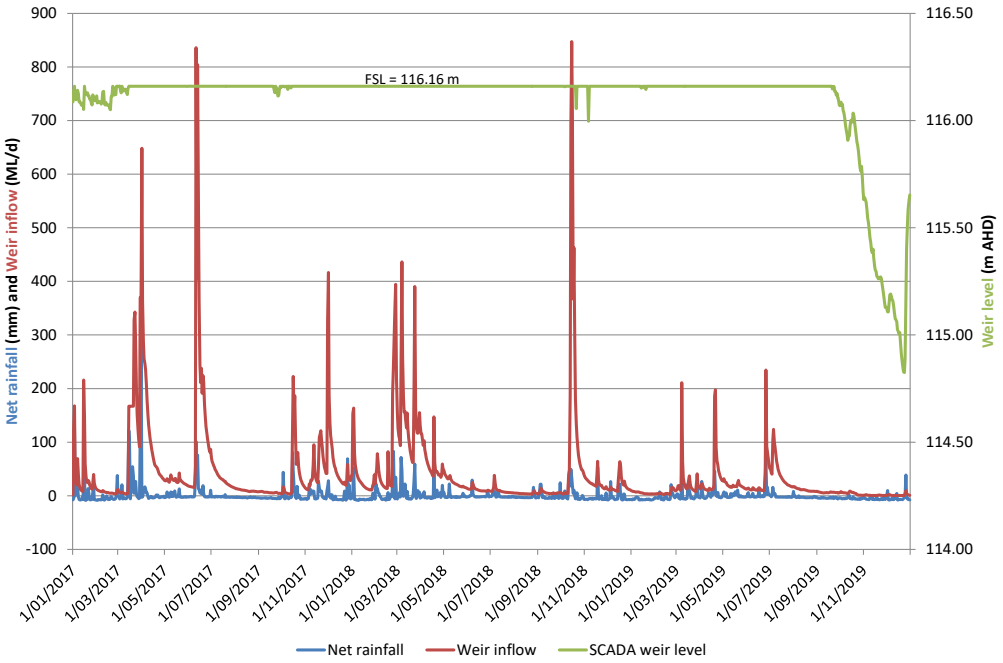

Figure 16: Rainfall, weir inflow and weir level: 2017 - 2019

During 2019 there were sustained periods of low rainfall, particularly in the spring and summer periods (with the lowest level experienced prior to Christmas 2019. During that time, the weir level dropped to approximately 1.4 m below the FSL (Figure 17 and Figure 18).

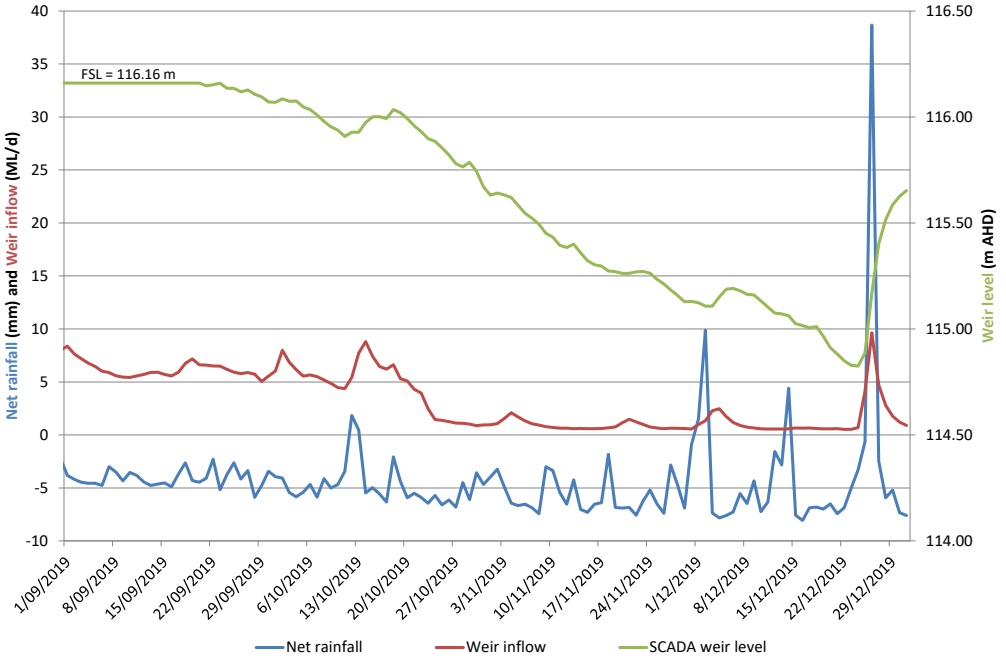

Figure 17: Rainfall, weir inflow and weir level: spring and summer 2019/20

Figure 18: Weir level (19 December 2019)

Photo - N. Ulrick

The weir level data suggests the water level dropped below FSL from 20/9/19 even though the weir inflow was above 5 ML/d for the following month. With daily demand approximately 1 ML/d and losses (channel and irrigation demand) of 0.29 kL/d, this is expected to be due to losses in the channel which become significant when the inflow reduces and the water level falls below the weir crest.

The pump supply was in operation from the end of October 2019 to mid-January 2020. During October 2019, Council also attempted to repair the major leaks in the channel although this was considered to be only partially effective at these locations. During December 2019, Council manually checked the SCADA level data to ensure accuracy. The WTP inflow meter was also checked and found to be accurate.

7.3.4 Model Validation

Validation of the model has been undertaken using recorded weir level between 1 January 2017 and 31 December 2019 (Figure 19) and actual demand experienced during that time. During summer 2019/20, the water sourced from the RCC emergency pipeline was 12,840 kL over 30 days from 23/12/19, compared to the total demand of 28,700 kL (45% of total demand).

As discussed in Section 7.3.3, a significant proportion of water from the weir is lost through channel leakage. The amount of channel leakage at various water levels was adjusted in the model until the storage level was replicated. Results are shown in Figure 19 and Figure 20. The model outputs align with the recorded weir level.

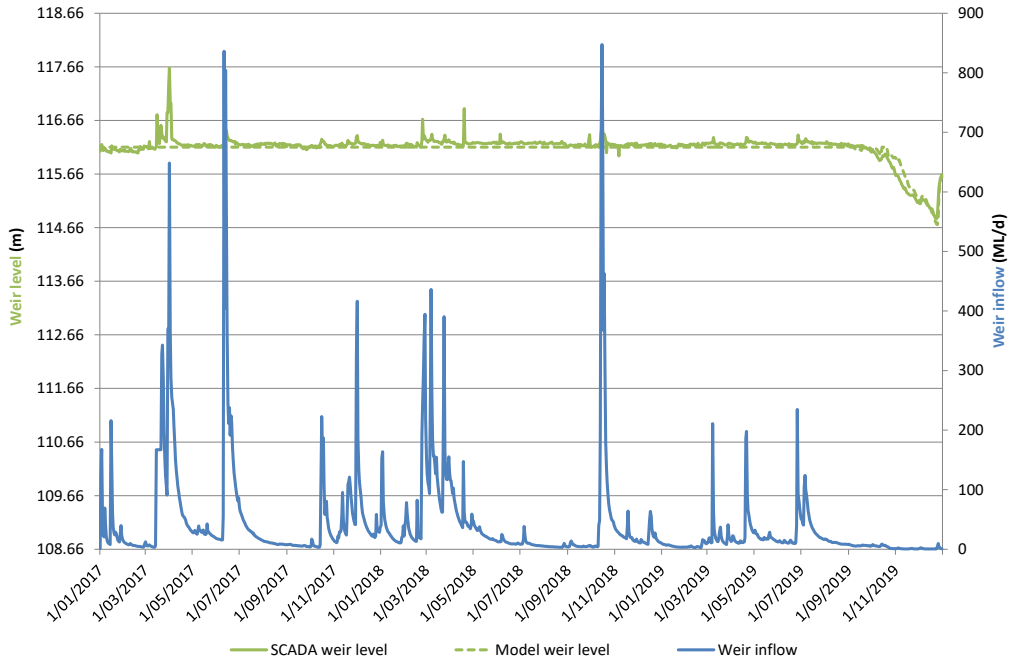

Figure 19: Model validation results: 2017 - 2019

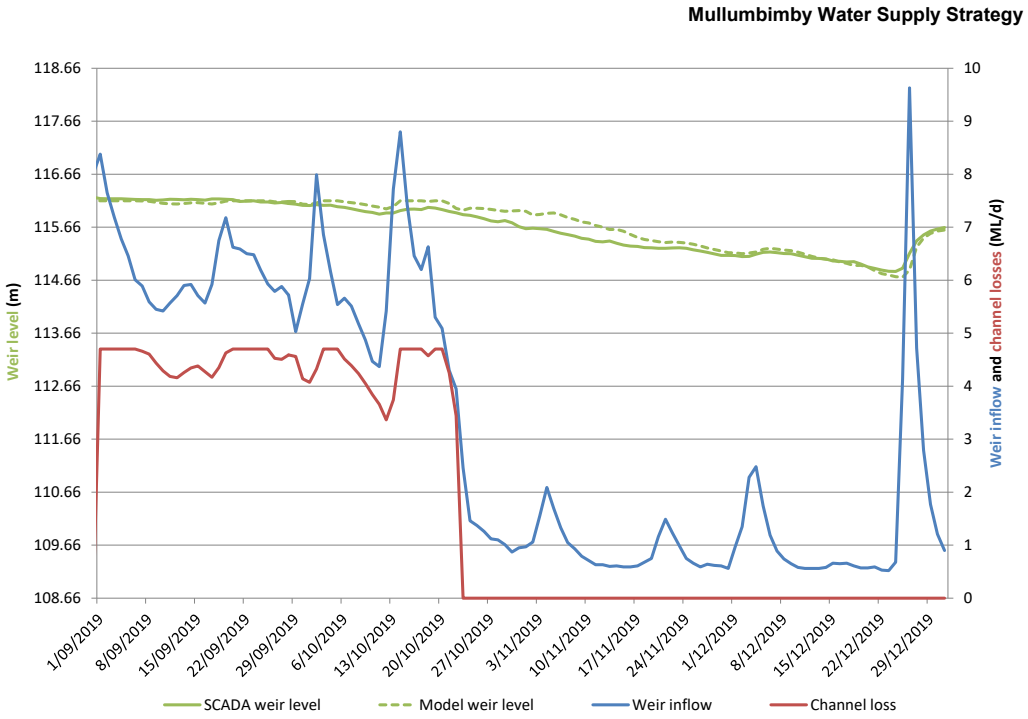

Figure 20: Model validation results: summer 2019

7.3.5 Current System Secure Yield

Current Climate

Results from the NSW Urban Water Services (2018) modelling are provided in Table 17. NSW Urban Water Services (2018) considered the results obtained from the Set 1 flows were more likely to be representative, however, to be conservative in terms of water supply security consideration may be given to adopting the lower estimates. This modelling methodology in NSW Urban Water Services (2018) does not consider the water supply operating rules for Mullumbimby but allows for demand restrictions when required to be introduced to meet the 5/10/10 rule.

Table 18: Secure yield estimates - current climate (NSW Urban Water Services, 2019)

Upstream irrigation allowance (ML/a)	Flow series[1,2]	Secure yield (ML/a) for historic climate (5/10/10)[3]	Applied at storage (% full)	Duration of restrictions (%)	% of years
None	1	430	80	0.27	5.38
	2	335	75	0.41	9.23
22.8	1	410	80	0.26	5.38
	2	305	75	0.40	9.23

Source: NSW Urban Water Services (2018)
1. Set 1 - based on gauging station 203062 (upstream of weir) and Sacramento model - rainfall runoff model.
2. Set 2 - based on gauging station 203062 (upstream of weir) and AWBM - rainfall runoff model.
3. Duration of restrictions does not exceed 5% of the time and frequency of restrictions does not exceed 10% of years (i.e. 1 year in 10 on average) and severity of restrictions does not exceed 10%. Systems must be able to meet 90% of the unrestricted water demand during water restrictions through a repetition of the worst recorded drought.

The secure yield was re-assessed using the GoldSim model for the period January 1890 to October 2018 with results shown in Table 18.

Table 19: Secure yield estimates - current climate (GoldSim model)

Upstream irrigation allowance (ML/a)	Flow series[1,2]	Secure yield (ML/a) for historic climate	Duration of restrictions (% of time)	Frequency of restrictions	Severity of restrictions
None	1	440	0.43	10%	0.061%
	2	260	0.43	10%	0.035%
22.8	1	410	0.44	10%	0.061%
	2	228	0.43	10%	0.035%

1. Set 1 - based on gauging station 203062 (upstream of weir) and Sacramento model - rainfall runoff model.

2. Set 2 - based on gauging station 203062 (upstream of weir) and Australian Water Balance Model (AWBM) - rainfall runoff model.

The model output for the storage behaviour for flow series 1, no irrigation demand and the historic climate is shown in Figure 21.

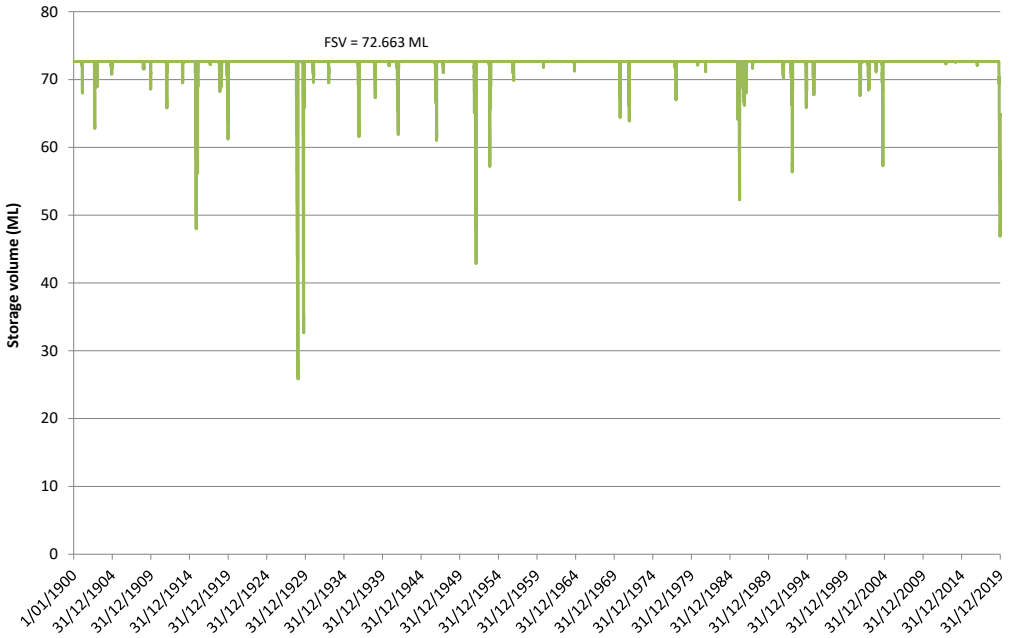

Figure 21: Secure yield modelling results - current climate

The GoldSim results obtained using Set 1 flow series are similar however the results for Set 2 are lower than obtained by NSW Urban Water Services (2018). Based on the findings of NSW Urban Water Services (2018), Set 1 flows have been used in the GoldSim model.

The secure yield assessment was repeated for the full record of hydrometeorological data (1/1/1890 - 31/12/2019, 130 years). The same yield results were obtained for the Set 1 flow series.

While irrigation demand is unknown, there are only a few properties adjacent to the weir pool and irrigation usage is predicted to be limited to stock and domestic uses. In addition, rainfall is generally high with monthly averages ranging from 53 mm in September to 247 mm in February with annual average of 1,826 mm. Therefore, in most years, irrigation demand is expected to be minimal. The GoldSim model will therefore assume no irrigation allowance but the yield analysis will consider the potential for irrigation extraction during dry periods.

Climate Change

The equivalent hydrological data with climate change based on 1°C warming and the historic data corresponding to the GCM database (1/1/1895 - 31/12/2008, 114 years) were also provided by NSW Urban Water Services for use in the model. The climate change data was generated by scaling the historical daily rainfall and evapotranspiration data for the A1B (1°C increase) warming scenarios. The secure yield assessment was repeated with hydrological and climate data for each of the GCMs in accordance with the draft *Guidelines on Assuring Future Urban Water Security* (NSW Office of Water, 2013). Results are shown in Table 19 using the methodology prescribed in the guidelines (NSW Office of Water, 2013).

Table 20: Secure yield estimates - climate change (GoldSim model)

Data Set	Secure yield (ML/a)	Duration of restrictions	Frequency of restrictions	Severity of restrictions
A: Historical data from NSW Database based on 5/10/10 design rule	340	0.166%	9.6%	0.011%
B: 15 GCMs based on 5/10/10 design rule				
GCM1	275	0.155%	8.8%	0.0096%
GCM2	304	0.17%	9.6%	0.011%
GCM3	262	0.186%	8.8%	0.016%
GCM4	222	0.211%	9.6%	0.016%
GCM5	290	0.221%	9.6%	0.019%
GCM6	273	0.202%	9.6%	0.017%
GCM7	314	0.171%	9.6%	0.012%
GCM8	263	0.182%	9.6%	0.012%
GCM9	267	0.205%	9.6%	0.017%
GCM10	355	0.137%	9.6%	0.01%
GCM11	293	0.173%	9.6%	0.012%
GCM12	266	0.178%	8.8%	0.013%
GCM13	230	0.2%	9.6%	0.015%
GCM14	327	0.17%	9.6%	0.012%
GCM15	331	0.159%	9.6%	0.011%
C: Median of 15 GCMs based on 5/10/10 design rule	275 (GCM1)			
D: Lowest of 15 GCM based on 5/10/10 design rule	222 (GCM4)			
E: Lowest GCM rerun for 10/15/25 design rule	322 (GCM4)			
Lesser of C and E	275			
Adopted % change in secure yield - based on median GCM (5/10/10)	[(275 - 340)/340] x 100 = -19.1%			
Secure yield using observed historical data based on 5/10/10 design rule (Table 18)	440			
Best estimate of future secure yield	356			

The secure yield with 1ºC climate warming calculated using the GoldSim model (356 ML/a) is similar to the result provided in NSW Urban Water Services (2018) (345 ML/a).

8. DEMAND ANALYSIS

8.1 Water Supply Customers

Council supplied data on the annual number of properties connected to the Mullumbimby water supply since 2011 (Figure 22). Since 2017, Council has categorised the customers into multi- and single residential customers and non-residential types (commercial, industrial, institutional). The ratio of multi-residential customers from 2017 - 2019 (average 5%) has been used to estimate multi-residential customers between 2011 and 2016. Growth in connections averaged 2.3% p.a. over the last 3 years. It is unclear why the reported number of connected properties decreased between 2011 and 2012, although this is assumed to be a correction in reporting methodology.

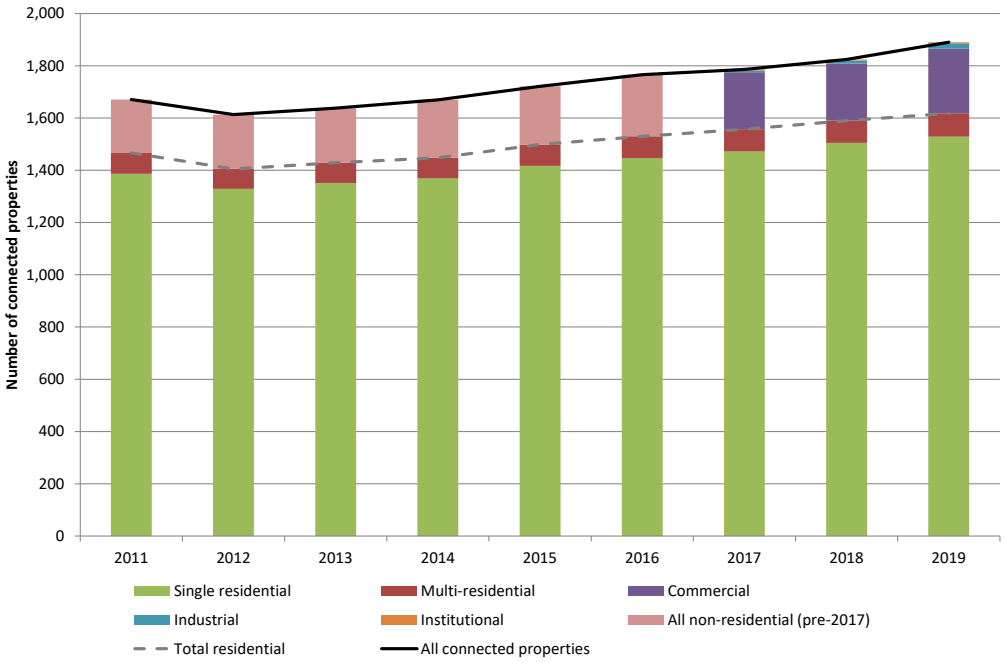

Figure 22: Water supply connected properties - 2011 - 2019

BASIX is the NSW Government's online sustainability tool that has a mandated water and energy savings for residential development in NSW. BASIX has mandated energy and water savings in regional NSW since July 2005. BASIX certificate information is available from the NSW Department of Planning and Infrastructure for 2011/12 to 2017/18. The certificates database provides information on building location and estimated water consumption.

The BASIX certificates have been analysed to determine the number of certificates in the Mullumbimby water supply area. The total number of certificates for each year in Mullumbimby is shown in Table 20. This includes BASIX certificates that specified that the property was using the town water supply. Certificates for developments in Mullumbimby and Mullumbimby Creek that specified use of tank water are assumed to be rural properties and were not included.

Table 21: BASIX certificate data - total number of certificates in Mullumbimby water supply area

Type	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	Total (2011-2018)
Single residential	26	22	38	55	53	43	57	294
Multi-residential	0	2	1	9	10	5	14	41

A BASIX compliant property is considered to represent a “water efficient” connection due to the installation of water saving measures such as efficient appliances and alternative water sources (rainwater tanks). The number of new BASIX houses has been assumed to be equivalent to the total number of new connections in the supply area. The number of renovated BASIX houses has been assumed to be the remainder of the BASIX certificates in each year. This may be an over-estimate as there may be some BASIX certificates that are not converted to BASIX connections. Similarly, a non-BASIX property is assumed to be non-efficient and a higher average consumption has been applied to account for the variation in household characteristics and water uses.

In addition to the new development, it has been assumed that some existing connections will be converted from non-BASIX to BASIX connections as they are developed or renovated. The rate of conversion is assumed to be 0.5% p.a. prior to 2015, 1.0% p.a. until 2040 and 0.5% p.a. beyond 2040.

The current number of connected properties is given in Table 21 and the historical data is shown in Figure 23.

Table 22: Connected properties - 2018/19

Property type	Number
Single residential	1,132
Multi-residential	38
BASIX single residential	397
BASIX multi-residential	51
Total residential	1,618
Commercial	247
Industrial	21
Institutional	4
Total non-residential	272
All connected properties	1,890

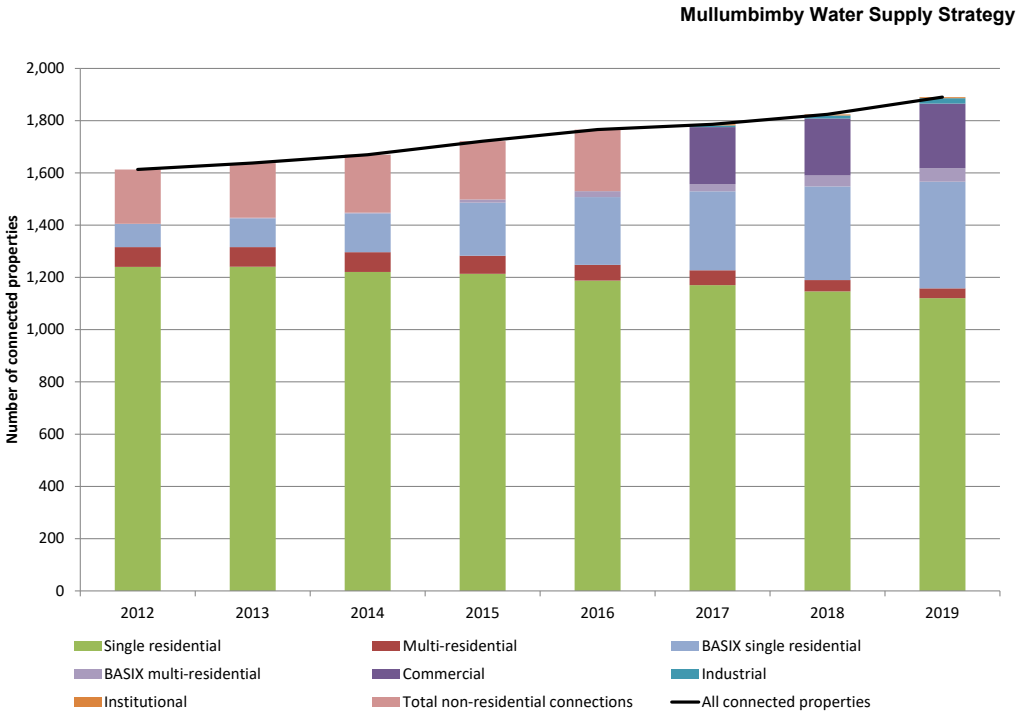

Figure 23: Historical connections profile

8.2 Historical Demand

8.2.1 WTP Inflow and Treated Water Production

BSC has supplied data on daily WTP inflow, treated water production for Mullumbimby water supply (July 2006 - May 2020) as shown on Figure 25 and Figure 26. Prior to 2013, the amount of WTP inflow was estimated from the treated water production data with an allowance for backwash volumes and these older data may be inaccurate.

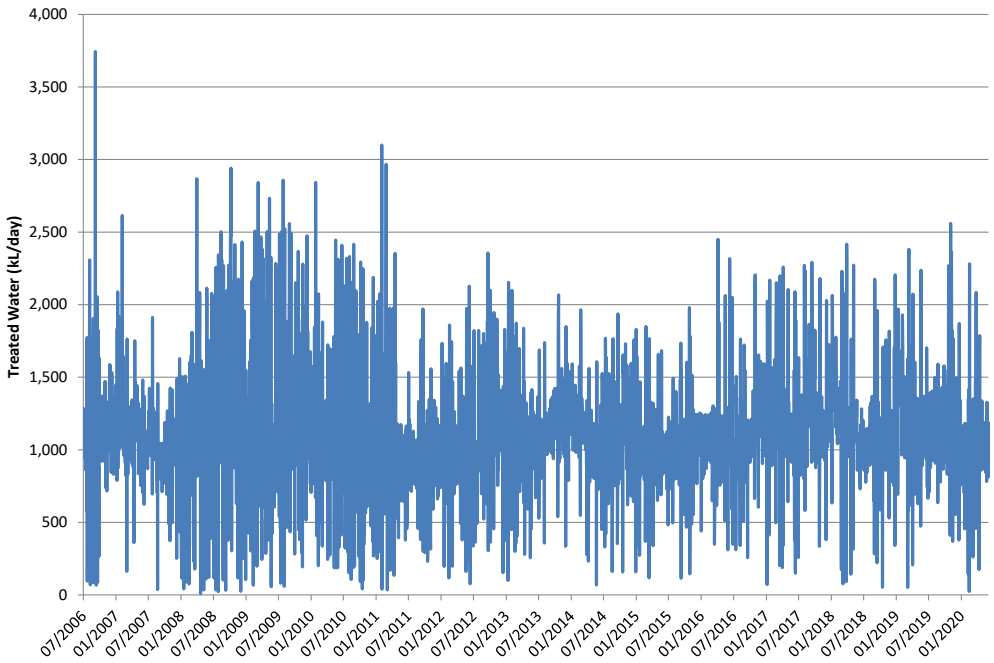

Figure 24: Daily treated water production

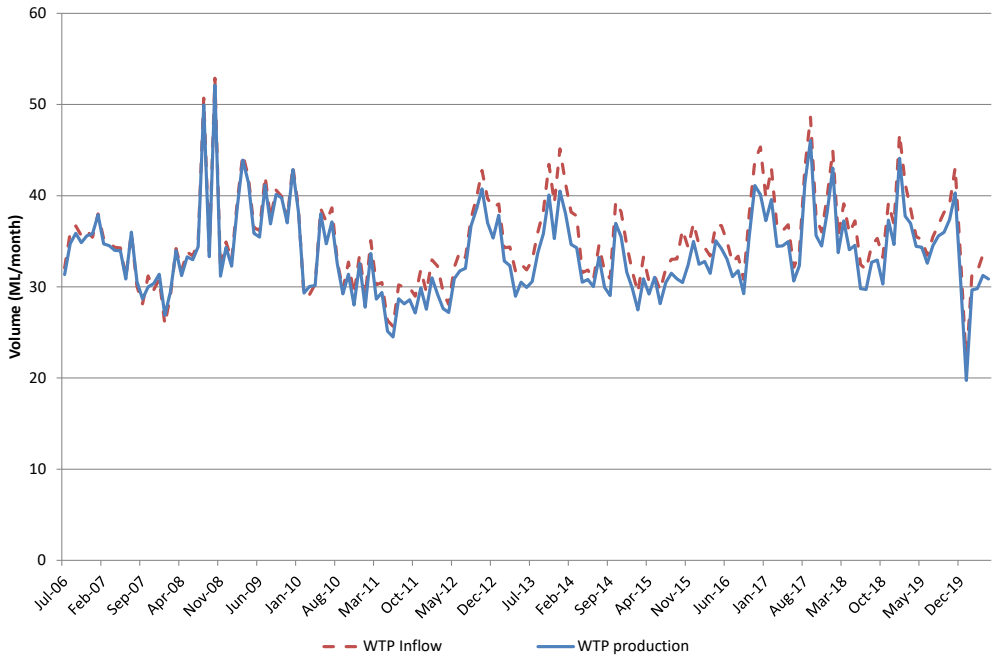

Figure 25: Monthly WTP inflow and treated water production

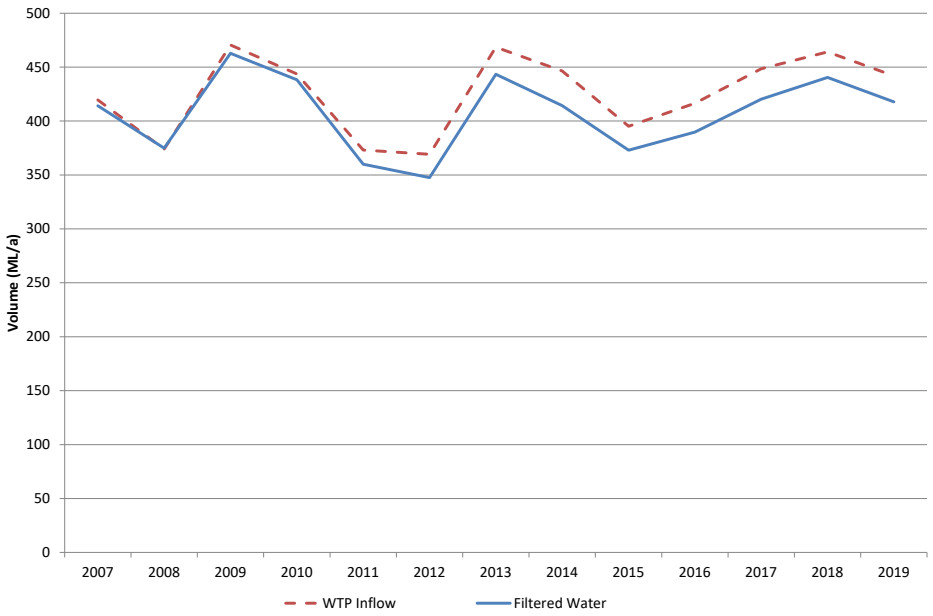

Figure 26: Annual WTP inflow and treated water production (2007 - 2019)

Data from the summer of 2019/20 during the drought and restriction periods are shown on Figure 27. The restrictions imposed have reduced total demand. During this period, the WTP production was supplemented with supply from the Rous regional supply as discussed in Section 12.1.1 and shown on Figure 28.

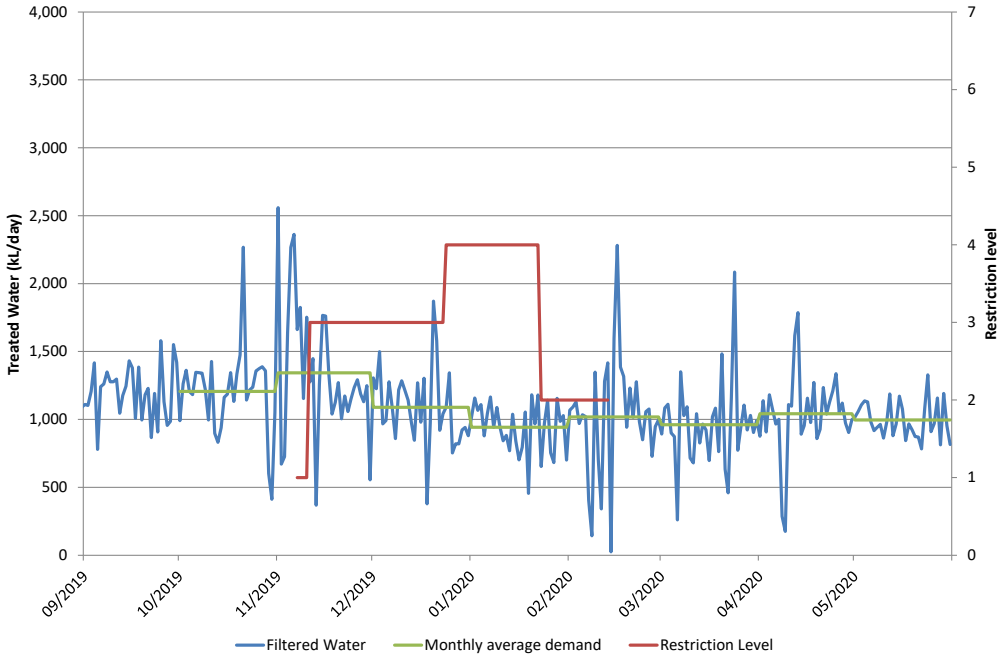

Figure 27: Daily treated water production and restrictions imposed (October 2019 - May 2020)

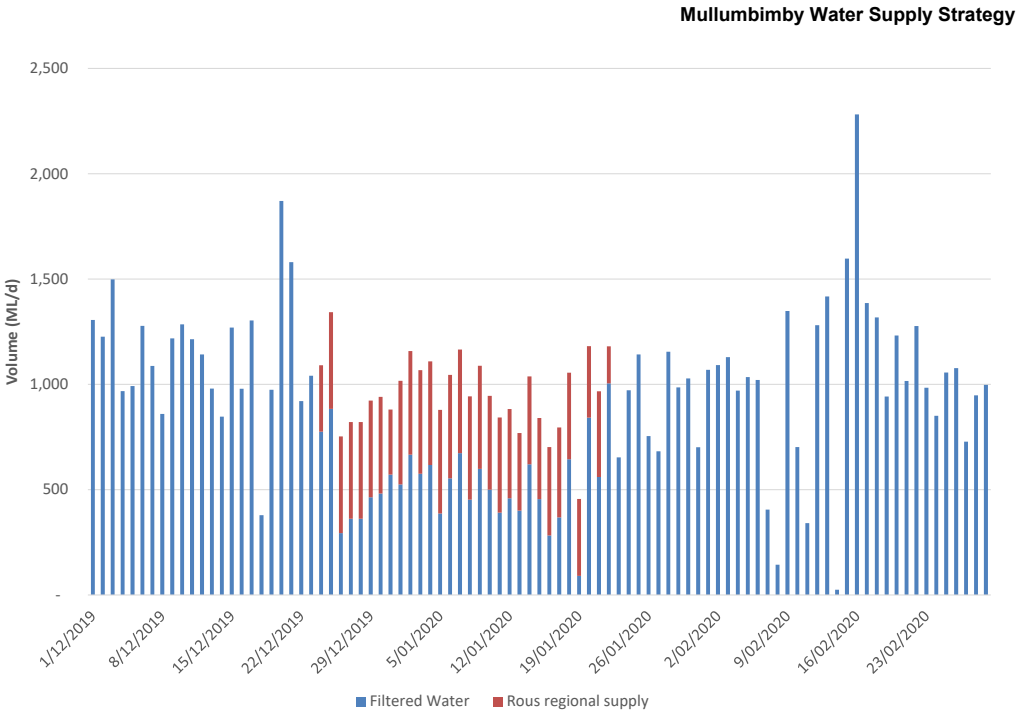

Figure 28: Supply from the WTP and Rous regional supply during summer 2019/20

8.2.2 Metered Consumption

BSC has supplied data on quarterly metered customer consumption between 2011 and 2016 and annual totals between 2017 and 2019 (Figure 29). Since 2017, data are reported for the non-residential customer categories (institutional, commercial, industrial).

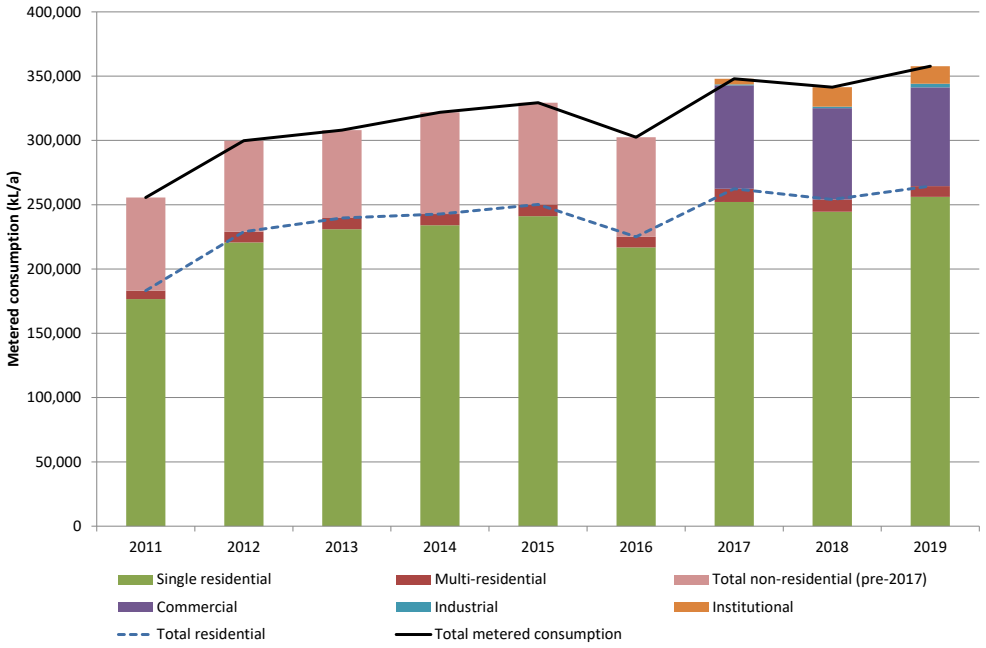

Figure 29: Metered customer consumption

The BASIX certificate data was also used to estimate the per connection consumption for BASIX compliant connected properties using the estimated water consumption reported on each certificate. The estimated water consumption for BASIX compliant buildings is the average water consumption on the BASIX certificates in the Mullumbimby water supply area at the time of their development application (Table 22).

Table 23: Estimated consumption for BASIX compliant connections

Connection Type	Estimated water consumption (L/conn/day)	Estimated water consumption (kL/conn/year)
Single Residential	316	116
Multi-residential	264	97

Data on the average consumption per connection type are shown in Table 23 and the historic consumption profile is shown on Figure 30.

Table 24: Consumption per connection type (2012 - 2019)

Customer Type	Average consumption per connected property (kL/a)
Single residential	176
Multi-residential	112
BASIX single residential	116
BASIX multi-residential	97
Commercial (2017 - 2019)	335

Customer Type	Average consumption per connected property (kL/a)
Industrial (2017 - 2019)	121
Institutional (2017 - 2019)	2,746

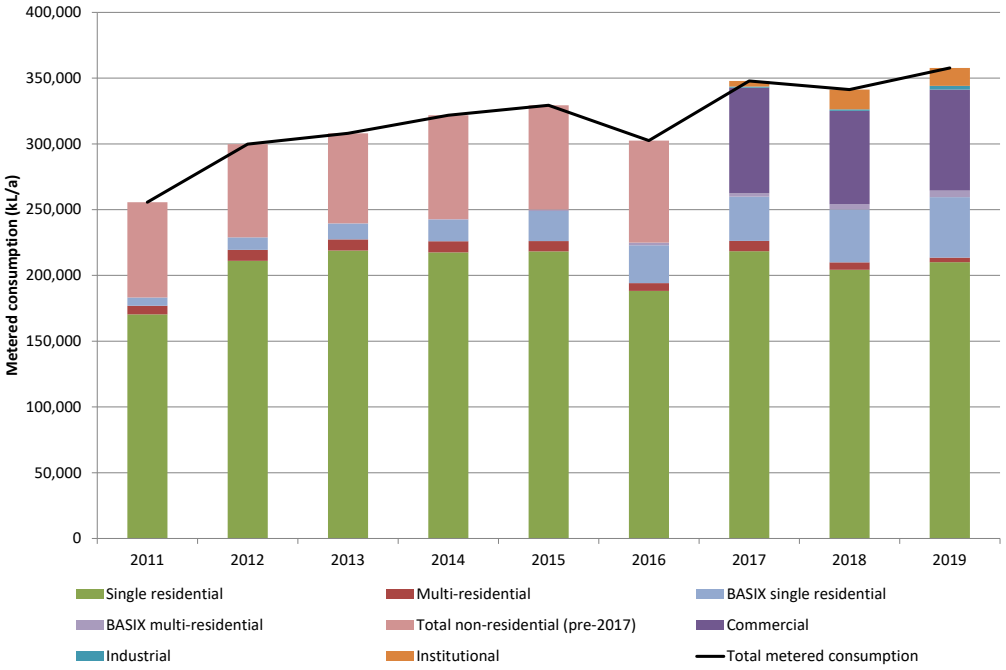

Figure 30: Historic consumption profile

8.2.3 Factors Influencing Demand

Annual consumption appears to be increasing between 2012 and 2019 (refer Figure 29). The impact of the following factors on metered customer demand has been assessed:

- Consumption per connected property (refer Figure 31). Residential and non-residential consumption per connected property has fluctuated each year with no noticeable increase or decrease over time.
- Climate (average maximum temperature and annual rainfall at Mullumbimby, refer Figure 32 and Figure 33). There is no obvious relationship between consumption and rainfall or temperature.
- Water pricing (usage charge, refer Figure 34). Despite the increasing price of water since 2007, there is no obvious impact on residential or non-residential consumption per connected property.

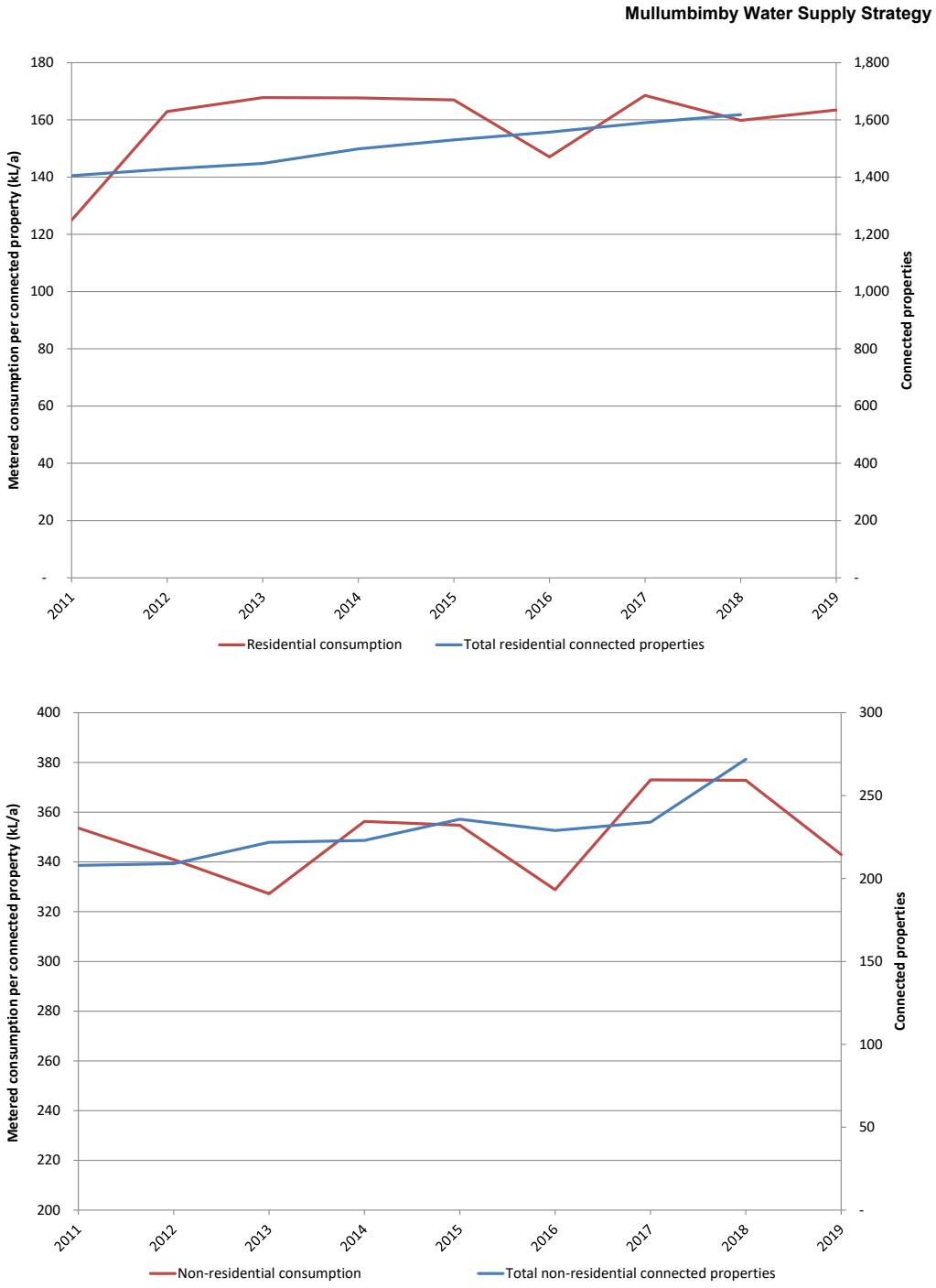

Figure 31: Comparison between connected properties and metered demand per property

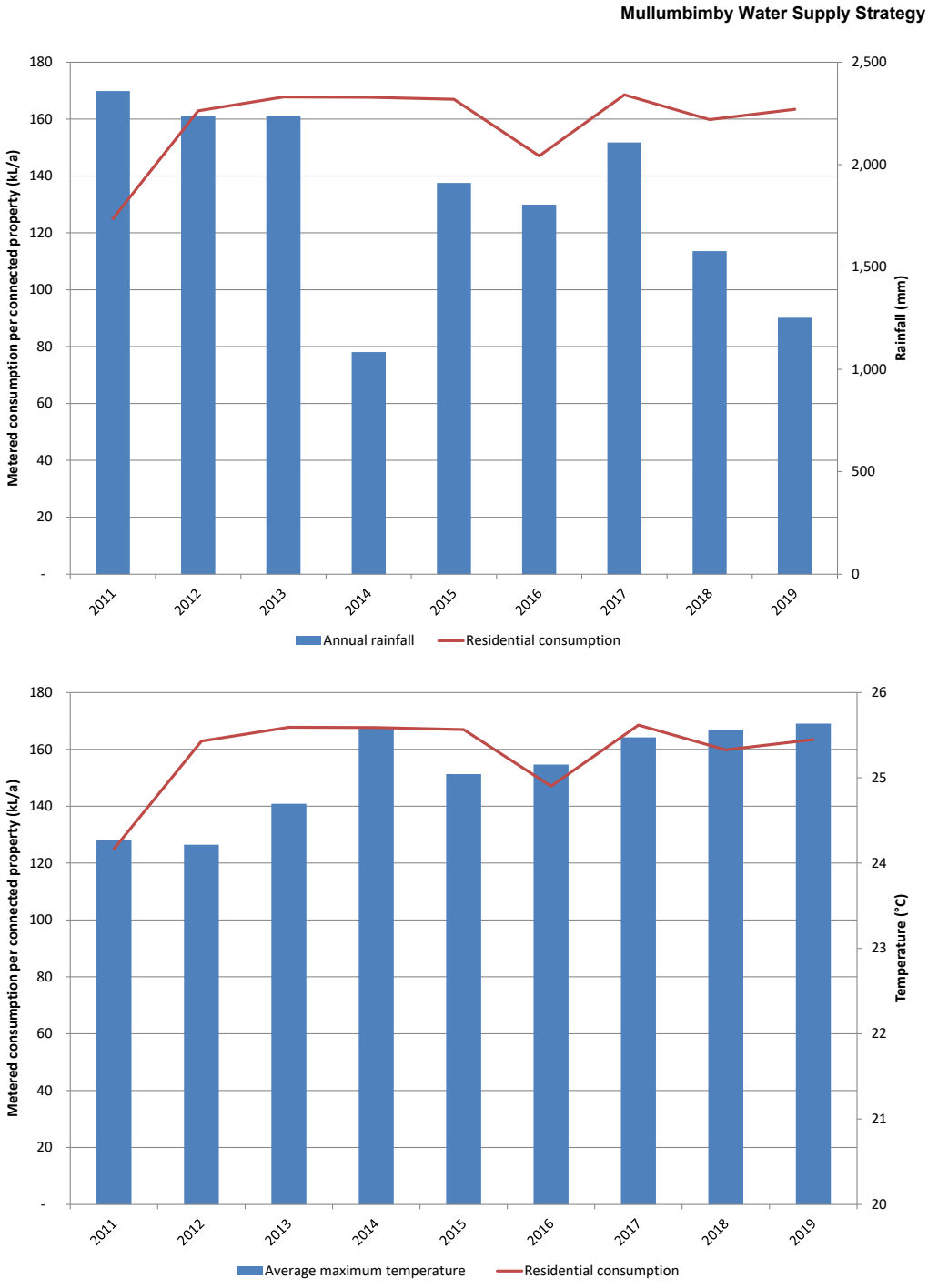

Figure 32: Comparison between climate and metered demand per residential property

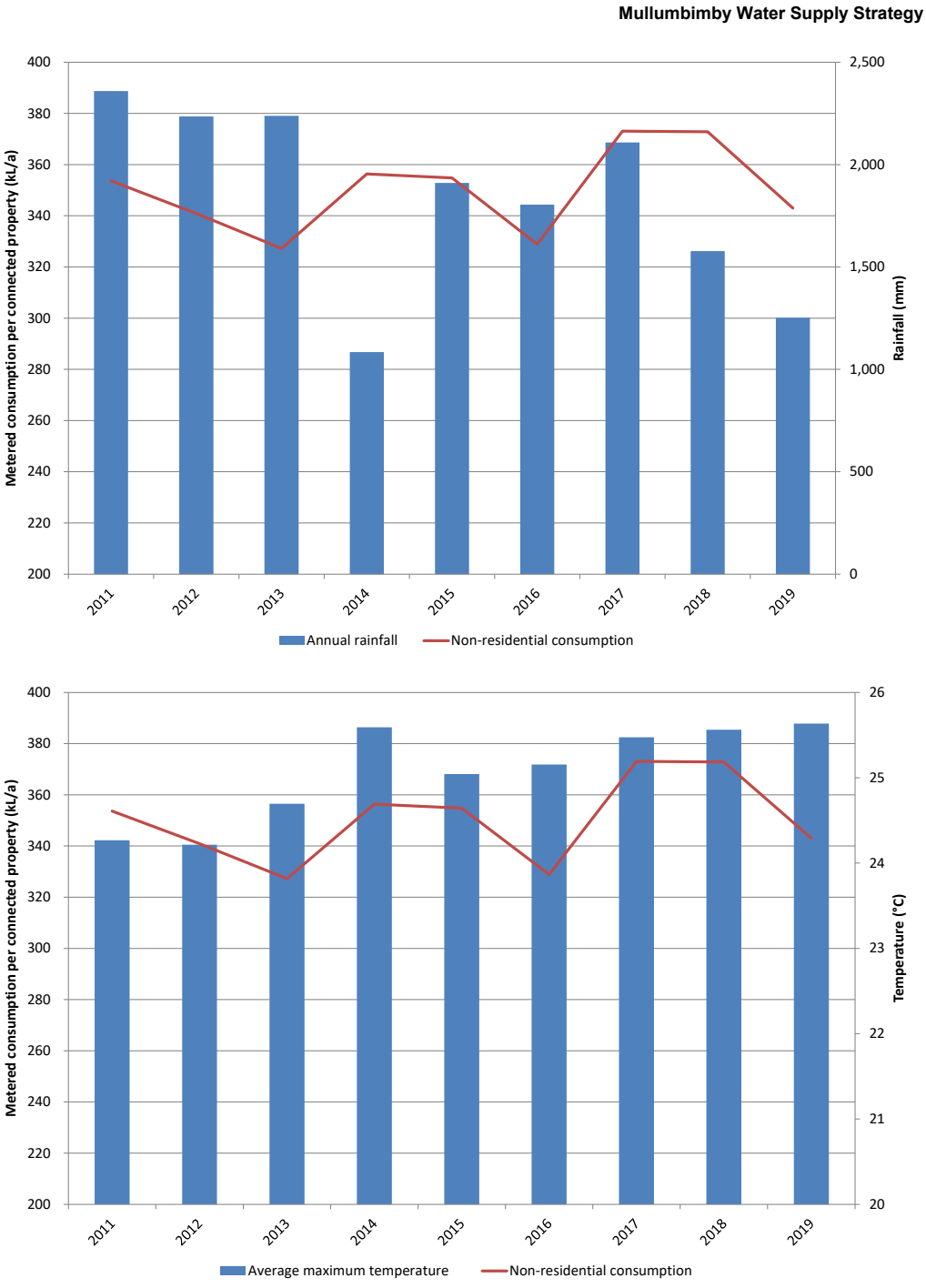

Figure 33: Comparison between climate and metered demand per non-residential property

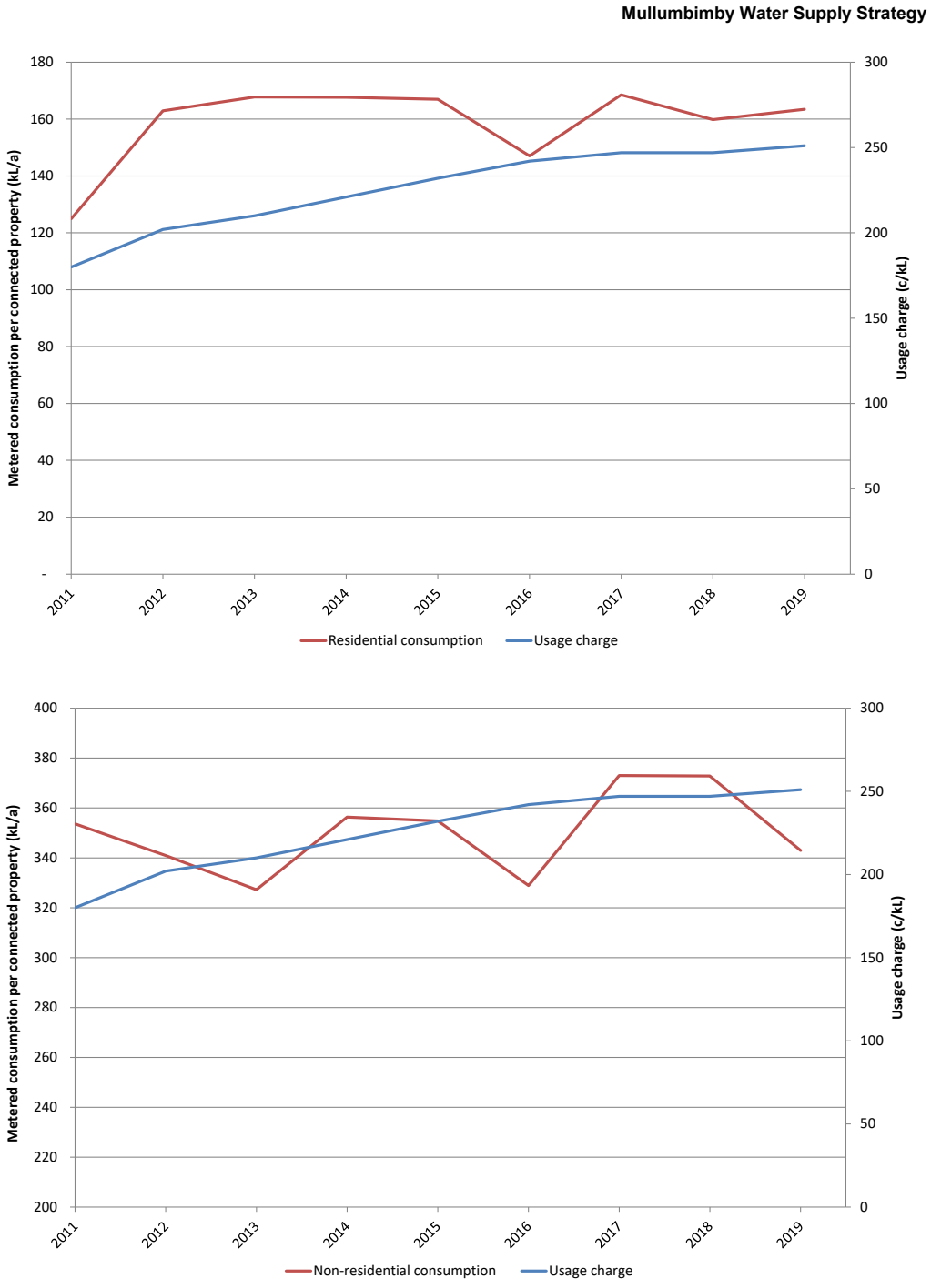

Figure 34: Comparison between usage charge and metered demand

8.2.4 Water Losses

Annual WTP inflow, filtered water, customer demand and water losses (WTP losses and non-revenue water, NRW, the difference between total water production and total metered consumption) are summarised in Table 24 and Figure 35. Since 2015, the calculated WTP losses have been 5.6% of raw water extraction and NRW has fluctuated between 10% and 22% of treated water production. Total losses have fluctuated between 16% and 27% of raw water extraction. This analysis does not consider losses in the rising main/ channel from the weir and tunnel into the WTP (Section 6.2).

Table 25: Water supply demand and losses (2007-2019)

Year	Raw water extraction (ML/a)	Treated water production (ML/a)	WTP losses (ML/a, % of raw water extraction)	Customer consumption (ML/a)	NRW (ML/a, % of treated water production)
2007	420	414	5 (1.3%)	307	107 (25.8%)
2008	370	371	N/A	296	74 (20.1%)
2009	407	402	5 (1.3%)	337	65 (16.2%)
2010	404	399	6 (1.4%)	347	52 (13.0%)
2011	332	321	10 (3.1%)	256	66 (20.4%)
2012	358	337	21 (5.8%)	300	37 (11.1%)
2013	459	435	24 (5.3%)	308	127 (29.2%)
2014	443	413	31 (6.9%)	322	91 (22.0%)
2015	390	367	23 (5.8%)	329	38 (10.3%)
2016	413	387	26 (6.3%)	303	84 (21.8%)
2017	444	419	25 (5.6%)	348	71 (16.9%)
2018	461	439	22 (4.8%)	341	98 (22.3%)
2019	442	418	24 (5.6%)	315	60 (14.4%)
Average (5 years)	430	406	24 (5.6%)	336	70 (17.3%)

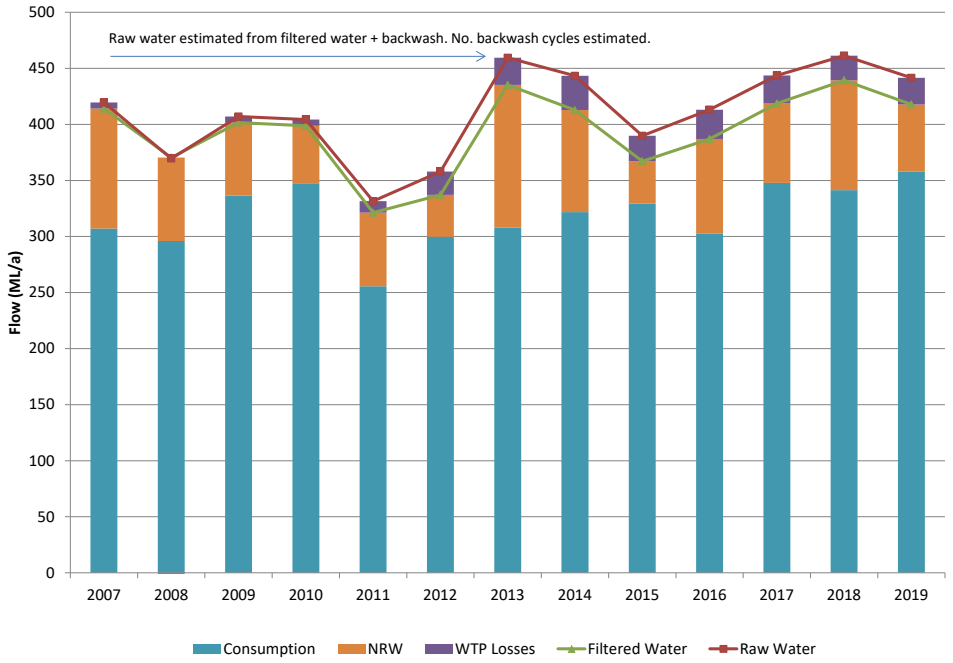

Figure 35: Historical water supply demand - Mullumbimby: 2007 - 2019

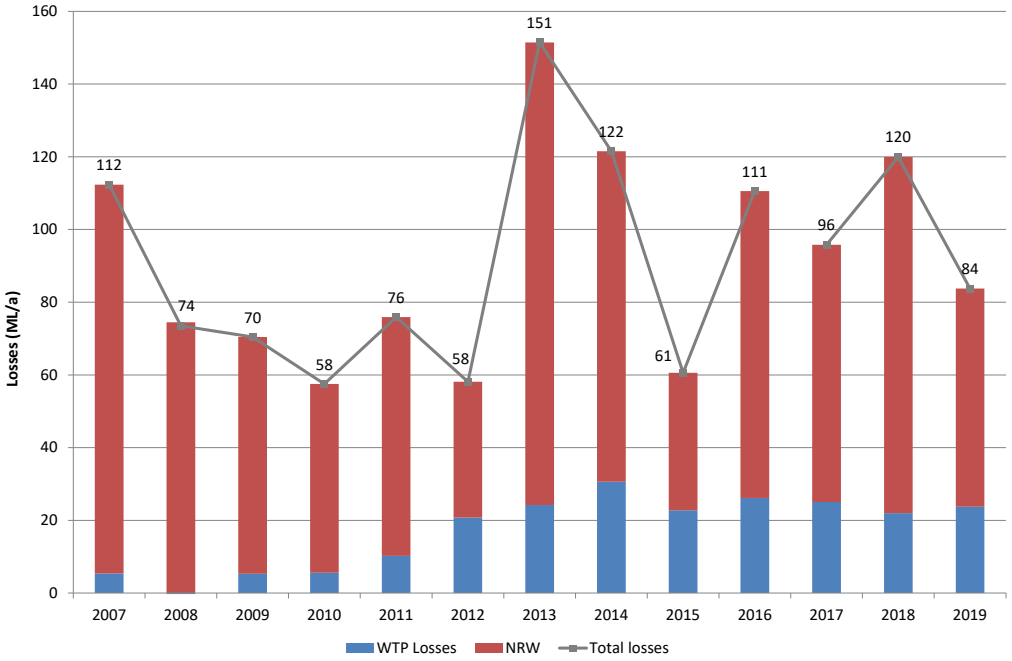

Figure 36: WTP losses and NRW - Mullumbimby

8.3 Average and Dry Year Demand

Daily water demand patterns are highly variable and are likely to be influenced by a broad range of factors. The council data provides an estimate of the consumption per connection type. This varies over the available time period which is due to the influences of short-term climate variations or other non-climate variables. Despite variability in the data there is an intuitive connection between climate and water demand which has been considered in this demand analysis.

The demand of non-residential connections may be less influenced by climate variables than residential connections. The demand patterns of some of the larger non-residential connections in the bulk supply area are likely to be influenced by factors other than climate. Conversely, water usage for non-residential connections such as sporting grounds and nurseries are more likely to be influenced by climate. No data on the consumption patterns of individual non-residential connections were available for analysis for this report.

The water losses vary from year to year. The reasons for these variations are not yet known, however it should be noted that as this estimate is derived from the difference between bulk and customer supply meters, metering errors are also incorporated into this statistic, as well as actual losses and real unmetered water.

Using the current NSW Security of Supply Methodology, 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). Analysis has been undertaken to identify key climate-influencing factors such rainfall, temperature and evaporation and evaluate changes in demand due to periods of dry/hot climate. This has been used to estimate the unrestricted dry year annual demand. The climate correction analysis undertaken for Mullumbimby water supply suggests that the dry year demand is 3.24% higher than the average demand (Appendix 3). The historical metered consumption per connected property for each customer type and the average, maximum and dry year consumption per connected property are shown in Table 25.

Table 26: Consumption per connected property (kL/a)

Connection type	2012	2013	2014	2015	2016	2017	2018	2019	Average since 2012	Maximum since 2012	Dry year
Single residential	170	176	178	179	157	186	177	186	176	186	182
Multi-residential	109	112	112	114	98	134	127	91	112	116	116
BASIX single residential	116	116	116	116	116	116	116	116	116	116	120
BASIX multi-residential	97	97	97	97	97	97	97	97	97	97	100
Total residential	163	168	168	167	147	169	160	163	163	169	168

Connection type	2012	2013	2014	2015	2016	2017	2018	2019	Average since 2012	Maximum since 2012	Dry year
Commercial	No data					368	325	311	335	368	346
Industrial	No data					120	104	138	121	138	124
Institutional	No data					1,069	3,765	3,405	2,746	3,765	2,835
Total non-residential	No data					373	373	343	363	373	375

8.4 Predicted Growth

BSC has prepared growth management strategies for urban land, rural areas and business/industrial land. Anticipated residential development from 2020 to 2036 is summarised in Table 26 and shown on Figure 38. Residential development is expected to be a mix of single and multi-residential properties (5.5%) that are BASIX compliant. The urban development is likely to be a mix of dwelling yield for the available lots with allowance for affordable housing (micro lots). The data in Table 26 is expected to be the most likely mix of dwelling yield (a combination of traditional and affordable housing) based on Council's urban land use strategy. Beyond 2036, the number of new residential connections each year is assumed to be the same as between 2032 and 2036.

Table 27: Anticipated residential development (new houses) to 2036

Stage	Vacant	Infill	New release areas	Total additional dwellings
Short-term	90	20	105	215
2 - 5 years	50	50	455	555
5 - 10 years	50	50	240	340
10 + years	43	40	125	208
Total	233	160	925	1,318

Source: BSC (2020a)

Anticipated business and industrial development from 2020 to 2041 is summarised in Table 27. Business tenancies are assumed to generate demand equivalent to a commercial property.

Table 28: Anticipated business and industrial development

Stage	Large footprint tenancies	Smaller tenancies	Industrial expansion
By 2022	-	20	20
By 2028	1	20	-
By 2031	-	20	-
By 2041	-	40	-

Source: BSC (2019b), BSC (2019c)

The resulting number of connected properties in each 10-year period is given in Table 28. Although the mix of future dwelling types is unknown, the application of the different consumption rates for BASIX single and multi-residential properties will allow for the variation in consumption based on dwelling size.

Table 29: Future connected properties

Connection Type	2020	2030	2040	2050
Single residential	1,109	1,003	907	863
Multi-residential	37	34	30	29
BASIX single residential	521	1,619	1,995	2,321
BASIX multi-residential	58	117	137	154
Total residential connected properties	1,726	2,773	3,070	3,367
Commercial	254	301	362	397
Industrial	31	41	41	41
Institutional	4	4	4	4
Non-residential connected properties	289	346	407	442
All connected properties	2,0214	3,119	3,477	3,809
Growth (total connections) % p.a.	6.6%	1.2%	1.0%	0.9%

The predicted growth in connected properties is shown on Figure 37.

The *Byron Shire Residential Strategy* (BSC, 2020b) predicts the population of Mullumbimby will be approximately 6,645 in 2036, an increase of 2,864 people since the 2016 Census (3,781 people) or 3.8 % p.a. increase in population over the 20-year period although all residents will not be served by the town water supply. Mullumbimby is expected to accommodate the largest number and percentage of additional dwellings and potential residents by 2036 (39% of the total urban population growth).

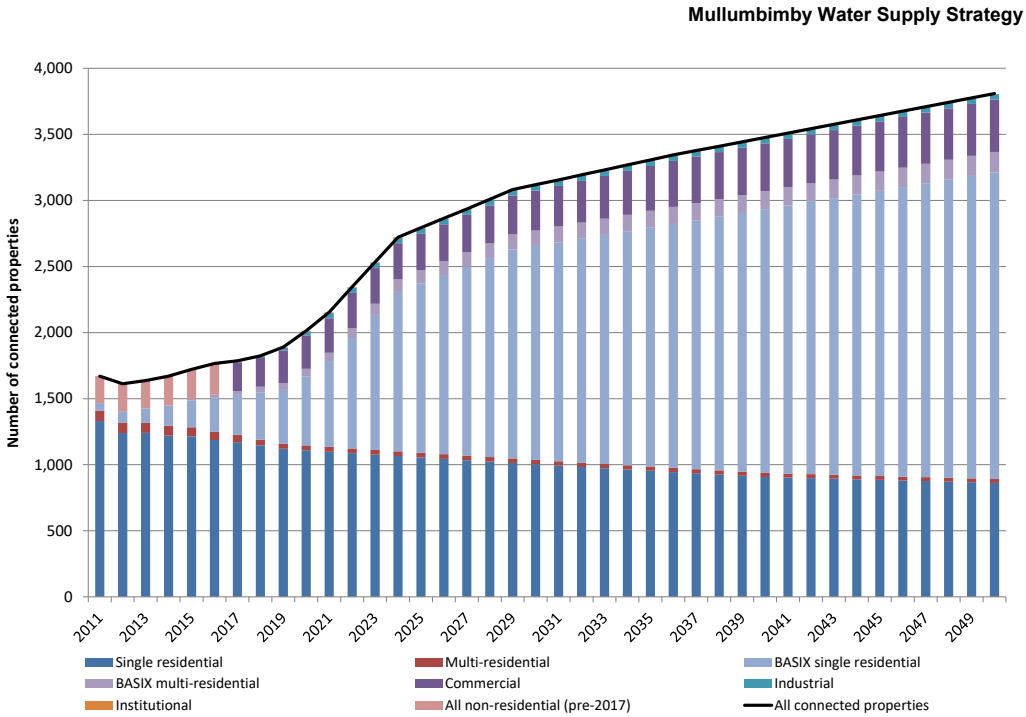

Figure 37: Forecast connected properties

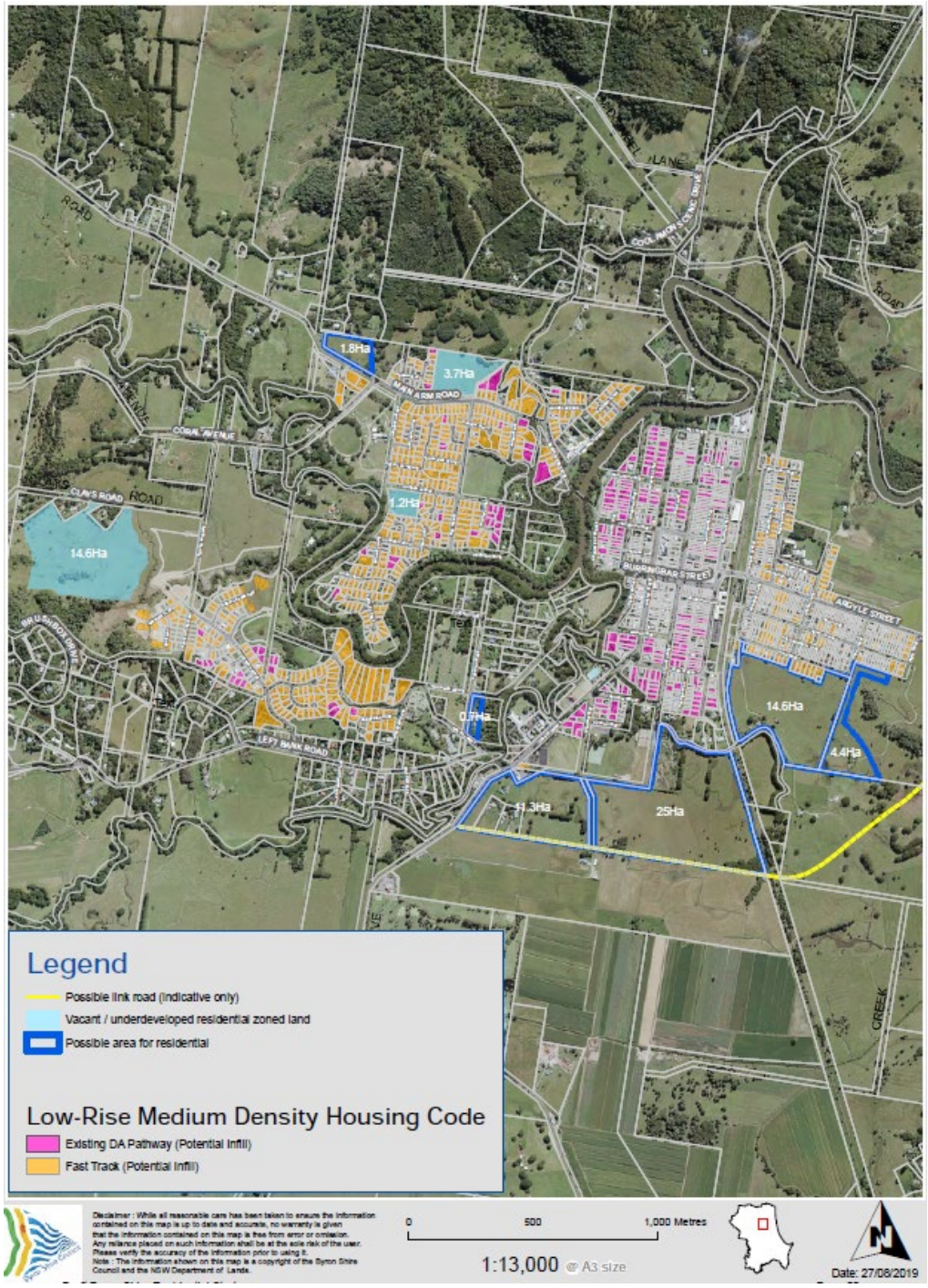

Figure 38: Potential urban housing supply - Mullumbimby

Source: BSC (2019a)

8.5 Predicted Future Demand

8.5.1 Consumption

The forecast average and dry year customer demand is shown on Figure 39.

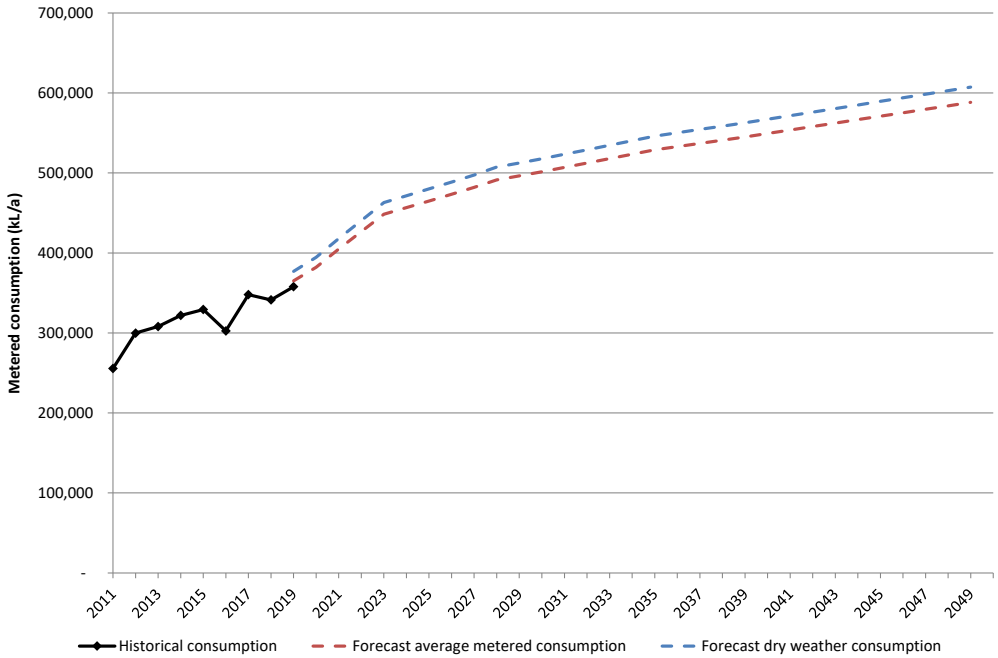

Figure 39: Forecast metered consumption - average and dry year

8.5.2 Water loss management measures

Two scenarios have been developed for water savings due to demand management:

1. No water loss management - using current average NRW = 17.3 % of raw water supply.
2. Predicted NRW with water loss savings due to pressure reduction measures implemented - NRW savings of 22 ML/a (Table 8).

The forecast dry year demand with scenarios 1 and 2 is shown on Figure 40. Forecast raw water extraction is summarised in Table 29.

Table 30: Annual demand forecast scenarios

Scenario		Demand (ML/a)			
		2020	2030	2040	2050
A1	Average demand with no water loss management	468	636	698	753
A2	Average demand with water loss savings	444	612	675	730
D1	Dry year demand with no water loss management	483	656	720	778
D2	Dry year demand with water loss savings	459	633	697	754

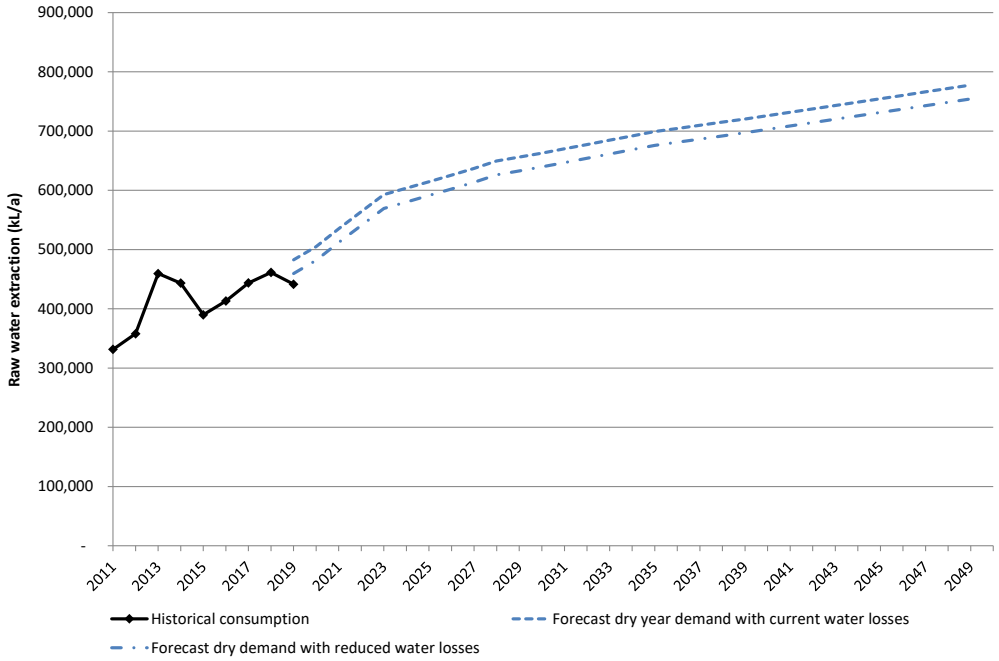

Figure 40: Dry year unrestricted demand forecast: water loss management scenario 1 and 2

8.6 Peak Day Demand

A peak day demand (PDD, WTP output and emergency supply) of 2.56 ML/d was experienced in November 2019 (Figure 24, since 2012). Average daily treated water demand (ADD) since 2012 is 1.1 ML/d. Table 30 lists the highest production days from June 2012 - May 2020 (i.e. production > 2.3 ML/day). Some days of peak demand were preceded by hot, dry conditions and in most cases, there was an obvious ramping up of water production prior to the peak and a ramping down following the peak. The data suggests that a real PDD of 2.56 ML/day (1,350 kL/d/connected property) was experienced in November 2019, following a sustained period of dry, hot weather with a peak demand ratio (PDD:ADD) of 2.3.

Data on connection types is not available to analyse the proportion of peak demand attributable to various uses. However, it is expected that increased water usage during hot, dry conditions would be primarily due to increased outdoor use such as watering gardens.

Table 31: Peak day production including emergency supply (2012 - 2020)

Date	Peak day Production (ML)	Discussion of climatic and other factors
20/9/12	2.36	Production levels ramping up on days before peak, then a low demand recorded the following day (0.305 ML) and then returning to average demand in the following days. Dry and hot month leading up to peak.
3/4/16	2.39	Production levels were average prior to the peak and remained high for 2 days then above average for the following week. High rainfall in month prior (250 mm) and high temperatures in week before and day of peak (maximum temp 29.5°C).
4/4/16	2.45	
8/6/16	2.32	Production levels were average prior to and after the peak. Very high rainfall in week prior (430 mm). Moderate temperatures in week before peak (max temp 22°C).
27/3/18	2.42	Production levels were low prior to the peak and high demand persisted for 2 days before returning to average in the week after the peak. High rainfall in week prior (120 mm). High temperatures in week before peak (max temp 30°C).
12/3/19	2.38	Production levels ramping up in the 2 days prior to the peak and high demand persisted for 2.5 weeks after the peak. Low rainfall in month prior (92 mm) and 17 mm rain in 5 days before peak. High temperatures (max temp 33°C).
1/11/19	**2.56**	Production levels were low prior to and 2 days after the peak but high demand persisted until December 2019. Very low rainfall (61 mm) in 4 months prior to the peak. High temperatures in week before peak (max temp 29.5°C).
6/11/19	2.36	

9. SECURITY OF CURRENT WATER SUPPLY

The secure yield results from Section 7.3.5 for the current and future climate are shown in Table 31. The secure yield estimates for Lavertys Gap weir do not include the RCC emergency supply (0.5 ML/d, 183 ML/a) which is shown separately.

Table 32: Updated secure yield estimates - Mullumbimby water supply

Secure Yield (ML/a)	Historic climate (5/10/10)	1°C climate warming
Lavertys Gap weir [1]	440	356
RCC emergency supply [2]	183	183
System security	623	539

1. Set 1 flow series - based on gauging station 203062 (upstream of weir) and Sacramento model - rainfall runoff model. Irrigation demand was assumed to be nil.

2. Intended to operate as an emergency supply only.

A comparison between historic demand and dry year demand (Scenario D2 with water loss savings) and the secure yield (Section 8.6) is provided in Figure 41. The guidelines (NSW Office of Water, 2013) do not specify the year to apply the yield with the climate experienced over the last 120 years (historic climate), the decline in yield to the projected 1°C climate warming and the decline in yield beyond that time. In the guidelines (NSW Office of Water, 2013), the 1ºC warming (assumed to occur at 2030) relates to changes from 1990 climate (i.e. 40 years of climate warming). The following assumptions have been made for this report:

- The secure yield with the current climate is assumed to represent the available supply in 2020 (as secure yield modelling includes consideration of the 2019/20 drought although this was not necessarily the worst drought on record).
- The secure yield with projected 1°C climate warming is assumed to represent the available supply in 2060 (as the climate warming data has been imposed on the 2019/20 drought in the secure yield modelling and 1°C climate warming is expected to occur in 40 years).
- Between 2020 and 2060, there is assumed to be a linear reduction in secure yield.
- Beyond 2060, the secure yield is unknown. Previous secure yield modelling methods have considered a 2°C climate warming scenario although this is not currently endorsed by the NSW Government and has not been applied here.

These assumptions are critical in assessing the target secure yield of the water supply and should be checked as new information becomes available.

Mullumbimby's demand for water is increasing with development and population growth. The current (2020) and 2050 dry year unrestricted demand are compared to the secure yield in Table 32. The RCC emergency supply pipeline improves the water supply security although it is not intended to operate any more than an emergency supply. Assuming that water loss reduction measures are implemented and the emergency supply is available, the supply will be secure until 2027 (Figure 41). After this time, the existing system cannot meet forecast demand without the potential for more frequent, longer and severe water restrictions.

The supply deficit at 2050 (excluding the emergency supply) will be 377 ML/a. This will be the target increase in yield with source augmentation for this strategy.

Table 33: Comparison of demand and secure yield

Component (ML/a)	2020	2050
Dry year unrestricted demand (including water loss reduction)	483	754
Secure yield - weir supply	440	377
RCC emergency supply	183	183
Total system yield	623	560
Supply deficit (excluding emergency supply)	+43	377

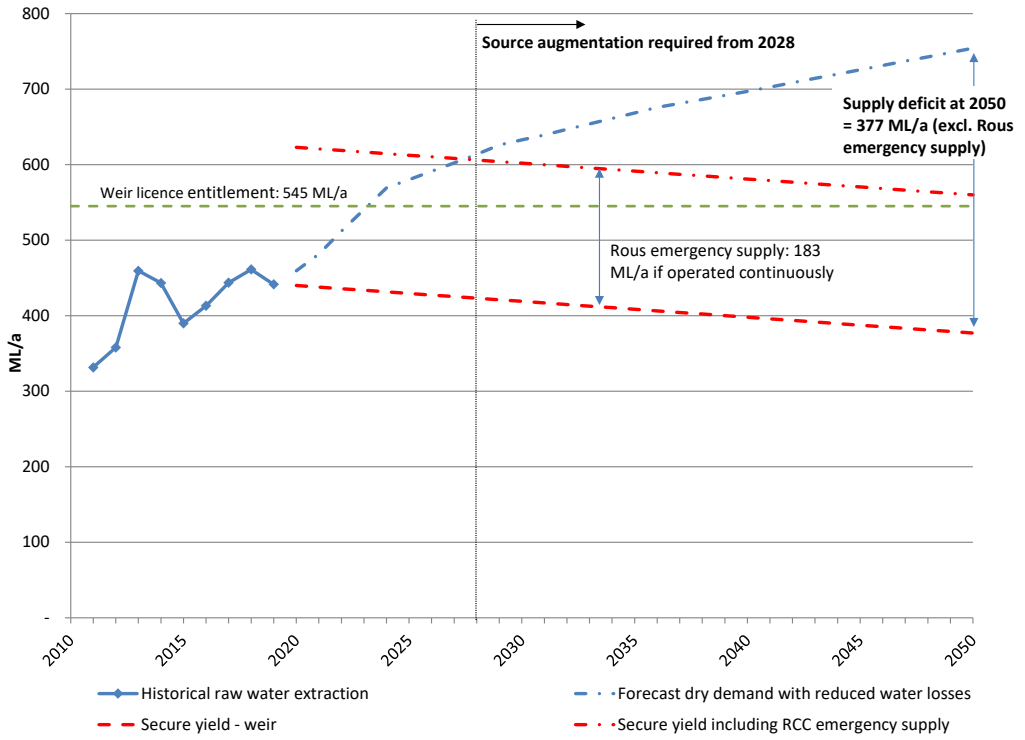

Figure 41: Comparison of forecast raw water demand, licence entitlement and secure yield

An increase in the weir licence extraction limit will be required from 2023 depending on the reliance on the supply from the weir.

10. WATER SUPPLY OPTIONS

A secure water supply is critical to ensure the Mullumbimby community's health and quality of life as well as a sustainable environment and continued economic prosperity. BSC has a duty to ensure that there is enough water available to meet the long-term needs of Mullumbimby.

Assuming that water loss reduction measures are implemented and the emergency supply is available for the whole town, the supply will be secure until 2027. After this time, the existing system cannot meet forecast demand without the potential for more frequent, longer and severe water restrictions. Based on the 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 town's long-term water needs. By 2050, the secure yield of the Mullumbimby water supply (Lavertys Gap weir) is forecast to be 377 ML/a. Based on the forecast dry year demand of 754 ML/a in 2050, the forecast annual yield deficit is 377 ML/a. The RCC emergency supply pipeline can supply 183 ML/a if operated continuously, leaving an additional 194 ML/a to be sourced from an alternative supply.

10.1 Supply-Side Options

Supply options have been identified through previous studies (JWP, 2005) as well as new options identified. The following options have been identified to potentially increase the water supply.

10.1.1 Raising Lavertys Gap weir

JWP (2005) determined that the total weir storage required to maintain a typical environmental flow condition (Section 6) and supply an average demand of 450 ML/a was 432 ML (an increase of 359 ML). Preliminary analysis undertaken by JWP (2005) indicated that this storage would be achieved with a FSL of 120 m AHD (3.84 m raising of the weir). The area inundated at this height was expected to be approximately 17.77 ha (an increase of 14.67 ha). Separate geotechnical, ecological and structural inspections were undertaken at the Lavertys Gap weir site (September 2003). Preliminary conclusions of JWP (2005) indicate that this option is feasible and that there are a number of engineering possibilities to achieve the result.

It is noted that water supply works approvals are not permitted to be granted or amended for in-river dams on third order or higher streams (including the Wilsons River at Lavertys Gap) in the Bangalow Area water source under the *Water Sharing Plan for the Richmond River Unregulated, Regulated and Alluvial Water Sources 2010*. The Bangalow Area water source has been classified as high instream values and high hydrological stress of hydrologic risk (NSW DPI Water, 2016d). The Water Sharing Plan is to be reviewed by June 2021.

10.1.2 Off-stream storage

Two sites were identified in JWP (2005) as possible locations to provide the additional storage required (assumed to be 430 ML). JWP (2005) assumed that the raw water from the weir would be transferred to the storage prior to treatment. Initial environmental and geotechnical assessment did not identify any problems with the identified sites. Other sites have been considered in this report (Section 12.3)

Under the *Water Sharing Plan for the Richmond River Unregulated, Regulated and Alluvial Water Sources 2010*, applications for conversion of licences to a high flow access licence entitlement (commencing at the

30th percentile flow) for up to five times the existing entitlement would be considered in the Bangalow Area water source (NSW DPI Water, 2016d).

10.1.3 Regional Interconnection

RCC bulk water supply

BSC currently distributes water purchased from the RCC regional supply to Bangalow, Brunswick Heads, Byron Bay, Suffolk Park, Ocean Shores, New Brighton, South Golden Beach and Billinudgel (all areas except Mullumbimby). The RCC emergency supply to Mullumbimby is available during drought (Section 3). In 2019, RCC supplied approximately 2,700 ML to Byron Shire Council for distribution to its customers and this demand is predicted to increase to 3,500 ML/a by 2050 (Hydrosphere Consulting, 2020). Full connection of the Mullumbimby supply area to the Rous regional supply would require an additional 730 ML/a by 2050 (Section 8.5).

JWP (2005) assessed the option of connection of Mullumbimby to the RCC regional bulk water supply. The study found that the weir could be retained if required for heritage reasons and may be used to supply water to the hydro-electric power station if it was reinstated. The existing emergency supply pipeline would need to be assessed for suitability as a permanent supply and would need to be extended to service the whole of Mullumbimby.

The total dry year demand for water at 2060 for the RCC regional water supply area 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. RCC has compared the water supply demand to the secure yield of the system (13,350 ML/a) and determined that a new regional water source will be required from 2024 (Hydrosphere Consulting, 2022b). The *Future Water Project 2060 Integrated Water Cycle Management Strategy* (Rous Future Water Project 2060, Hydrosphere Consulting, 2022b) outlines RCC's preferred strategy for augmentation of water supply sources. 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. The Future Water Project 2060 documents the outcomes of detailed investigations undertaken regarding potential source augmentation options and implementation scenarios for the regional water supply. The scenarios were 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 RCC [61/20], the long-term strategy was developed to include a diversified portfolio of actions to meet the region's water security needs. Stage 1 (2021 - 2025) of the adopted scenario includes Marom Creek WTP treating groundwater from Alstonville in addition to existing surface water supplies from Marom Creek weir. Stage 2 (2026 -2029) of the adopted scenario will include the implementation of the Tyagarah groundwater source as a primary supply and maintaining Woodburn groundwater as a dry period supply. Source augmentation options beyond Stage 2 will require further investigation but will include additional groundwater schemes, desalination or water recycling (Figure 42).

The Rous Future Water Project 2060 will also include:

- Ongoing implementation of the *Rous Regional Demand Management Plan 2023-2026* and regular review and update of the plan.

- Water loss management.
- Smart metering.
- 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.

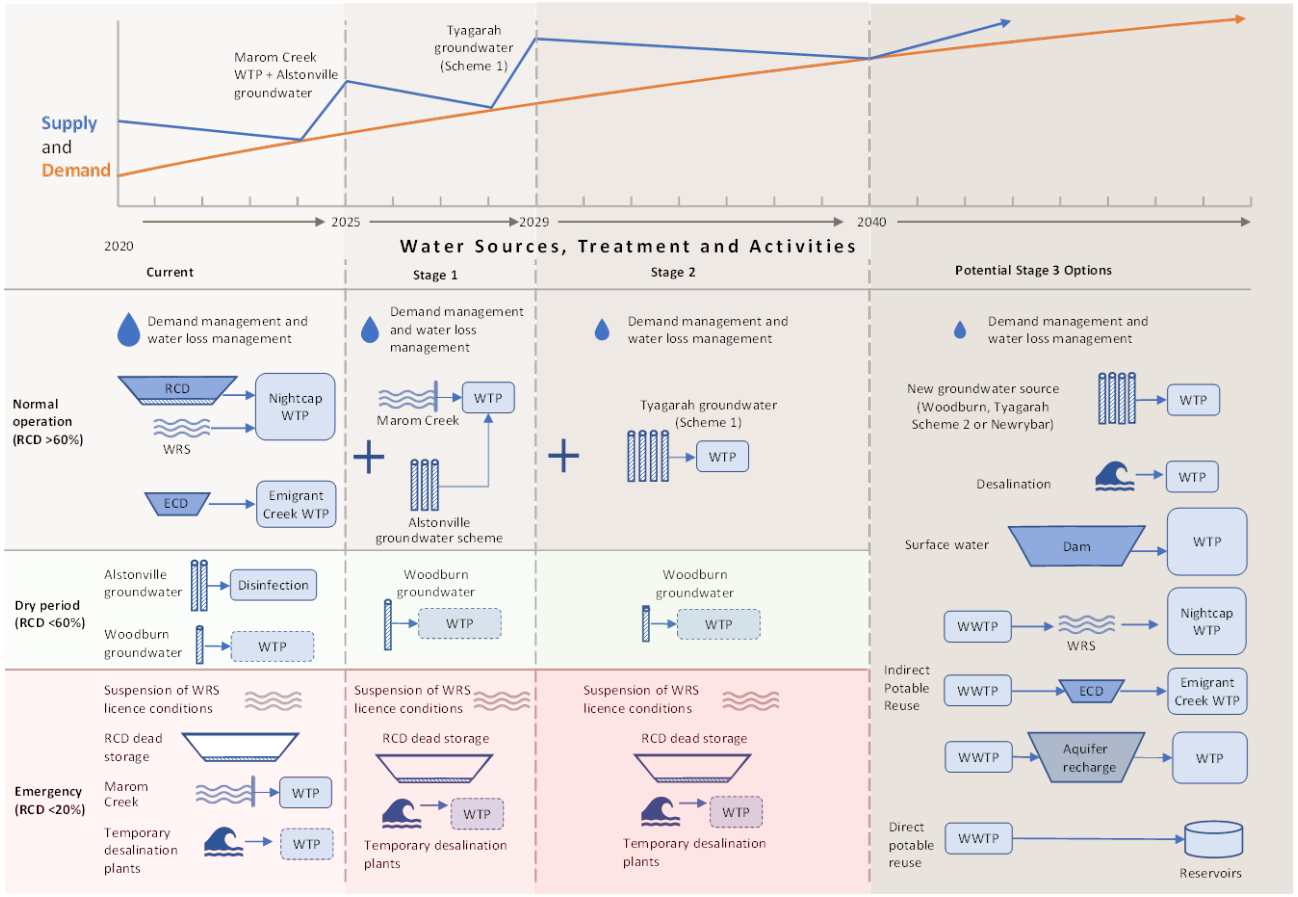

Figure 42: Staging of water source augmentation - RCC Future Water Project 2060

Source: Hydrosphere (2022)

Wider Northern Rivers region

The *Northern Rivers Regional Bulk Water Supply Study* (Hydrosphere Consulting, 2013) examined potential scenarios for interconnecting the region's water supplies to address water security issues. The study assesses five scenarios which each involve integrating Mullumbimby into the RCC regional supply scheme. The five scenarios are summarised in Table 33.

Table 34: Interconnected regional water supply scenarios

	Means of supply augmentation	Means of interconnection
Scenario 1	Desalination	Connect Nimbin, the Channon, Mullumbimby and Casino to the RCC supply and connect the RCC supply area to the Tweed supply area via a pipeline between Ocean Shores and Pottsville.
Scenario 2	Construct 50,000ML Dunoon Dam and Raise Clarrie Hall Dam	
Scenario 3	Construct 85,000ML Dunoon Dam	
Scenario 4	Raise the Toonumbar Dam by 20m	Connect Nimbin, the Channon, Mullumbimby, Casino and Kyogle to the RCC water supply and connect the RCC supply area to the Tweed supply area via a pipeline between Ocean Shores and Pottsville.
Scenario 5	Raise the Toonumbar Dam by 10m and raise Clarrie hall dam	

The study concluded that significant financial, social and environmental benefits are expected to be gained from interconnecting the regions water supply as well as improving the resilience and flexibility of the system. These options would require the cooperation of the Northern Rivers Joint Organisation of Councils, RCC, Tweed Shire Council and individual LWUs including Byron Shire Council. These options are also included in the long list of options in the Draft *Regional Water Strategy for the Far North Coast* (DPIE, 2020). The long-term strategy for Mullumbimby considers interconnection with the RCC regional supply in the short-term. In the longer term, RCC and other regional water supply authorities may consider additional interconnection options.

10.1.4 Stormwater reuse

The *Northern Rivers Regional Bulk Water Supply Study* (Hydrosphere Consulting, 2013) considered large-scale urban stormwater reuse as a future water source. Urban areas generate large amounts of stormwater due to impervious surfaces such as roads, pavements, car parks and buildings. Stormwater can be an alternative to mains water supply use, particularly for non-potable uses. However, there are health and environmental risks associated with the use of stormwater due to its associated pollutants. Unlike recycled water, stormwater supplies are very sporadic, especially in a sub-tropical climate of high rainfall during summer and low rainfall during winter such as the Northern Rivers. As a result, stormwater is very climate dependent with supply in dry times being unreliable. Any stormwater storage would need to be large enough to capture large rainfall events during the wet season and supply it throughout the low rainfall times of the dry season. The regional study found that the large-scale reuse of stormwater often contributes very little to the reduction in potable water demand.

Stormwater as a substitute for environmental flows was not considered in detail in JWP (2005) due to the low quantity of stormwater during dry weather (and low stream flow) when environmental flows would be required. In addition, additional treatment will be required to bring the water to an acceptable quality, the

distance and elevation of the town and the treatment plant would require significant investment in a transfer system and there would be high ongoing operation costs.

Improving stormwater management is included in the long list of options in the *Draft Regional Water Strategy for the Far North Coast* (DPIE, 2020).

10.1.5 Desalination

The source of water for desalination can include seawater, brackish estuarine water, brackish groundwater and sewage effluent. There are currently no desalination plants in the Northern Rivers region. The *Northern Rivers Regional Bulk Water Supply Study* (Hydrosphere Consulting, 2013) found that desalination presents an attractive option for future water supply for the Northern Rivers region due to its potential to supply a virtually unlimited amount of water that is independent from climate impacts such as drought. Desalination is approaching a level of technological maturity where it can underpin future urban water needs at a reasonable cost if water efficiency, water recycling, return flow and river source options are fully utilised. There are many issues to consider including the source of water (either seawater, estuarine or brackish groundwater), brine disposal, energy consumption and costs. The Northern Rivers study included a supply scenario with a new 70 ML/d marine desalination facility, potentially located between Ocean Shores and Pottsville to supply the whole region (Tweed Shire, RCC bulk supply, Casino, Nimbin and Mullumbimby).

The RCC Future Water Strategy (MWH, 2014) considered desalination plant(s) that could be staged with smaller modules and augmented as required. Ballina Shire Council also considered a 20 ML/d desalination plant to supplement the regional RCC bulk supply. The Mullumbimby Drought Management Plan (HydroScience, 2014) suggests that a temporary mobile desalination plant could be considered as an option to provide a flexible water supply solution during an emergency situation. It proposes that a 0.5 ML/d mobile desalination plant could be installed at Brunswick Heads with water transferred through the emergency pipeline which was built to connect Mullumbimby to the RCC water supply network.

Decentralised desalination and regional desalination are included in the long list of options in the Draft Regional Water Strategy for the Far North Coast (DPIE, 2020).

10.1.6 Groundwater

A new groundwater source could be developed to supplement the supply from Lavertys Gap weir. Groundwater supplies in Woodburn and the Alstonville area have been used by RCC and Ballina Shire Council to supplement surface water sources. The current level of groundwater use for urban water supply in the region is low with groundwater used infrequently to augment water supply during drought periods. Groundwater has also been considered as a new supply source by LCC for Nimbin, RVC for Casino and Tweed Shire and RCC to augment their major supplies. The *Northern Rivers Regional Bulk Water Supply Study* (Hydrosphere Consulting, 2013) considered small-scale localised supplies in the regional supply scenarios.

Characterising coastal groundwater resources is included in the long list of options in the *Draft Regional Water Strategy for the Far North Coast* (DPIE, 2020).

10.1.7 Indirect potable reuse of treated wastewater

Indirect potable reuse (IPR) involves delivery of highly treated reclaimed water directly into an existing major storage dam or possibly a groundwater source, for subsequent extraction, treatment and transfer using existing distribution infrastructure. Through the use of reclaimed water from an urban wastewater treatment plant, this option can provide a new water source that is always available even in drought conditions. The yield of the supply is only limited by the effluent flows and the capacity of the reclaimed water treatment facilities. The process already occurs unintentionally in a number of locations within Australia e.g. the RCC Wilson River Source intake is downstream of Bangalow STP. IPR has also been considered by RCC as part of its Future Water Project 2060 to augment existing supplies. The water supply augmentation options assessment for the Tweed District considered advanced treatment of 75% of the available effluent from the Banora Point WWTP and Kingscliff WWTP and pumping of the water through a 50 km pipeline to Clarrie Hall Dam but concluded that the option is expensive and not socially acceptable. Richmond Valley Council also considered IPR from Casino STP to the river 2 km upstream of Jabour weir to augment its water supply.

Indirect potable reuse of purified recycled water is included in the long list of options in the *Draft Regional Water Strategy for the Far North Coast* (DPIE, 2020).

10.1.8 Upgrade the raw water supply from the weir

In normal operation, water flows into the channel from the weir storage and flows by gravity to the WTP. A significant quantity of water leaks from the channel through cracks in the channel walls. This flow re-enters Wilsons Creek downstream of the weir and is not of concern when the weir is overtopping as it provides additional environmental flows and the water is not required as raw water supply. When the water level drops below the weir crest, this volume of leakage can be significant, and the water level can drop quickly. Council has attempted to repair sections of the channel but this is considered to be ineffective due to the large extent of structure defects.

The raw water pump (15 L/s) and pipeline within the channel are generally used when the water level at the weir is below the level of the weir crest. Until recently, the channel stop board leaked and a significant amount of water was still able to enter the channel. The stop board was replaced in January 2020 and this has now been resolved. As the WTP operates at 45 L/s and there is no raw water storage at the WTP, the pump is only used as a temporary measure.

Council has investigated options for the transfer of raw water to the WTP as discussed in Section 12.6. Once implemented, the preferred option will minimise the leakage in the raw water supply.

10.1.9 Brunswick River surface water sources

Surface water sources in the Brunswick River have previously been considered for augmentation of the Rous regional water supply (Public Works Department, 1984) but not considered in detail due to the limited opportunities for instream dams. The tidal limit of the Brunswick River estuary extends to Mullumbimby and the estuary is a Habitat Protection Zone within the Cape Byron Marine Park. Estuarine surface waters would require desalination as discussed in Section 10.1.5. The construction of instream dams is prohibited in the lower catchment water sources (including in the Lower Brunswick River water source, Figure 43) under the *Water Sharing Plan for the Brunswick Unregulated and Alluvial Water Sources 2016.*

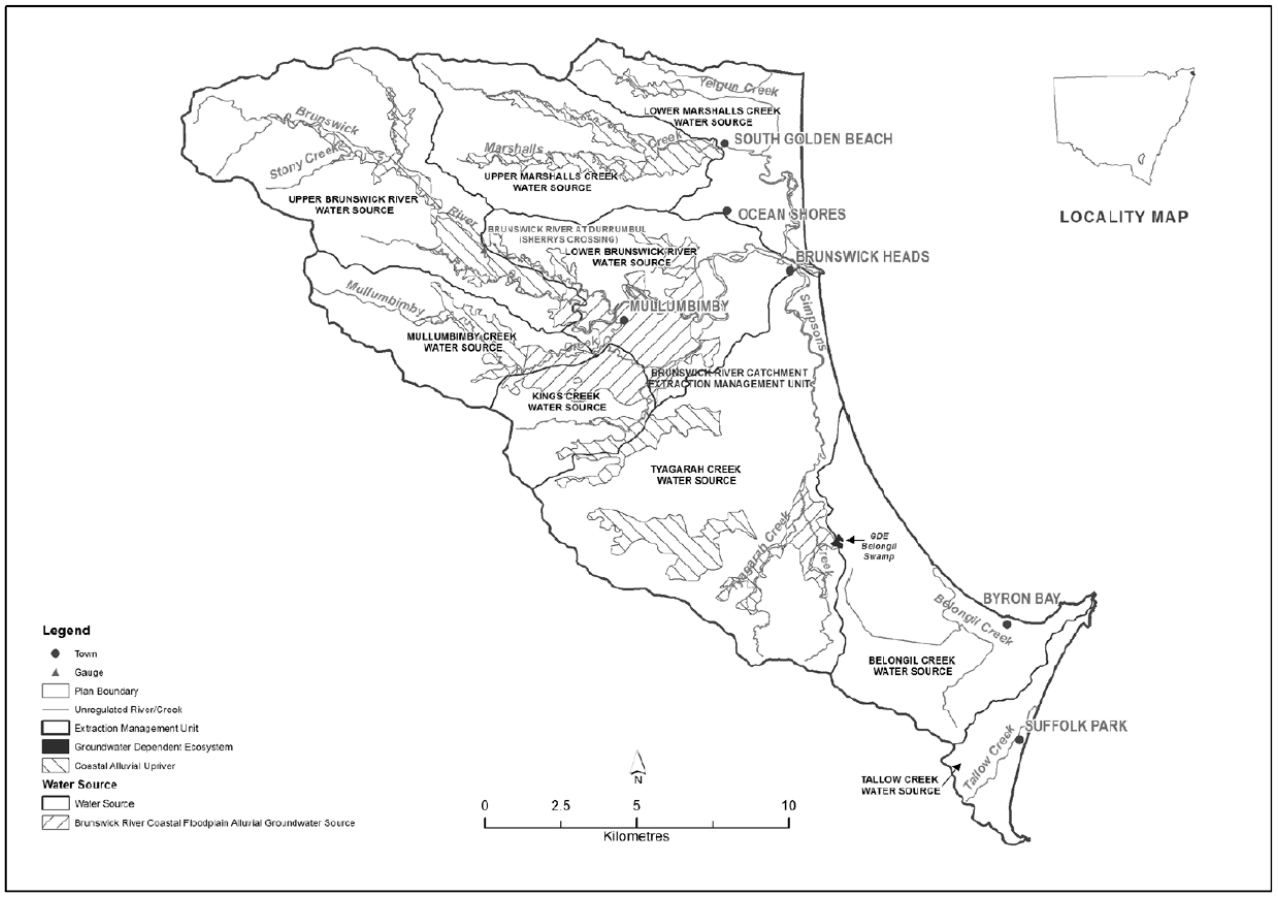

Figure 43: Water Sharing Plan map - Water Sharing Plan for the Brunswick Unregulated and Alluvial Water Sources 2016

Source: NSW DPI Water (2016b)

The *Water Sharing Plan for the Brunswick Unregulated and Alluvial Water Sources 2016* does not permit the granting of new unregulated river access licences. Entitlements can be purchased from existing licences consistent with the dealing rules and can also be converted to high flow access licences (commencing at the 30th percentile flow) for up to 5 times the existing entitlement. However, the high flow entitlements are capped at 187 ML/a, 297 ML/a and 440 ML/a for the Kings Creek, Mullumbimby Creek and Upper Brunswick River water sources respectively (Figure 43). The construction of instream dams is not prohibited in these upper catchment water sources (NSW DPI Water, 2016b).

The social, environmental and economic impacts of establishing a surface water source in the freshwater reaches of the Brunswick River have not been considered in detail. The Background Document for the *Water Sharing Plan for the Brunswick Unregulated and Alluvial Water Sources 2016* (NSW DPI Water, 2016b) identifies threatened species known or modelled to be present in the upper catchment water sources, medium-high hydrologic stress or hydrologic risk and medium instream values. Due to the Water Sharing Plan constraints, legislative risks with this option are considered to be significant. In addition, either an instream dam and potentially an off-stream storage is assumed to be required to provide the required yield. Environmental flows and fish passage requirements will affect the yield.

10.2 Demand-Side Options

The following options have been identified to reduce the demand for raw water from Lavertys Gap weir.

10.2.1 Demand management

The RDMP includes actions for BSC to reduce demand (Section 4). Most of these options are still under-development and the full cost and demand reduction are unknown. Water loss reduction measures have been assumed to be successful (Section 8.5.2) and are ongoing. While additional demand management measures may be introduced, these have been discounted through the development of the RDMP and will not be considered further in this report. BSC will continue to incorporate demand management measures in water supply planning and will collaborate with RCC on ongoing review of the RDMP which may identify additional demand management measures.

10.2.2 Increased drought restrictions

The water supply is required to meet the NSW Government's security of supply rule (5/10/10) where the duration of restrictions does not exceed 5% of the time and frequency of restrictions does not exceed 10% of years (i.e. 1 year in 10 on average) and severity of restrictions does not exceed 10%. Systems must be able to meet 90% of the unrestricted water demand during water restrictions through a repetition of the worst recorded drought. BSC has developed a drought restriction policy for Mullumbimby and a set of triggers (Section 3) for introduction of restrictions. A more stringent set of triggers may be introduced to reduce demand earlier and prolong the supply available from the weir (i.e. a lower level of service may be acceptable to the community). However, a secure supply would minimise the financial implications of emergency responses including use of the RCC emergency supply. The social implications of a more stringent restriction regime have not been assessed. Community consultation is required to test the willingness to accept more frequent or more severe water restrictions.

10.2.3 Rural effluent reuse

JWP (2005) considered that any treated effluent available for reuse from the Brunswick Valley STP is likely to be used for agricultural reuse. The recycled water from Brunswick Valley STP is delivered to the Main Arm Recycled Water Scheme and used on two local farms. The draft Byron Shire Effluent Management Strategy 2017-2027 (BSC, 2017) has been prepared to establish the path for effluent management in the Byron Shire over the next ten years. The Main Arm Recycled Water Scheme has been the least successful effluent management application in Byron Shire with the scheme failing to meet community aspirations. In theory, rural reuse projects are able to utilise high volumes of effluent, however the uncertainty with the operation of rural schemes due to external limitations such as high rainfall (low demand for alternative water sources) and the business decisions of private landowners increases the risks associated with the development of rural schemes. The effluent management strategy proposes expansion of the existing rural scheme, a new wetland regeneration and biomass cropping scheme (Sustainability Reserve) and wetlands at Ocean Shores. The benefit of rural reuse depends on the demand for potable water substitution (which is minimal for agricultural applications) and water quality requirements.

Providing purified recycled wastewater for industry and rural users is included in the long list of options in the *Draft Regional Water Strategy for the Far North Coast* (DPIE, 2020).

10.2.4 Urban effluent reuse

Recycled water for non-potable supply to households and businesses is available in some parts of the region including Ballina Shire and Byron Bay. Rebates are available for non-residential customers through the Sustainable Water Partner Program (in the RDMP) where the property is not required to connect to an approved recycled water scheme as part of BASIX. Council 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). The RDMP includes an action for Council to document a strategy for implementation of the recycled water schemes in their LGAs including areas to be serviced now and in the future, connection types, customers eligible for the rebate, funding, administrative requirements and marketing/promotional activities.

10.2.5 Private supplies

Properties not connected to the town water supply rely on household rainwater tanks, bore water or direct river extraction. In times of prolonged drought, rainwater tanks may be depleted or groundwater/surface water extraction may be restricted and these private water supplies will purchase potable water from town water supplies via water carters. While BASIX mandates the inclusion of rainwater tanks in new developments, additional incentives are required for existing customers to install a rainwater tank or for new developments to install a larger tank. The RDMP includes rainwater tank rebates for customers in the RCC bulk supply area and equivalent rebates to customers of the local water supply schemes (including Mullumbimby). This is complementary to the BASIX scheme which requires rainwater tanks to be installed for all new developments in NSW. Council also provides guidance to customers for tank selection by roof catchment and usage. Rainwater tanks provide opportunities for reduction in demand during normal climatic conditions (i.e. when tanks are refilled by rain). During droughts, the effectiveness of rainwater tanks diminishes with larger tanks able to store more water for dry periods.

The BASIX requirements will address any demand reduction opportunities from rainwater tanks in new developments and rebates can assist with encouraging water efficiency in pre-BASIX houses (although all rainwater tanks supplying internal uses are required to have potable water top-up from the mains supply). Rainwater tanks in existing water supply areas are likely to fail in severe drought and customers will rely on town water supplies. This was experienced in recent (2019/20) droughts with significant demand for water carting to properties serviced by rainwater tanks across the region (from town water supplies).

10.2.6 RCC emergency bulk water supply

The emergency supply pipeline from the RCC bulk supply at St Helena is the current back-up supply for Mullumbimby (Section 3).

10.3 Other Infrastructure Requirements

Some of the options will require relocation or replacement of existing infrastructure or new infrastructure for raw water transfer or treatment. The WTP is more than 80 years old and despite some upgrades, it is likely that the plant will require major refurbishment or replacement in the near future (Sections 6.3 and 12.6). In addition, the location of the WTP will not be suitable for all options. For the options relying on raw water supply from the weir, secure operation of the raw water channel is required (Section 12.7).

11. COARSE ASSESSMENT OF OPTIONS

A preliminary assessment of the supply-side and demand-side options was undertaken to document the attractiveness and issues related to each option and develop a short-list for further consideration. The preliminary assessment criteria are given in the following table. Economic criteria were not assessed in the coarse assessment but will be considered as part of detailed option and scenario assessment.

Table 35: Coarse assessment criteria - supply-side and demand-side options

Criteria	Measure
Beneficial	The option is expected to result in a measurable improvement in water security through a reduction in water demand, an increased water supply or both.
Safe/ fit for purpose	The option meets water quality and/or health legislation and guidelines relevant to its intended use.
Availability/ reliability	The option can supply water when most needed (i.e. drought).
Compatibility	Compatibility of the option with existing infrastructure or operations - additional infrastructure required to enable combination with existing systems is feasible.
Acceptability	Social (prevailing community opinion), political, heritage and legal (current regulatory environment).
Timeliness	Potential to be implemented efficiently (lead time including studies required, approval requirements, and construction timeframe).
Technical feasibility	Proven and reliable technology that can be applied with certainty.
Environmental sustainability	Ecological impact and resource use - known issues and potential footprint.

The coarse screening assessment was undertaken using the currently available information as reported in previous studies. The assessment outcomes are (Table 35):

Good the option is expected to fully achieve the assessment criteria objectives

Partial the option is expected to partially achieve the assessment criteria objectives

Poor the option is not expected to achieve the assessment criteria objectives

The following options will be considered further including detailed assessment of social, environmental and financial implications:

- Base case (for comparison with augmentation options).
- Raising Lavertys Gap weir.
- Off-stream storage.
- Permanent connection to the RCC bulk water supply.
- Groundwater.
- Upgrade the raw water supply from the weir.
- Urban effluent reuse.

Table 36: Preliminary assessment of options

No.	Option	Beneficial	Safe/ fit for purpose	Availability/ reliability	Compatibility	Acceptability	Timeliness	Technical feasibility	Environmental sustainability	Conclusion
1	Raising Lavertys Gap weir	Storage will increase but the expected need for environmental flows and fish passage will affect the yield.	Raw water quality will be affected but WTP processes are expected to be adequate.	The expected need for environmental flows will affect the supply yield, particularly at low flows.	Relocation of some raw water transfer infrastructure will be required. Land acquisition will be required.	Does not comply with current legislation but may be considered as part of Water Sharing Plan review. Some community opposition is expected.	Will require significant lead time for approvals.	Technically feasible.	Loss of biodiversity will result but could be offset.	Further consideration is recommended.
2	Off-stream storage	Storage will increase but the expected need for environmental flows and fish passage will affect the yield.	Raw water quality can be managed.	Storage of high flows will provide security during drought.	New raw water transfer infrastructure and relocation of WTP will be required depending on location of storage. Land acquisition will be required.	Likely to be considered acceptable for the majority of the community.	Will require significant lead time for approvals.	Technically feasible.	Minimal impact depending on location.	Further consideration is recommended.

No.	Option	Beneficial	Safe/ fit for purpose	Availability/ reliability	Compatibility	Acceptability	Timeliness	Technical feasibility	Environmental sustainability	Conclusion
3	Permanent connection to the RCC bulk water supply	Secure long-term supply assuming RCC Future Water Strategy is implemented.	High quality	Reliable assuming RCC Future Water Strategy is implemented.	Extension of water transfer system required.	Likely to be considered acceptable	Minimal lead-time	Technically feasible.	Minimal impact.	Further consideration is recommended.
4	Stormwater reuse	Not likely to significantly contribute to reduced demand or increased supply.	Treatment will be required depending on end use.	Climate dependent with supply in dry times unreliable.	Additional storage, transfer, treatment and distribution infrastructure required.	Likely to be considered acceptable	Will require significant lead time for approvals.	Technically feasible.	Minimal impact.	Not recommended.
5	Desalination	Unlimited increase in supply.	Treatment required.	Climate independent.	Estuarine and ocean water sources are a significant distance from Mullumbimby. Significant transfer, treatment, distribution and waste disposal infrastructure required.	Likely to be considered acceptable if energy use can be offset.	Will require significant lead time for approvals.	Technically feasible.	High energy use but can be offset.	Not recommended as a local supply option for Mullumbimby but potentially advantageous as a larger regional supply option.

No.	Option	Beneficial	Safe/ fit for purpose	Availability/ reliability	Compatibility	Acceptability	Timeliness	Technical feasibility	Environmental sustainability	Conclusion
6	Groundwater	Assumes adequate supply can be found.	Treatment will be required depending on source water quality.	Will be impacted during drought.	Additional treatment and transfer infrastructure required.	Likely to be considered acceptable.	Potentially significant lead time.	Technically feasible.	Minimal impact.	Further consideration is recommended.
7	Indirect potable reuse	Constant source of water.	Treatment required.	Climate independent.	Transfer system (pumping and pipeline) from Brunswick Valley STP will be significant.	Community opposition is expected. Regulatory requirements are unknown but there is a risk that approval would be refused on health grounds.	Potentially significant lead time. NSW government policy has not been developed for planned indirect potable reuse.	Technically feasible.	Minimal impact if appropriately treated.	Not recommended.
8	Upgrade the raw water supply from the weir	Increased supply during low flows through reduced wastage.	No change from current.	Source augmentation will still be required.	Transfer system modifications and raw water storage will be required.	Likely to be considered acceptable.	Minimal lead-time.	Technically feasible.	Minimal impact.	Further consideration is recommended.

No.	Option	Beneficial	Safe/ fit for purpose	Availability/ reliability	Compatibility	Acceptability	Timeliness	Technical feasibility	Environmental sustainability	Conclusion
9	Northern Rivers regional interconnection	Secure long-term supply assuming RCC Future Water Strategy and Tweed Shire Council source augmentation are implemented.	Existing treatment facilities are acceptable.	Reliable assuming RCC Future Water Strategy and Tweed Shire Council source augmentation are implemented.	Transfer system will be required.	Likely to be considered acceptable.	Potentially significant lead time. RCC and Tweed Shire Council are implementing the next stage of their water strategies independent of a regional approach.	Technically feasible.	Minimal impact.	Not recommended as a local supply option for Mullumbimby but potentially advantageous as a long-term regional supply option.
10	Brunswick River surface water source (freshwater)	Yield has not been assessed but either instream or off-stream storage is assumed to be required to provide the required yield. The need for environmental flows and fish passage will affect the yield.	Treatment will be required depending on source water quality.	Will be impacted during drought.	Transfer system may be significant depending on source location. Treatment facility required.	Does not comply with current legislation but may be considered as part of Water Sharing Plan review. Some community opposition is expected.	Potentially significant lead time.	Assumed to be technically feasible.	Potentially high energy use and impact on biodiversity but could be offset.	Not recommended as a local supply option for Mullumbimby

No.	Option	Beneficial	Safe/ fit for purpose	Availability/ reliability	Compatibility	Acceptability	Timeliness	Technical feasibility	Environmental sustainability	Conclusion
11	Demand management (RDMP)	Demand reduction expected.	No change from current.	Source augmentation will still be required.	No change from current	Likely to be considered acceptable	Minimal lead-time	Technically feasible.	Minimal impact.	Implementation of RDMP actions will form part of the long-term strategy.
12	Increased drought restrictions	Demand reduction expected during drought conditions.	No change from current.	Source augmentation will still be required.	No change from current	Community consultation has not been undertaken but the community may be prepared to forgo water security to reduce augmentation costs.	Minimal lead-time	Technically feasible.	Minimal impact.	Not recommended as part of the long-term strategy but may be required until water security is resolved.
13	Rural effluent reuse	No change to potable water use.	Existing wastewater treatment is appropriate for end uses.	Source augmentation will still be required.	No change from current.	Likely to be considered acceptable.	Minimal lead-time.	Technically feasible.	Minimal impact.	Implementation of Effluent Management Strategy actions will form part of the long-term strategy.

No.	Option	Beneficial	Safe/ fit for purpose	Availability/ reliability	Compatibility	Acceptability	Timeliness	Technical feasibility	Environmental sustainability	Conclusion
14	Urban effluent reuse	Demand reduction expected.	Treatment will be required.	Source augmentation will still be required.	Additional treatment and distribution infrastructure required.	Likely to be considered acceptable	Potentially significant lead time.	Technically feasible.	Minimal impact.	Further consideration is recommended.
15	Private supplies	Demand reduction expected.	No change from current	Source augmentation will still be required.	Rainwater tanks and/or private bores required.	Likely to be considered acceptable	Minimal lead-time	Technically feasible.	Minimal impact.	Implementation of RDMP actions (rainwater tank rebates) will form part of the long-term strategy.
16	RCC emergency bulk water supply	Demand reduction expected.	No change from current	Source augmentation will still be required.	No change from current	Likely to be considered acceptable	Minimal lead-time	Technically feasible.	Minimal impact.	Current emergency source will form part of the long-term strategy.

12. DETAILED ASSESSMENT OF SHORT-LISTED OPTIONS

Detailed information on the short-listed options from Section 11 is provided below. Legislative requirements are summarised in Appendix 1.

12.1 Option 1 – Base Case

As discussed in Section 9, the current supply is expected to be secure until 2027 assuming the emergency supply is available (earlier if water loss management measures are not implemented). If the raw water supply is not augmented, it is likely that restrictions will be imposed more frequently and the weir supply will be depleted in a prolonged drought. The RCC emergency supply pipeline can only service part of the town and other emergency response options would be required for the north-western areas if the weir supply was unable to supply the demand. There is a significant amount of growth predicted for Mullumbimby and this new development would be compromised without augmentation of the supply. Tourism may also be affected if restrictions are required more frequently. The emergency response options are discussed in the following sections.

12.1.1 Emergency response

In the event that the Lavertys Gap weir is unable to provide the town with sufficient water supply, emergency response options include the existing RCC supply, water carting, accessing the water in dead storage and a new emergency source.

RCC emergency supply

As discussed in Section 3, there is an emergency supply pipeline with agreement with RCC to supply 0.5 ML/d from the RCC bulk supply to the lower areas of the Mullumbimby distribution system (Figure 44). This pipeline is estimated to supply water to 45% of properties in Mullumbimby.

The emergency supply is currently charged as a Special Approved Connection which is a charge for a temporary connection where no payment for capital headworks have previously been made ($5.43 per kL in 2024/25, RCC, 2024a). The special approved connection rate will remain while the Mullumbimby connection remains as a temporary emergency supply.

The drought management plan (HydroScience, 2014) indicates that the emergency supply would be utilised during level 7 restrictions. During summer 2019/20, the water sourced from the emergency pipeline was 12,840 kL over 30 days from 23/12/19 (during level 4 restrictions), compared to the total demand of 28,700 kL (45% of total demand).

Due to flooding in February/ March 2022, Mullumbimby's water supply was offline from February 27 and staff were unable to access the WTP until March 1 due to flooding and damaged access roads. Because the WTP was unable to treat water, the RCC emergency supply connection was activated and water restrictions were put in place. Mullumbimby relied on the emergency connection for two weeks and used more than 13,300 kL.

During level 4 restrictions, the target demand is 0.83 ML/d (Table 15, based on current demand) and the volume of water remaining in the weir storage is 42.2 ML (31.7 ML active storage). If the emergency pipeline

can supply 45% of the Mullumbimby demand (0.37 ML/d), there would be 69 days of supply left in the storage until another emergency response option is required. This timeframe could be increased with higher level restrictions to a maximum of 111 days.

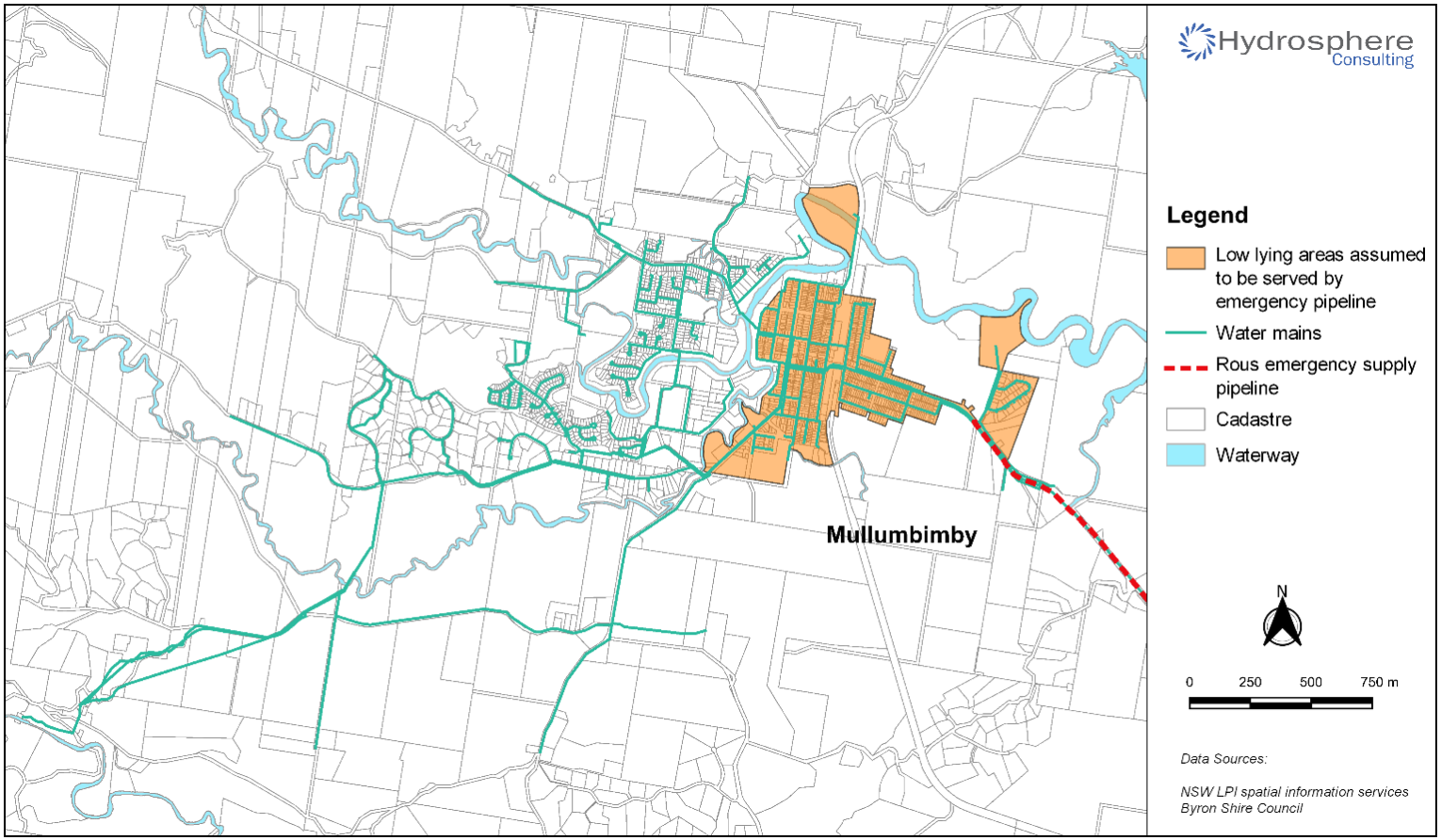

Figure 44: Emergency supply service area

Water carting

During a drought or emergency situation, if local sources of water or assets have failed, Council will be required to cart water from a different Council water supply or neighbouring Council area. Water carting is a temporary measure, for a limited time, until other solutions can be found due to the volume, time, cost and logistical requirements of transporting water. The economic feasibility of carting also depends on the distance from potential water supplies and infrastructure requirements.

Emergency water requirements for Mullumbimby have been calculated in accordance with the NSW Government publication "*Drought and Emergency Relief for Regional Town Water Supplies*" (NSW Government, 2018) as shown in Table 36. The resident population of Mullumbimby is estimated to be 3,900 (.id, 2020).

If the Lavertys Gap water source is exhausted, water would also need to be carted to the two reservoirs in order to service the higher areas of the town. The predicted water carting demand is 267 kL/d.

Table 37: Estimated emergency water demand for Mullumbimby

Component	Allowance (L/p/d)	Demand (kL/d)	Assumptions
Residential	95	370.5	Sewered system, reticulated water supply
Schools	37	18.5	Estimated 500 non-resident (rural) population
Health facilities		40.0	Aged care, medical centres, estimate
Hotels		20.0	Various, estimate
Cafés/restaurants		20.0	Various, estimate
Public toilets		5.0	Estimate
Tourists	95	1.9	Estimate 20 per day
Other		10.0	Estimate
Total emergency water demand		485.9	
RCC emergency supply		500.0	Estimated maximum supply to low-lying areas served by emergency supply
Water carting demand		267.2	Areas not currently served by emergency supply (55% of total demand)
Level 7 demand target		520.0	Whole town

The closest bulk water filling station is at Tyagarah. Using bulk water carters, 22 x 12 kL tanker loads or 11 x 25 tanker loads would be required each day. The total cost would be $8,650 - $17,300 per day. NSW government subsidy may be available (for freight costs in excess of the NSW median usage charge, approximately $2.37 per kL in 2023).

Access dead storage

The 2018 survey of the weir storage identified 5 compartments of dead storage that are not currently accessible by the raw water intake (Figure 45). The volume of the dead storage compartments is shown in Table 37. This volume of water is only sufficient to supply 20 days at emergency restriction level 7 (assuming water is accessible and of suitable quality).

Table 38: Dead storage volumes

Compartment	Approximate distance from weir (m)	Dead storage level (m below FSL)	Dead storage volume (kL)
1	0 - 30	4.0	324
2	40 - 230	3.7	1,731
3	260 - 340	3.2	512
4	350 - 600	3.1	4,900
5	660 - 950	1.8	2,988
Total		-	10,455

Groundwater source

A groundwater bore may be established as an emergency source. The groundwater resources in the area are discussed in Section 12.5.

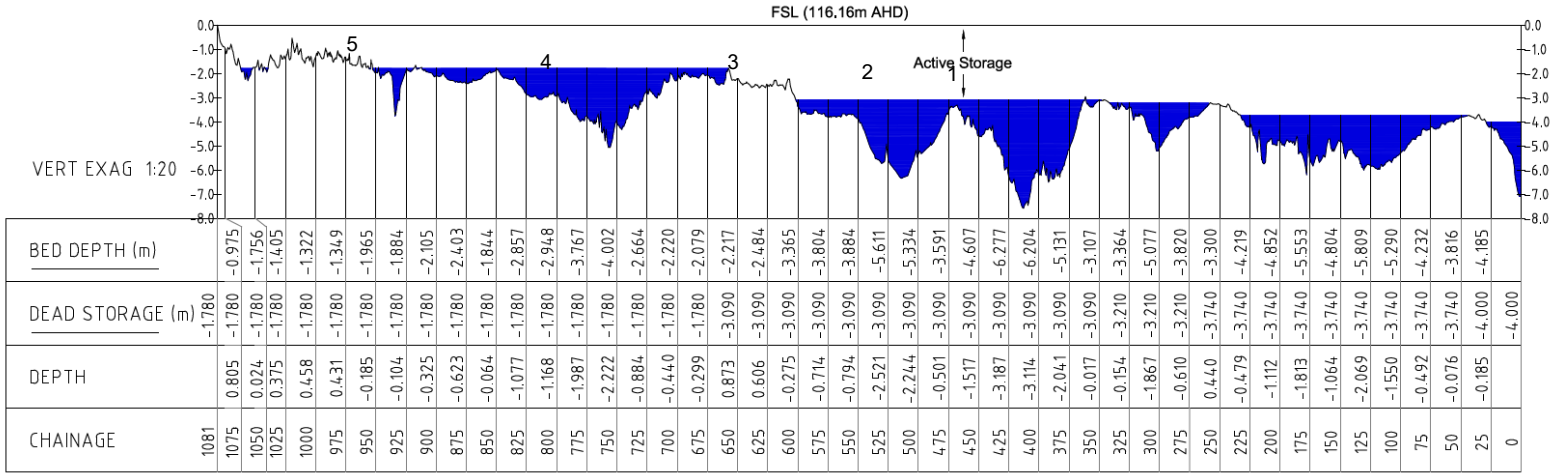

Figure 45: Lavertys Gap weir dead storage

Source: Hydrosphere Consulting (2019)

Depths based on hydrographic survey undertaken by Hydrosphere Consulting 12, 13 & 14 November 2018. Depths relative to the weir crest at 116.16m AHD. Chainage starting at weir crest following deepest river sections. Dead storage is shown as blue hatching.

12.2 Option 2 - Raising Lavertys Gap Weir

This option involves raising the height of the weir to provide additional storage. Currently the weir is a 7 m high concrete arch dam with FSL of RL 116.16 mAHD (Hydrosphere Consulting, 2019). The arch dam wall has a crest length of 46 m and is designed to be overtopped at the crest. This option considers scenarios in which the FSL is increased by various heights.

12.2.1 Weir Height

The estimated volume and inundation area impacted by raising Lavertys Gap weir was calculated from a combination of existing LiDAR data and data collected during the previous hydrographic survey (reported in Hydrosphere Consulting, 2019). Weir height increases to 5.5 mAHD were modelled as this is the height required to achieve 450 ML of storage, similar to the amount determined in JWP (2005) to provide the required secure yield. However, JWP (2005) estimated that an increase in storage of 450 ML would be achieved with a weir raising of 3.84 m to 120 mAHD.

Volumes and surface areas for weir height increases (0.5 m intervals) are summarised in Table 38. The projected inundation areas do not include flood surcharge inundation. All volume calculations include previously identified 'dead storage'.

Table 39: Weir raising options

Increase in weir height (mAHD)	New weir crest (mAHD)	Storage capacity (ML)	Increase in storage capacity ML (%)	Surface area (m^2)	Additional inundated area (m^2)
-	116.16	72.7	0	27,104	0
0.5	116.66	87.6	14.9 (20%)	32,280	5,176
1.0	117.16	106.8	34.1 (47%)	40,714	13,610
1.5	117.66	128.8	56.1 (77%)	47,315	20,211
2.0	118.16	154.4	81.7 (112%)	55,085	27,981
2.5	118.66	184.0	111.3 (153%)	63,004	35,900
3.0	119.16	217.4	144.7 (199%)	69,432	42,328
3.5	119.66	254.6	181.9 (250%)	78,622	51,518
4.0	120.16	280.0	207.0 (285%)	87,549	60,454
4.5	120.66	343.0	270.3 (371%)	97,463	70,359
5.0	121.16	394.3	321.6 (442%)	106,911	79,807
5.3	121.46	430.1	357.4 (492%)	113,374	86,270
5.5	121.66	450.2	377.5 (519%)	116,816	89,712

12.2.2 Construction

The structural report (SMEC, 2003) included in the 2005 strategy (JWP, 2005) considered three options for raising the weir wall by 3.84 m to a height of 120 mAHD (the height required to provide the additional storage considered necessary to provide the required yield):

- Raise the wall as an arch dam - addition of a concrete arch to the top of the dam, retaining the type and general appearance of the dam.
- Construct a gravity dam immediately downstream of the existing weir.
- Stabilise the weir wall using grouted anchors and raise as a cantilever dam.

The option recommended by SMEC (2003) for raising the weir based on assessed risks relating to foundations, constructability, flooding, heritage and costs was to construct a gravity dam downstream of the existing weir wall. This would entail constructing a new gravity dam wall from roller compacted concrete immediately downstream of the existing arch dam wall. The existing arch wall would form the upstream face of the dam but would be effectively abandoned. This would involve cleaning the foundation downstream of the existing weir as well as considerable excavation on the left side (southern side) to construct the new wall. Detailed site survey, geotechnical and flooding investigations would be required to confirm the suitability of any weir raising option.

12.2.3 Environmental flows

In the context of dams and weirs constructed on rivers, “environmental flows” refers to the flows in the river required to maintain the aquatic environment in a condition similar to its natural state. Environmental flows are typically achieved by releasing low flows from the weir however they may also be achieved by discharging stormwater or treated wastewater into the weir storage.

JWP (2005) discussed the implications of environmental flow requirements planned to be introduced at that time and found that this would have a significant impact on storage behaviour and secure yield during dry periods and may negate any increases in yield achieved by raising the weir. The following environmental flow requirements were assumed in JWP (2005):

“All flows are passed below Q_{95}, 80% of the flows are passed between Q_{95} and Q_{80}, and at least Q_{80} flows are passed when the flow in the river is above Q_{80}. Q_{95} is a flow condition which occurs 5% of the time (i.e. 95% of the time the river flows exceed this condition).”

This was the less conservative assumption of the two environmental flow scenarios considered in the 2005 strategy (refer Section 6).

The current water access licence includes no restrictions on extraction for town water supply. The water sharing rules for the Bangalow Area water source (under the *Water Sharing Plan for the Richmond River Area Unregulated, Regulated and Alluvial Water Sources, 2010*) include pumping restrictions as follows (NSW Office of Water, 2014):

“… water cannot be taken for more than 6 hours per day when the flow in the Wilsons River at the Eltham gauge is greater than 24 ML/d and less than or equal to 31 ML/d.”

Amendment provisions indicate that environmental flow rules may be implemented within the life of the Plan for the purposes of providing habitat flows for the Eastern Freshwater Cod. The Water Sharing Plan is due for amendment in July 2021. Any requirements for environmental flow releases would need to be determined in consultation with DPIE - Water and the Natural Resources Access Regulator (NRAR).

The flow duration curve for inflow to the weir is shown in Figure 46. The environmental flow releases resulting from the environmental flow rule used in JWP (2005) at various inflows are shown in Figure 47. This does not consider flow releases due to weir overtopping.

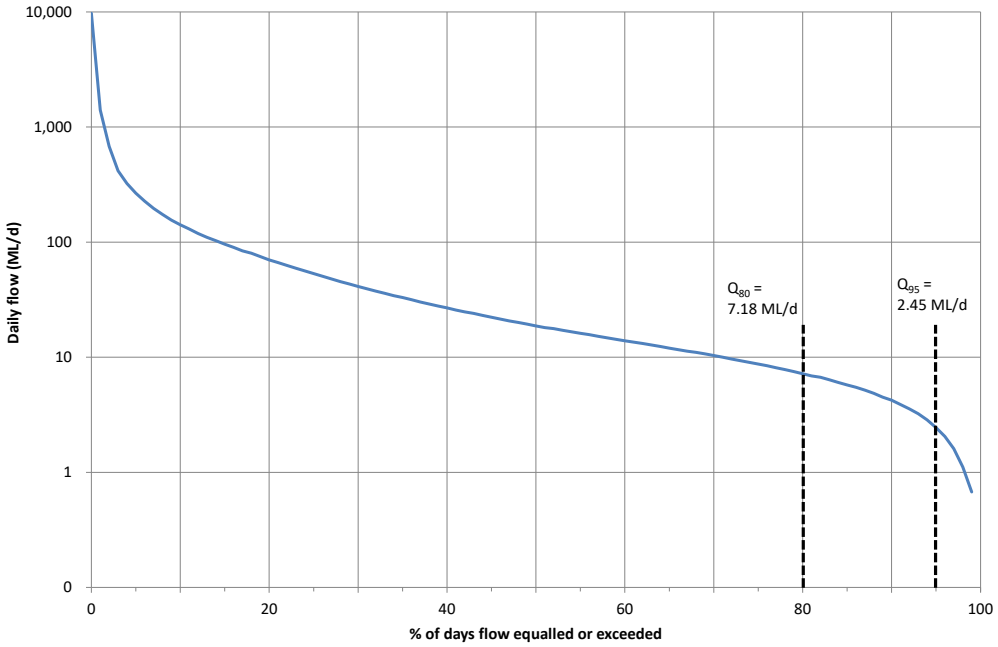

Figure 46: Flow duration curve - inflow to the weir

Source: Modelled flows using Set 1 - based on gauging station 203062 (upstream of weir) and Sacramento model - rainfall runoff model and gauge flows (203062) 10/3/2016 - 5/1/2020

As shown in Figure 47, all inflows below 2.45 ML/d are released with this environmental flow rule. Based on the historic inflow series (Set 1), there were 2,373 days when the inflow was less than Q_{95} (5% of time in 130 years of data). The modelled storage response with the 5 m weir raising and environmental flow releases is shown in Figure 48. Between November 1985 and January 1987 (when the storage would have been drawn down the most), the inflow was below Q_{95} for 66% of the time. On these days, the storage would be drawn down as no inflows would be available to meet demand. With the 5 m weir raising option, the dead storage level would be reached if this environmental flow regime was imposed with a demand of 440 ML/a (equivalent to the current secure yield). Hence security of supply is not achieved. Level 3 restrictions would be imposed but the inflow trigger for higher restrictions (0.5 ML/d) is not reached. Environmental flow releases for this scenario are shown in Figure 49. The weir is not overflowing during this period. With this environmental flow rule, environmental flow releases are substantially less than the overflows that occur at present (with the lower weir).

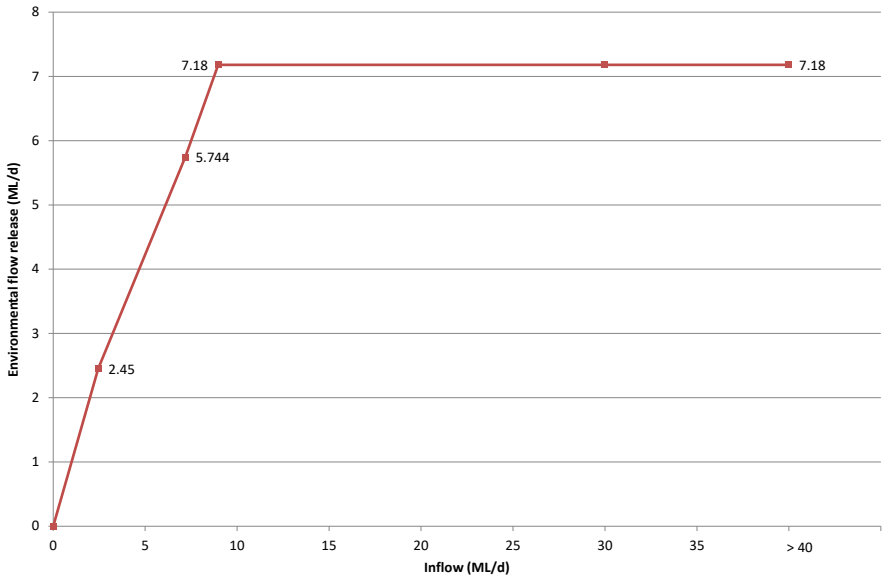

Figure 47: Environmental flow releases with assumed environmental flow rule

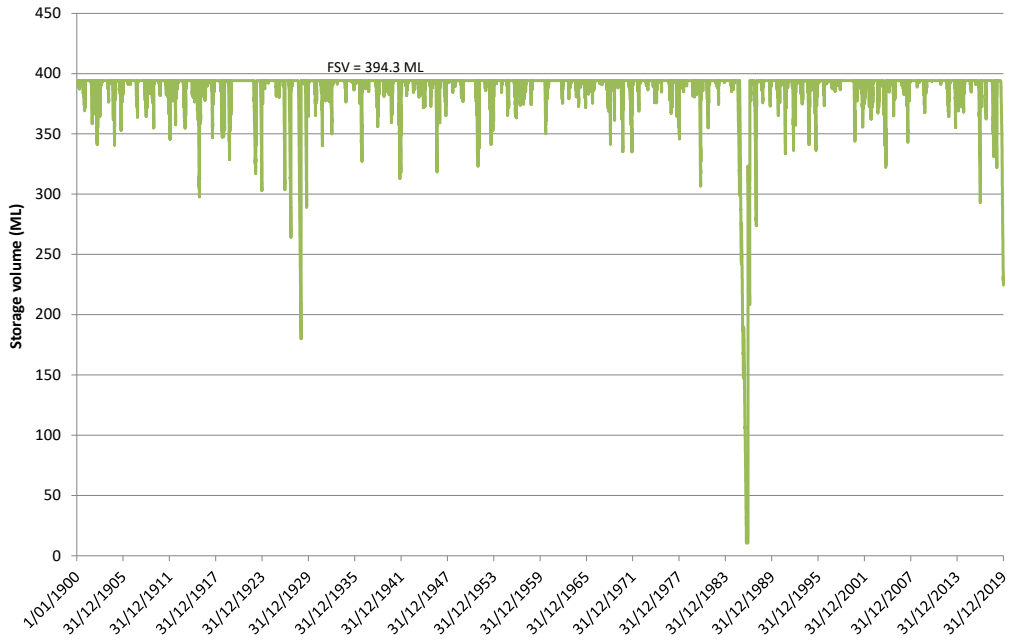

Figure 48: Storage response with 5 m raising and environmental flow releases (demand = 440 ML/a)

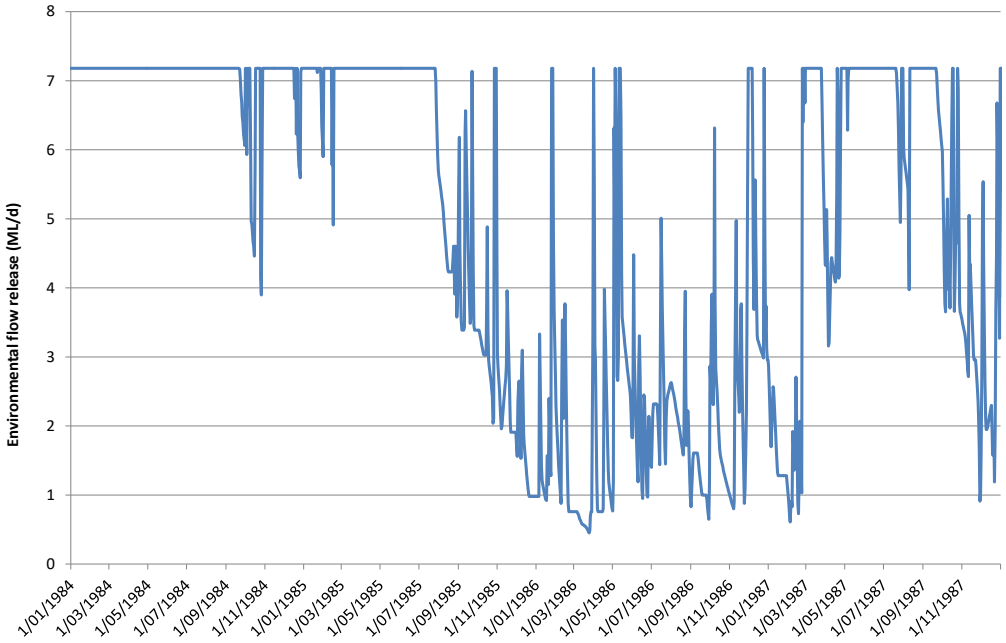

Figure 49: Environmental flow releases with 5 m raising (demand = 440 ML/a)

A revised flow regime has also been considered to mimic emergency provisions with nil environmental flow releases below the level 7 restriction level (31% storage or 122 ML which is higher than the current weir level). Figure 50 shows that the weir would have been drawn down to the level 7 restriction level for 3 months during 1986. Environmental flow releases would have been 0.65 ML/d on average during that time.

Figure 50: Storage response with 5 m raising and modified environmental flow releases (demand = 440 ML/a)

12.2.4 Inundation area and land acquisition

The current inundation area and potentially inundated areas and infrastructure impacted by raising the weir by 2.0 m, 4.0 m and 5.5 m AHD intervals are presented in Figure 51.

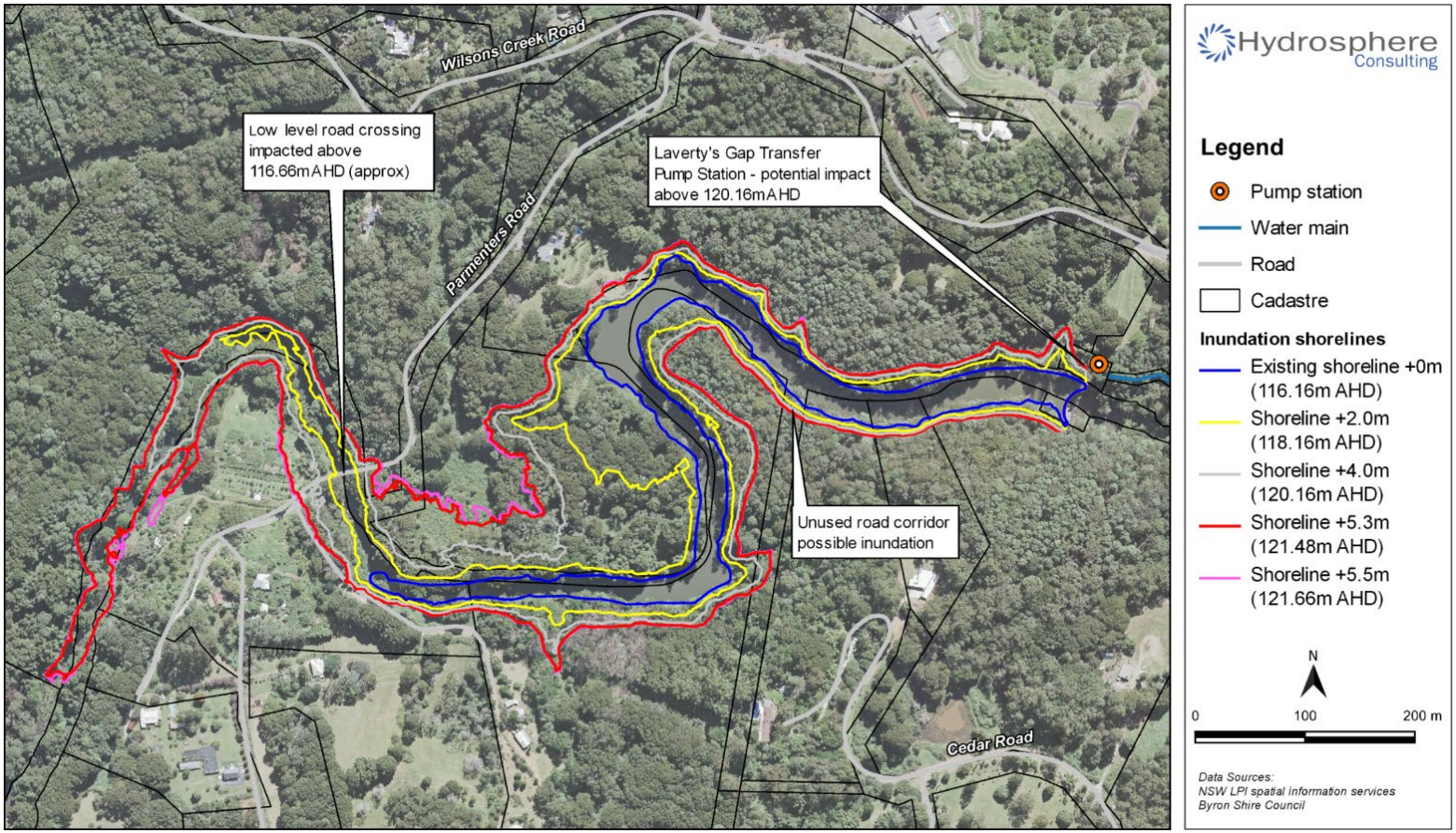

Figure 51: Potential inundation scenarios

Any increase in weir height will likely impact eight private lots upstream of the weir and the weir site (Council owned) to varying degrees relative to topography. Any change in weir height will also increase inundation of road corridors as well as the low-level river crossing on Parmenters Road which will be impacted from an increase above 116.66 mAHD (0.5 m raising). Further consideration would have to be given to rebuilding this crossing as the access road to the adjacent properties would become impassable. Additionally, above approximately 120.16 mAHD (4.0m raising), Lavertys Gap transfer pump station would likely be impacted (refer Table 39).

Table 40: Summary of potential inundation impacts

Increase in weir height (m AHD)	Potential inundation impacts
≥1.0	Eight private lots and weir site partially inundated. Parmenters Road inundated. Seven properties use the road for access to town. Private pump infrastructure likely to require relocation.
≥2.5	Lavertys Gap raw water transfer pump station potentially inundated.
≥4.0	Neighbouring property partially inundated.
≥5.5	Additional neighbouring property and access road partially inundated.

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. Vegetated buffer zones are used to:

- Exclude incompatible land use (e.g. stock access).
- Provide “filtering” capability to remove contaminants and reduce turbidity of runoff and reduce reliance on water treatment processes.
- Offset the effects of remote contaminant sources.
- Reduce erosion and sedimentation (hence improve storage longevity).
- Improve storage water quality through reduced ‘dead’ storage, environmental incidents and operational requirements.
- Allow long-term land management planning (revegetation, bush fire access, provision for future dam raising inundation areas).
- Create additional environmental value (e.g. biodiversity, habitat offset, fauna movement corridors).

There is no standard size for buffer zone widths which range from less than 20m in width to several kilometres depending on site specific factors such as catchment land-use, land tenure, slope, vegetation type and cover as well as project specific factors such as costs, operational requirements and land acquisition arrangements. At this stage, the need for a buffer zone has not been assessed. If a vegetated buffer zone is required further land acquisition would be required.

12.2.5 Potential environmental impacts

A preliminary assessment of environmental impacts associated with weir raising options is provided in the following sections.

Terrestrial flora and fauna

A detailed flora and fauna assessment has not been undertaken for the areas potentially impacted by the construction works and land inundation. A preliminary ecological assessment (FRC Environmental, 2003) undertaken as part of JWP (2005) found that the project area is within an area of high natural biodiversity, as it is in an area of overlap between biogeographic zones (the McPherson-Macleay Overlap). A combination of climatic and geographic conditions has produced an area that has both temperate and tropical species as well as having a significant number of species that are endemic to the region. Most of the vegetation surrounding the weir pool formed by Lavertys Gap weir is dominated by camphor laurel with other weed species and rainforest remnants. Near Lavertys Gap weir the riparian forest is dominated by brush box and white mahogany with many other native species such as forest sheoak and hovea. Given the extent of clearing in the area, any remnant native forests are considered to be of conservation significance and will provide habitat for threatened flora and fauna species (FRC Environmental, 2003).

Figure 52 shows the vegetation mapped by BSC within the inundation area (by plant community type). Vegetation mapped as subtropical rainforest and north coast wet sclerophyll forest will become permanently inundated and require removal as a result of raising the weir by the different heights.

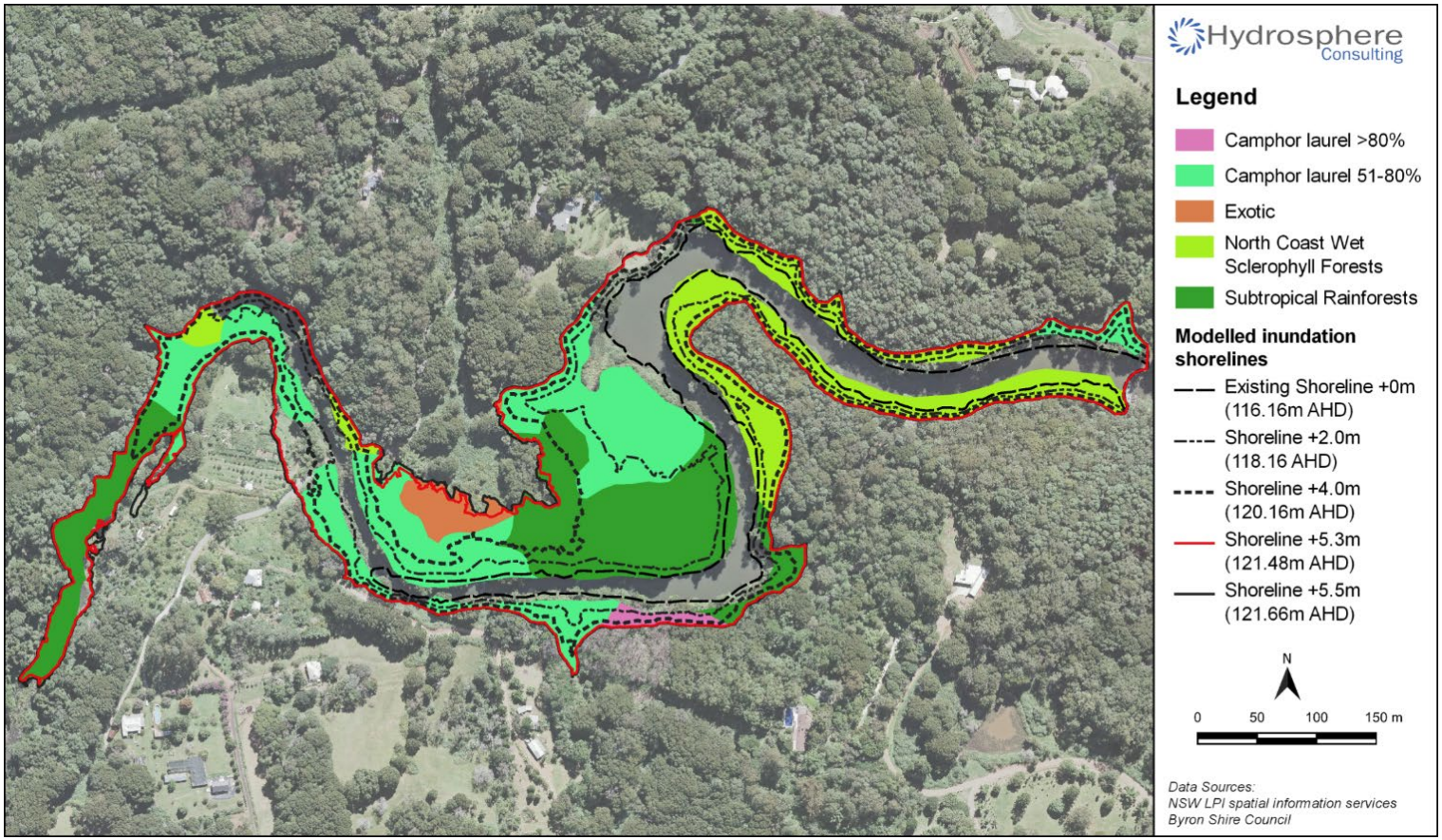

Figure 52: Vegetation within shorelines

Aquatic habitat

The weir pool upstream of Lavertys Gap weir is relatively broad and deep near the weir, but shallows to less than 0.5 m deep in the upstream area. Upstream areas of the dam are characterised by a boulder, rubble and very coarse sand bottom, with plants such as *Lomandra longifolia* (spiny headed mat rush) colonising the bank and small islands (FRC Environmental, 2003).

Wilson's Creek is likely to support a diverse assemblage of both native and introduced fish species. Many of the freshwater fish found in the Richmond River system (and likely to be found in Wilson's Creek) will migrate, moving both laterally and longitudinally at some stage of their lifecycle. However, upstream migration is now blocked by the weir and hence it is expected that diadromous species would no longer be expected upstream of the weir given the age of the structure.

Platypus (*Ornithorhynchus anatinus*) have been sighted within the vicinity of the weir. The status of the platypus is described as common but vulnerable. Platypuses require access to pool and riffle habitat as the major source of food and to firm banks for the construction of burrows and the nest used for rearing young. Two species of turtle have also been recorded in the Byron Shire - *Chelodina longicollis* (long-necked tortoise) and *Elseya latisternum* (saw shelled turtle) (FRC Environmental, 2003).

The waterway makes up part of the indicative distribution (high probability of the species occurring) of two freshwater threatened species - Eastern Freshwater Cod (*Maccullochella ikei*) and southern purple spotted gudgeon (*Mogurnda adspersa*). This section of the Wilsons River is also included in the Byron Bay LGA 'Key Fish Habitat' map published by NSW Department of Primary Industries (DPI - Fisheries). Key Fish Habitat are those aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. Raising the weir is likely to impact any species present by altering flows and potentially altering habitats. Impacts on individual species would need to be fully considered and fish passage structure options identified. A fish passage structure may be required in accordance with the *Fisheries Management Act 1994* to offset these impacts.

FRC Environmental (2003) found that inundation of land upstream of the existing weir pool will change the nature of the aquatic habitat from a diverse, highly productive riverine community to a lentic one characterised by deeper, still waters. Overall species diversity is likely to decrease and the changed conditions are likely to favour introduced species at the expense of native ones.

Threatened Species

Searches of the following information and databases were conducted to obtain an updated list of threatened species potentially occurring within the study area:

- Richmond River Water Sharing Plan.
- NSW BioNet database.
- *Environmental Protection Biodiversity Conservation Act 1999* (EPBC) Protected Matters Search Tool.

The *Water Sharing Plan Background Document* (NSW DPI Water, 2016d) identifies threatened species occurring in each water source that are likely to be sensitive to extraction and have been considered when

assessing the water source values. Some threatened species such as the Eastern Freshwater Cod are highly sensitive to low flow extraction and is now locally extinct in the Richmond River system (DPI, 2012). Purple spotted gudgeon were not identified in the *Water Sharing Plan Background Document* (NSW DPI Water, 2016d).

Table 41: Threatened species in the Wilsons Creek/ Bangalow area identified in the Water Sharing Plan

Species Name	Bangalow Area (includes Wilson's Creek)
Fish	
Eastern Freshwater Cod	Known to occur
Frogs	
Fleay's Barred Frog	Expected to occur
Giant Barred Frog	Expected to occur
Green-thighed Frog	Expected to occur
Loveridge's Frog	Expected to occur
Pouched Frog	Known to occur
Stuttering Frog	Known to occur
Wallum Froglet	Expected to occur
Birds	
Black Bittern	Known to occur
Black-necked Stork	Known to occur
Osprey	Expected to occur
Other Fauna	
Large Footed Myotis	Known to occur
Wet Flora Species	
Ball nut	Known to occur
Phyllanthus microcladus	Known to occur
Thorny Pea	Known to occur

Source: NSW DPI Water (2016d)

A search of the NSW BioNet database revealed records of four different threatened flora and fauna species within the potentially inundated footprint plus a 50m buffer as shown in Figure 53. The search revealed sightings of the following threatened species within the inundation area:

- Red boppel nut (*Hicksbeachia pinnatifolia*) - Vulnerable (*Biodiversity Conservation Act 2016* (BC Act)).
- Red lilly pilly (*Syzygium hodgkinsoniae*) - Vulnerable (BC Act; *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act)).
- Rough-shelled bush nut (*Macadamia tetraphylla*) - Vulnerable (BC Act; EPBC Act).

- Thorny pea (*Desmodium acanthocladum*) - Vulnerable (BC Act; EPBC Act).

The search report identified two listed ecological communities, 60 threatened species and 15 migratory species that are known to occur, likely to occur or that may occur within the study area which includes the potentially inundated areas plus a 50m buffer (Table 41).

A search of the EPBC Protected Matters Search Tool returned two listed threatened ecological communities, 60 listed threatened species and 15 listed migratory species protected by the EPBC Act as either likely or known to occur in the area. Of these, the following species are most likely to be affected by the change in flows resulting from raising the weir:

- Fleay's Frog (*Mixophyes fleayi*) - Endangered (BC Act, EPBC Act).
- Giant Barred Frog - Endangered (BC Act, EPBC Act).
- Wallum Sedge Frog - Vulnerable (BC Act, EPBC Act).

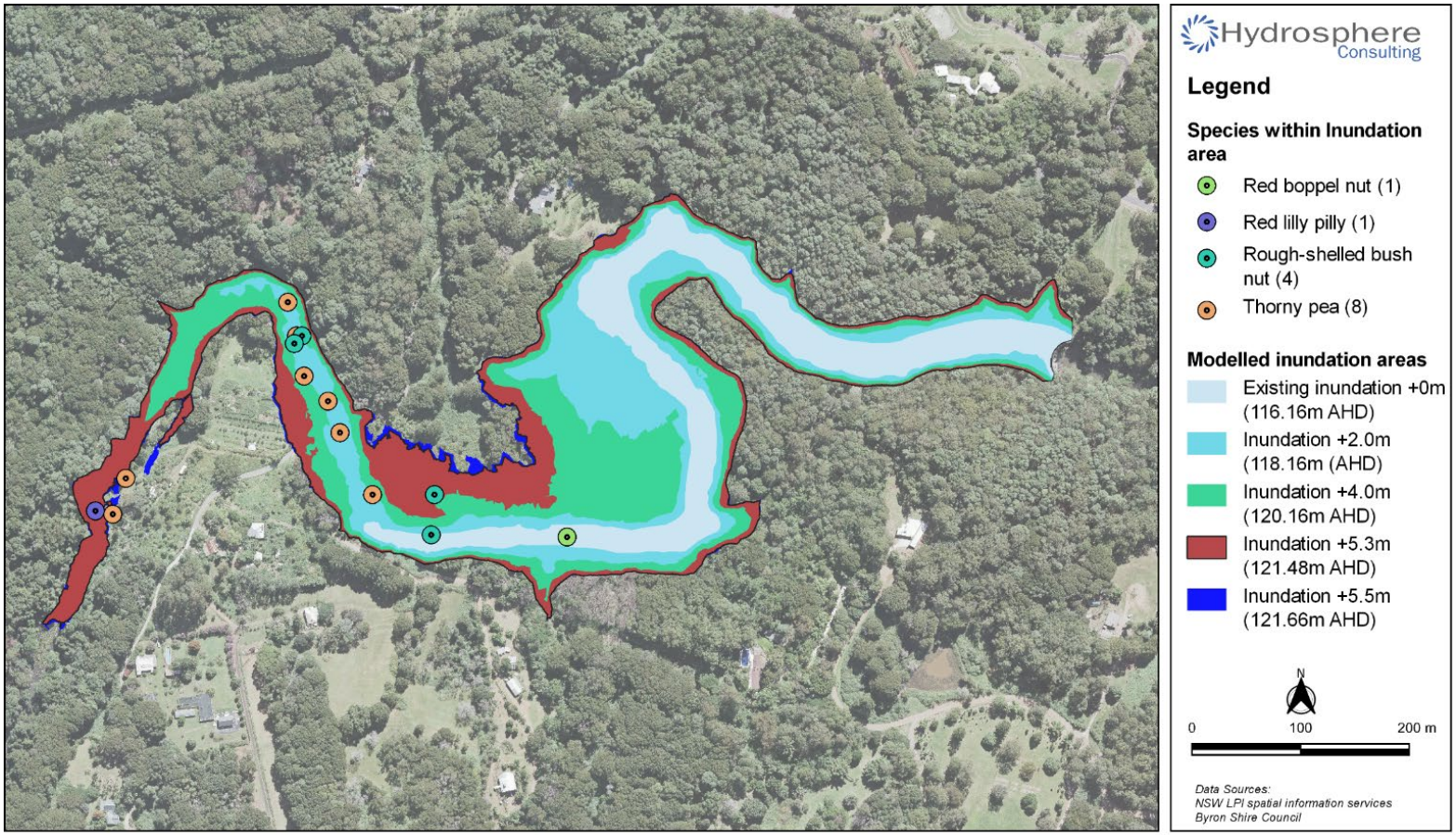

Figure 53: Threatened species recorded in BioNet NSW Atlas search at Lavertys Gap weir

Table 42: BioNet Atlas search results

Species or species habitat known to occur within area	Conservation Status	
	BC Act	EPBC Act
Australasian Bittern	Endangered	Endangered
Red Goshawk	Critically Endangered	Vulnerable
Australian Painted Snipe	Endangered	Endangered
Eastern Freshwater Cod	FM Act: Endangered	
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll	Vulnerable	Endangered
Koala	Vulnerable	Vulnerable
Smooth Davidson's Plum	Endangered	Endangered
Thorny Pea	Vulnerable	Vulnerable
Small-leaved Tamarind	Endangered	Endangered
Floyd's Walnut	Endangered	Endangered
Red Boppel Nut	Vulnerable	-
Rough-shelled Bush Nut	Vulnerable	Vulnerable
Durobby	Vulnerable	Vulnerable
White-throated Needletail	-	Migratory Species
Black-faced Monarch	-	Migratory Species
Spectacled Monarch	-	Migratory Species
Satin Flycatcher	-	Migratory Species
Painted Snipe	Endangered	Endangered
Critically endangered species or species habitat likely to occur within area		
Lowland Rainforest of Subtropical Australia	-	Critically Endangered
Regent Honeyeater	Critically Endangered	Critically Endangered
Swift Parrot	Endangered	Critically Endangered
Critically endangered species or species habitat that may occur within area		
Australian Fritillary	Endangered	Critically Endangered
Curlew Sandpiper	Endangered	Critically Endangered Migratory Species
Eastern Curlew	-	Critically Endangered, Migratory
Coxen's fig-parrot	Critically Endangered	Endangered
Black-breasted Button-quail	Critically Endangered	Vulnerable
Hooded Plover	Critically Endangered	Vulnerable

Flooding

Raising the weir will result in flooding impacts upstream during flood flows and also has the potential to alter flood behaviour downstream. The extent of flooding impacts is unknown and has not been assessed in this study.

Water quality

The construction phase of the gravity dam wall is likely to negatively affect the water quality downstream with higher turbidity levels and suspended solids concentrations due to runoff from disturbed soils downstream of the weir. There is also potential for unintended contaminants to spill into the water from construction activities. These impacts can be managed through standard control measures.

Raising the weir will have temporary impacts on the in-storage water quality during the first inundation after the raising through mobilisation of sediments and decomposing vegetation from the newly inundated areas. The inundation area would be cleared of most vegetation and fauna relocated prior to inundation.

Any long-term downstream water quality impacts will need to be considered and assessed in the development of the environmental flow regime.

European heritage

The Mullumbimby hydro-electric power station (including the weir and channel) is listed under the *NSW Heritage Act*. An assessment of heritage significance would be required to determine impacts on heritage values.

Aboriginal cultural heritage

A search of the Office of the Environment and Heritage Aboriginal Heritage Information Management System (AHIMS) has identified no Aboriginal sites nor any Aboriginal places declared near the project location. An Aboriginal heritage assessment would be required to determine any impacts on cultural heritage.

Fish passage

All proposals for the construction of, or modification to dams, weirs or similar structures are required to be referred to DPI - Fisheries for assessment. For the construction or the major modification or alteration of dams, weirs and regulators the construction of a fishway will generally be required. Under Section 218 of the *Fisheries Management Act*, a public authority that proposes to construct, alter or modify a dam, weir or reservoir on a waterway (or to approve of any such construction, alteration or modification) must notify the Minister of the proposal, and must, if the Minister so requests, include as part of the works for the dam, weir or reservoir, or for its alteration or modification, a suitable fishway or fish by-pass.

The appropriateness of a particular fishway and its design specifications are usually dealt with on a case-by-case basis. Where the nature of the structure or other factors mean that it is not cost-effective or practical to install a fish passage structure or restore fish passage and greater ecological outcomes can be achieved elsewhere, fish passage trade-offs may be considered. A trade-off involves ensuring equal or more cost-effective fish passage outcomes through transferral of fish passage works from the proposed works site to an alternative site or sites. Generally, trade-off sites must:

- Occur within the same catchment as the compliance site.

- Be identified by DPI - Fisheries as a high priority for rehabilitation of a fish passage barrier.
- Not be a site where planned upgrade works are proposed in the next 10 years.
- Derive equal to or greater ecological benefit than providing fish passage at the original compliance site.
- Be discussed and agreed upon by DPI - Fisheries.

The existing weir structure does not include a fishway or fish passage. The requirement for a fishway, fish passage offset or permit to obstruct free passage of fish would need to be negotiated with DPIE - Fisheries. Increasing the height of the weir will make it more difficult to install an effective fishway. Fishways under 6 m high are very successful in transferring fish in this region of Australia. Fishways over a greater height are typically more complicated and expensive to design. FRC Environmental (2003) concluded that developing and maintaining an effective fishway may be a major constraint to the development of this option.

In eastern Australia, rock-ramp fishways, vertical slot fishways, bypass channel fishways and fishlocks have been successfully used to circumvent instream obstructions. Rock ramp fishways are generally used for low barriers (up to two metres high), vertical slot fishways for medium sized barriers (up to six metres high), bypass channels for dams and weirs up to eight metres high and fish locks for high barriers (typically over eight to ten metres high).

12.2.6 Secure yield

Secure yield estimates for the historical and changed climate patterns and Set 1 inflows for the weir raising scenarios including the modified environmental flow regime are shown in Table 42. The secure yield for the historic climate would be below the secure yield of the current weir with raising less than 5 m. The secure yield estimates do not include the RCC emergency supply.

Table 43: Secure yield estimates - weir raising

Raising scenario	Increased storage volume (ML)	Environmental flows[1]	Secure yield (ML/a) for historic climate	Secure yield (ML/a) for 1°C warming[2]
0 m	-	No	440	356
2 m	82	No	672	Not estimated
2 m	82	Yes	252	Not estimated
3 m	145	Yes	332	Not estimated
4 m	207	Yes	393	Not estimated
5 m	322	Yes	525	423

1. There is currently no requirement for environmental flows and no infrastructure available to allow for environmental flows apart from weir overtopping. Weir raising scenarios would include facilities to release flows.

2. The climate change factor calculated for 5 m raising scenario with climate change is 0.772 (1/1/1895 - 31/12/2008).

A raising of 5 m only provides a modelled yield benefit of 65 ML/a for the current climate. The model output for the storage behaviour with 5 m raising and historic climate and modified environmental flow regime is shown in Figure 54. The modelling shows that the storage with a 5m raising (including environmental flow

provision) would still be drawn down to the level 7 (emergency) level when exposed to similar climatic conditions.

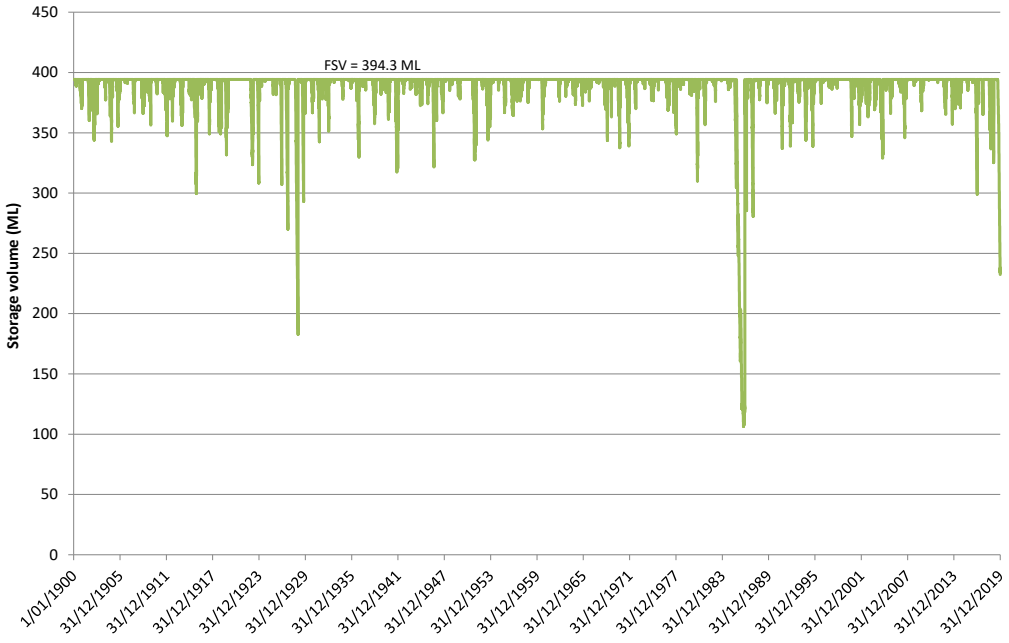

Figure 54: Secure yield modelling results - 5 m weir raising with historic climate and modified environmental flow regime (525 ML/a)

If environmental flows were not imposed with the weir raising, security of supply is likely to be achieved (with increased secure yield) however, the overflow from the weir would be substantially reduced and downstream aquatic environments would be negatively impacted.

A 5 m weir raising is expected to provide the required secure yield until approximately 2035 (including the RCC emergency supply). The secure yield of the water supply system with the weir raising constructed by 2028 is shown in Figure 55.

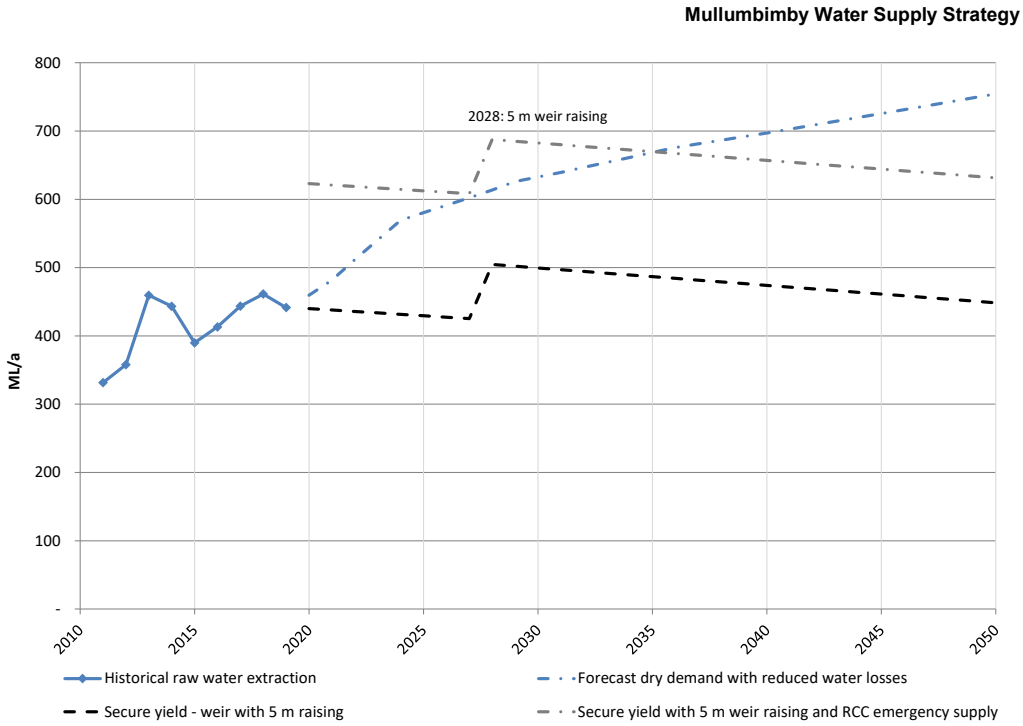

Figure 55: Secure yield with 5 m weir raising

12.2.7 Cost estimates

JWP (2005) estimated the total capital to raise the weir by 4m with a concrete mass gravity dam constructed on the downstream side of the existing arch as $9.77 million (escalated to 2025$) including $1.81 million for a fishway. The 2005 report quotes an accuracy level in the order of 20% and does not include land acquisition costs, any required environmental offset costs or the costs of rebuilding inundated assets.

Walgett Shire Council (2014) reported a cost estimate of $12.9 million (2025$) to raise the Walgett weir by 1 m. The cost estimation included $6.7 million for the constuction of a vertical slot fishway.

Raising Jabour weir at Casino from a height of 3.8 m by 0.5 m - 3.0 m was estimated to cost between $4.9 million and $16.4 million exluding land acquisition costs or containment (e.g. levees) for breakout areas (2025$, Hydrosphere Consulting, 2008). A vertical slot fishway at Jabour weir converted to a fish lock at the time of weir raising by 2 m was estimated to cost $9.78 million (2025$) by NSW Public Works (2012).

A revised indicative cost estimate for raising the weir by 5 m with a fishway is shown in Table 43. Costs associated with the raw water supply upgrade or WTP are not included but will be addressed in scenarios where this would be required (Section 13). Cost estimates are included in Appendix 2.

Table 44: Cost estimate - raising weir by 5m

Item	Cost estimate (2025 $)
Capital cost	$24,418,000
Operation and maintenance	$218,000 p.a.

12.3 Option 3 - Off-Stream Storage

This option involves the construction of a new, off-stream reservoir between Lavertys Gap weir and Mullumbimby township. The existing weir would remain in use and high flows (i.e. above those flows that overtop the weir with allowance for environmental flows) would be transferred from the weir to fill the new off-stream storage. The stored water would either be used as an emergency supply for when water level in the weir level begins to drop or as the main raw water feed into the WTP. Aeration of the water in the new storage is likely to be required to maintain water quality.

12.3.1 Storage site

The site for the storage would be chosen based on topography, slope/elevation, vegetation cover and proximity to existing infrastructure. Any site requires a dam wall to retain water along with varying degrees of excavation, depending on the topography and volume of storage required.

The off-stream storage would be constructed as a “turkey’s nest” dam where the material excavated within the reservoir would be used to construct the peripheral embankment, bunding the reservoir on several sides with clay lining. The construction would utilise the existing topography, locating the reservoir at the foot of hills, hence reducing construction costs where possible. Areas with steep relief would require more extensive excavation into the hill. Potential sites should make use of the natural topography to minimise excavation whilst balancing the water drainage into the dam. There has been no site assessment, land holder consultation or on-ground site assessment undertaken to date.

Due to the topography, raw water stored in the off-stream storage would need to be pumped back to the WTP if it is retained in its current position. If an off-stream storage option is pursued, relocation of the WTP to the off-stream storage site should be considered (refer Section 12.6). The proposed raw water transfer system upgrade (Section 12.6) would also need to be extended to the off-stream storage site.

12.3.2 Potential environmental impacts

The off-stream storage reservoir is expected to be located on predominantly cleared grazing land. As such the construction of the dam is expected to have minimal ecological impact.

A fishway or suitable offset is expected to be required similar to the weir raising options.

Hydrological, flooding and drainage impacts (including impacts on downstream flows) have not been assessed. Catchment impacts would need to be assessed in terms of storage water quality, spillway requirements and any diversion of creek flows around the storage.

The storage and new WTP would be visible from surrounding higher elevation areas.

12.3.3 Secure yield

The surface area of the off-stream storage is similar to the increase in surface area for the weir raising scenarios (and hence the effect of evaporation would be similar). As environmental flows would be achieved through overflows from the current weir, additional environmental flow releases have not been included although further consultation with regulatory stakeholders is required to confirm this. While the operational philosophy is yet to be developed, the yield increase resulting from the off-stream storage scenarios has been assessed through increasing the storage available (similar to the effect of weir raising).

Secure yield estimates for the historical and changed climate patterns and Set 1 inflows for various off-stream storage volumes are shown in Table 45. A 200 ML storage is expected to provide the required secure yield until approximately 2060 (including the RCC emergency supply). The secure yield of the water supply system with an 80 ML and 200 ML off-stream storage constructed by 2028 is shown in Figure 57. An additional source would be required from 2045 if the 80 ML storage was constructed.

Table 45: Secure yield estimates - including off-stream storage

Off-stream storage volume (ML)	Secure yield (ML/a) for historic climate	Secure yield (ML/a) for 1°C warming[1]
-	440	356
80	670	479
200	885	633

1. The climate change factor calculated for the 200 ML storage with climate change is 0.715 (1/1/1895 - 31/12/2008).

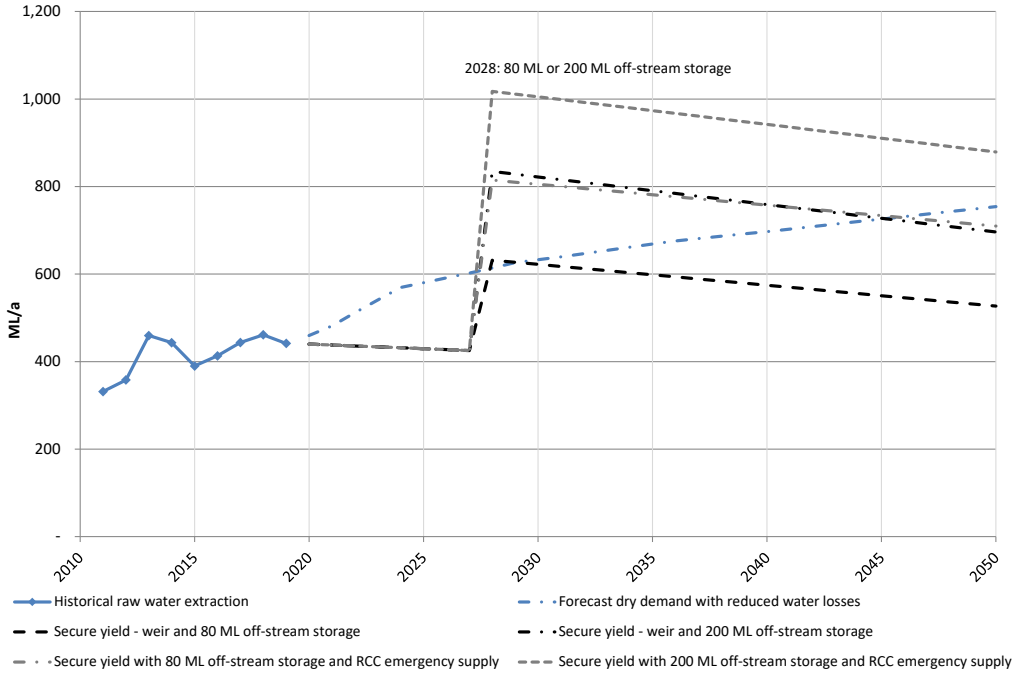

Figure 56: Secure yield with off-stream storage

12.3.4 Cost estimates

JWP (2005) estimated the total capital cost of a 450 ML off-stream storage to be $11.4 million (2025$) including land acquisition, fishway or suitable alternative offset and transfer system but not including a new WTP.

The new infrastructure required for the off-stream storage scenario includes:

- New storage – four potential storage sites have been identified as example sites to inform the project. These have a water surface area ranging from 5 to 7 ha. The storage development will also require batters, road access, carpark, amenities, pipeline from the weir, pipeline to the new WTP and buffer zones.
- New WTP – the WTP site (ideally adjacent to the storage) needs to be approximately 4 ha in addition to the pipeline from the storage and pipeline to the reservoir, road access, carpark, amenities and buffer zones. If not enough land is available at the storage location, then a separate land parcel, with duplicated area requirements for the several of the above facilities would be required.
- Council would need an easement for any access required on non-Council-owned land.

A revised indicative cost estimate for a 200 ML off-stream storage is shown in Table 46 including land acquisition. The site area required for the new infrastructure was estimated based on a potential site layout on the lot with the least constraints (topography, creeks, public roads, distance from the weir and distance to the reservoirs). Some parts of the lot will not be used in the short-term but would allow for potential expansion in future if required. The required total area for the OSS and WTP initial site is estimated as 43 ha but it is likely that the whole of the lot would be purchased. Costs associated with the raw water supply upgrade, WTP or fishway are not included but will be addressed in scenarios where this would be required (Section 13). Cost estimates are included in Appendix 2.

Table 46: Cost estimate - 200 ML off-stream storage

Item	Cost estimate (2025 $)
Capital cost	$47,625,000
Operation and maintenance	$250,000 p.a.

This cost estimate assumes the excavated material is suitable for use in construction of the storage walls and that pipework to transfer the raw water from the weir to the storage is in place. Geotechnical investigations would be required to confirm site suitability and cost estimates.

12.4 Option 4 - Full Connection to RCC Regional Supply

12.4.1 Pipeline extension

JWP (2005) considered a permanent connection to the RCC bulk supply (the regional water supply) which would replace the current water supply from Lavertys Gap weir. In future, the pipeline from St Helena reservoir is expected to be able to supply 3.2 ML/d as discussed in Section 3 which would be sufficient to supply the Mullumbimby demand beyond 2050 (average demand at 2050 is predicted to be 2.1 ML/d). The pipeline would be extended to the Azalea Street reservoirs (2.8 km). The Left Bank Road and Azalea Street reservoirs are interconnected and this arrangement (with a booster pump) would service the whole urban area of Mullumbimby. Potable water supply options would need to be developed for the trunk main customers with this arrangement.

Following the February/ March 2022 flood event in the NSW Northern Rivers region, a natural disaster zone was declared under the Australian Government Disaster Recovery Funding Arrangements (Recovery Fund).

Delivery of this program is being led by NSW Public Works and is a partnership between Water Infrastructure NSW, Department of Planning and Environment – Water and the Local Water Utilities. Due to the flooding event and the circumstances that caused loss of the water supply to Mullumbimby, an extension of the existing emergency trunk water main from the RCC regional supply to Azalea Street reservoirs was proposed and approved by the funding body as a flood resilience project under the Recovery Fund. The approved budget is $5.0 million including detailed survey, detailed design, geotechnical analysis, various required environmental management plans, pipe supply, construction, contract and project management.

The required pipeline upgrades have been identified (Planit, 2022) and detailed design of the pipeline extension has been completed (Planit Consulting, 2024). It is expected that the physical on-the-ground works will commence in 2024.

12.4.2 Option 4A - permanent connection to regional supply

A permanent connection to the RCC regional supply would mean that Mullumbimby would be supplied with bulk water from RCC bulk supply to the inlet of Azalea Street reservoir. The extension of the emergency supply pipeline to Azalea Street reservoir (4B) would be required as an interim measure. BSC would be responsible for distribution to customers in Mullumbimby which is the same arrangement as the remainder of Byron Shire urban areas.

This option would negate the need for the weir supply as a raw water source for Mullumbimby.

12.4.3 Option 4B - emergency connection to regional supply

The existing RCC emergency supply pipeline will be extended to service the remaining areas of Mullumbimby (Section 12.4.1). BSC would then retain Lavertys Gap weir and WTP as the normal supply regime with future augmentation with another raw water supply source. The customers along the Wilsons Creek Road trunk main would still be serviced by the weir supply and WTP if there was sufficient water in the weir storage.

12.4.4 Potential environmental impacts - pipeline

The pipeline route will follow existing roads within urban areas of Mullumbimby and environmental impacts are expected to be minimal.

12.4.5 Potential environmental impacts – RCC regional supply

The RCC Future Water Project 2060 included an MCA to select the preferred long-term strategy of a diversified portfolio of actions including groundwater supplies, recycled water, demand management and water loss management (Hydrosphere Consulting, 2022b). The MCA methodology built on previous studies undertaken by RCC in 2014 and a detailed assessment of options and supply scenarios. The environmental assessment criteria used in the RCC Future Water Project 2060 included:

- 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, GDEs) 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).

Based on the MCA, the most favourable regional supply scenario is groundwater which scored higher on environmental and social criteria than scenarios including a new dam. While limited environmental investigations have been undertaken by RCC for groundwater options (potential impacts on GDEs require further assessment), RCC considers that the impacts are manageable. RCC considers that suitable measures can be put in place to obtain planning approval and ensure stakeholder acceptance of the groundwater scenarios (Hydrosphere Consulting, 2022b).

The unrestricted dry year demand of Mullumbimby customers is expected to be 633 ML/a in 2030 or 4.7 % of the Rous demand forecast at 2030 (13,480 ML/a) and 754 ML/a in 2050 or 5.0% of the Rous demand forecast at 2050 (15,175 ML/a). In preparing its demand forecast, RCC considered the additional demand that would result from connection of local supplies (including Mullumbimby, Casino, Wardell and Nimbin). RCC is already committed to providing 183 ML/a (0.5 ML/d) as an emergency supply to Mullumbimby.

In 2024, RCC advised BSC that there would be no requirement to augment its supply to connect Mullumbimby to the regional supply.

12.4.6 Secure yield

If Mullumbimby became part of the RCC regional supply, the secure yield would be determined by the RCC bulk supply system. RCC is currently investigating options to ensure long-term security. As such, this option is considered to provide long-term security for Mullumbimby (either as a permanent or emergency supply).

12.4.7 Cost Estimates

The extension of the pipeline to Azalea Street reservoir is estimated to cost $5.0 million and will be funded through the Disaster Recovery Fund.

For the permanent connection option (Option 5A), JWP (2005) included a connection fee equivalent to headworks contributions (in accordance with the RCC Development Servicing Plan, DSP) but also considered options where lower headworks contributions would apply. In 2024, RCC confirmed that headworks contributions would not apply to existing Mullumbimby customers. A permanent connection would result in RCC's Bulk Water headwork charges being levied on new developments in the Mullumbimby supply zone.

It is assumed that the emergency supply pipeline is operated when level 4 restrictions are in place. The frequency is expected to increase with the impacts of climate change over the long-term. The cost of the water as an emergency supply for Option 5B is $5.43 per kL in 2024/25 (Special Approved Connection, RCC, 2024a).

The notional price of water charged by RCC to member councils is $2.34 per kL in 2024/25. RCC has published price increases to 2034 in its long-term financial plan (RCC, 2024b).

Cost estimates for the permanent and emergency supply option are given in Table 47. Costs associated with the raw water supply upgrade or WTP are not included as they will not be required. Cost estimates are included in Appendix 2.

Table 47: Cost estimate - RCC regional supply

Item	Cost estimate (2025 $)
Permanent supply	
Capital cost (Disaster Recovery Fund)	$5,000,000
Purchase of water (bulk supply) – average over next ten years	$2,069,000 p.a.
Emergency supply	
Capital cost (Disaster Recovery Funding)	$5,000,000
Purchase of water (emergency supply)[1] – average over ten years	$176,000 p.a.

1. Average cost with emergency supply estimated to be required 10% of the time.

12.5 Option 5 - Groundwater

This option involves supplementing the current water supply from Lavertys Gap weir with a new groundwater source. The groundwater supply could be either a permanent supply supplementing the weir supply or used as an emergency supply only as suggested in the 2014 drought management plan (HydroScience, 2014). This water would either be pumped directly to the WTP for treatment or to the weir storage depending on the location of the bore supply and future location of the WTP.

There are five groundwater sources within the Mullumbimby/Wilsons Creek region within 5 km of the WTP/weir. Table 48 provides a summary of the geology, water quality, yield, socio-economic and environmental risks of each source. The environmental risk rating considers the impacts of extraction on the groundwater source and any high priority GDEs and identifies risks to ecological, water quality and aquifer integrity assets. The socio-economic risk assessment considers the dependence of local communities on groundwater extraction. A detailed description of the geology and groundwater sources is provided in the following sections.

12.5.1 Geology

The geology underlying Mullumbimby and the surrounding area is comprised of the following rock types (from oldest to youngest rock) (McKibbon, 1995):

- Palaeozoic age sedimentary rocks of the Beenleigh Block (Part of the New England fold belt) form the effective geological basement of the area. The Neranleigh Fernvale Beds of this unit outcrop the areas surrounding Mullumbimby (EHA, 2008). These beds consist of strongly folded and structurally deformed greywacke, slate, phyllite and quartzite.
- Tertiary age volcanics overlay the deep bedrock formations. The key geological unit of the tertiary age volcanics within the Mullumbimby area are the Lamington volcanics comprising sub-alkali basalt with members of rhyolite, trachyte, tuff, agglomerate and conglomerate.

- To the South and west of Mullumbimby, underlying the Lamington volcanics, are the consolidated sediments of the Clarence Morton Basin.
- Quarternary age alluvial sediment associated with the low-lying coastal flats and river valley-fill.

Figure 59 shows the surface geology in the Mullumbimby area and geological cross section showing geology at depth from a location to the north-west of Mullumbimby. The mapping shows that river gravels and alluvium (labelled 'Qa') cover the low-lying areas immediately surrounding Mullumbimby. To the north-west is the Neranleigh-Fernvale group (labelled 'Pzn'). The Neranleigh-Fernvale group is approximately 3,000 ft (914 m) thick. The North Coast volcanics (or Lamington volcanics) lie to the south-south-west of Mullumbimby which overlie the Clarence-Moreton Basin.

Table 48: Characteristics of groundwater sources in the area

Groundwater source	Geology	Quality	Yield	Estimated likely bore production (per bore)	Socio-economic risk	Environmental risk	Water Sharing Plan
Brunswick River Coastal Floodplain Alluvial	Floodplain alluvial	Variable Salinity: 200 - 3,500 mg/L	Typically low	NA	Medium	Medium	*Water Sharing Plan for the Brunswick Unregulated and Alluvial Water Sources, 2016*
New England Fold Belt	Fractured rock	Conductivity: 1,000 - 10,000 µS/cm	Typically: 0.5 L/s - yields of up to 16L/s obtained in gold coast area	NA	Low	Moderate	*Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources, 2016*
Clarence Moreton Basin	Porous rock	Variable, typical salinity 500 mg/L	Typically: < 1 L/s	NA	Moderate	Low	
North Coast Volcanics	Fractured rock	Typically excellent	Typically: 5-10 L/s	15-235 ML/a	Moderate	High	
Tweed-Brunswick Coastal Sands	Beach and dune sands	Typically fresh, high risk of encountering acid sulphate soil	Typically: 0.5-6 L/s	10-95 ML/a	Moderate	High Could potentially affect GDEs	*Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources, 2016*

Sources: NSW DPI (2016a), NSW DPI (2016b), NSW DPI (2016c), DLWC (1998), Parsons Brinckerhoff (2011), Jacobs (2015), DLWC (1998).

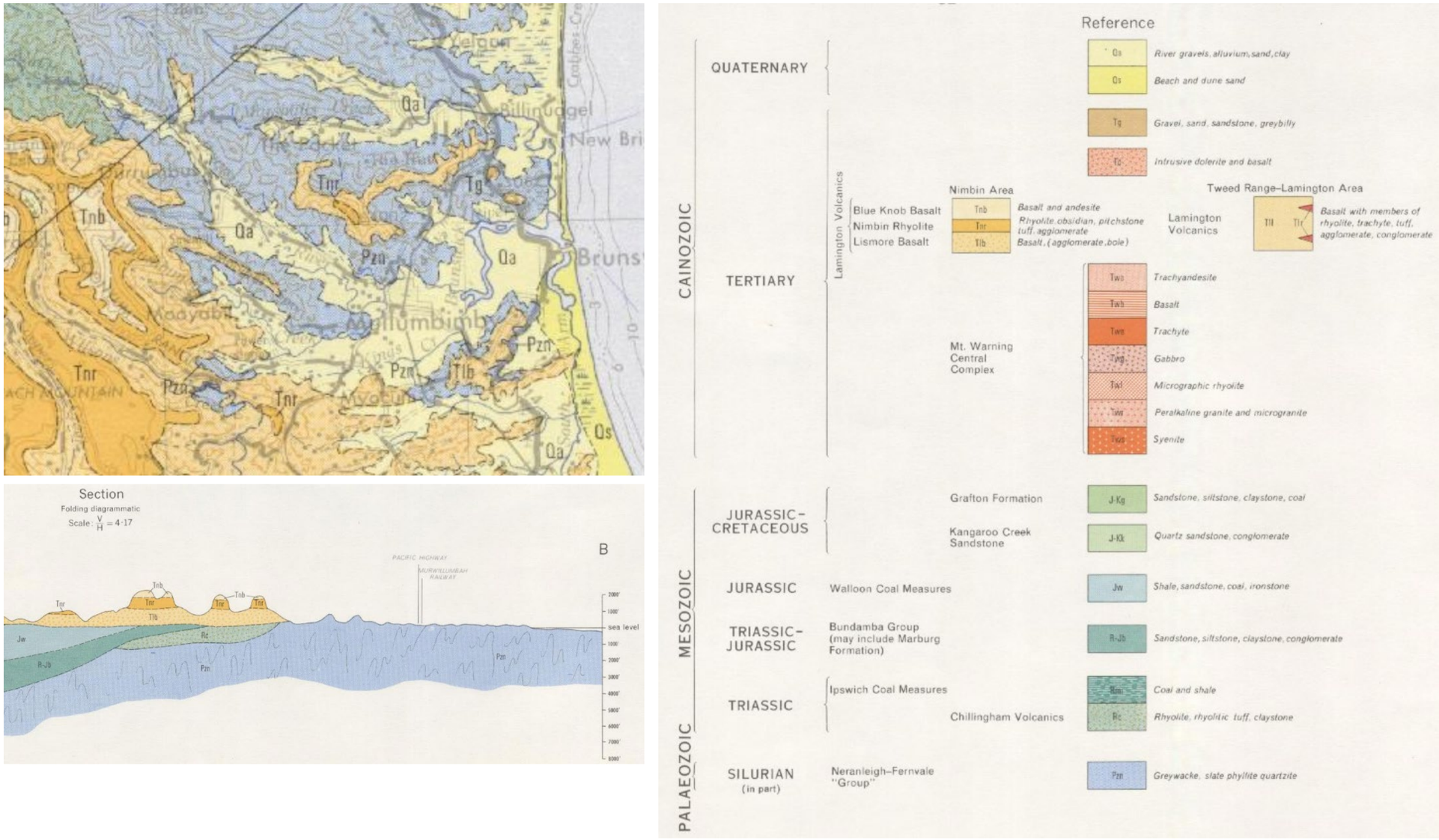

Figure 57: Mullumbimby surface geology and cross section showing geology at depth from location to the north-west of Mullumbimby

Source: Tweed Heads 1:250,000 Geological Survey of NSW (1972)

12.5.2 Potential Groundwater Sources

Figure 60 shows the location of groundwater sources in the Mullumbimby area including the aquifers of the porous rocks of the Clarence Morton Basin, fractured rock of the North Coast Volcanics and the New England Fold Belt and unconsolidated sediments of the Brunswick River alluvium and coastal sands.

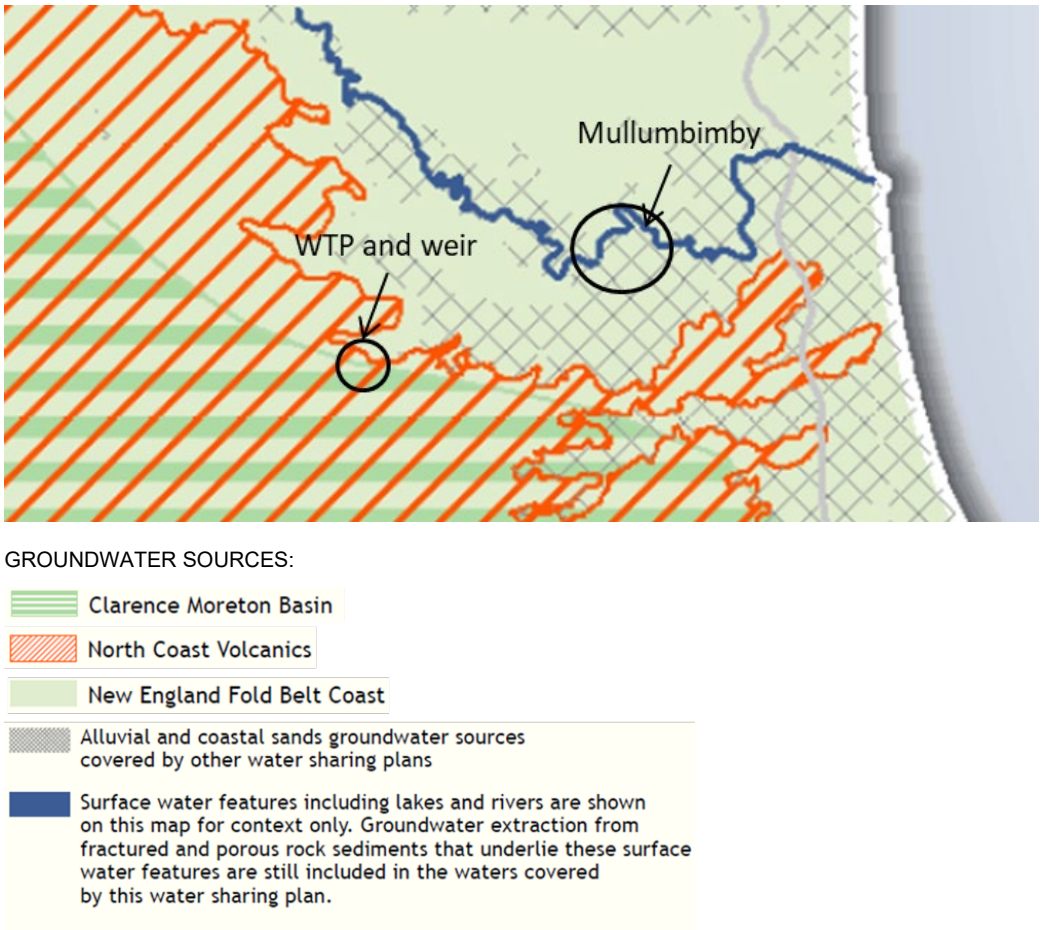

Figure 58: Groundwater sources in the Mullumbimby area

Source: NSW DPI (2016a)

Based on the information discussed below on the typical yields and water quality, the Tweed-Brunswick Coastal Sands and North Coast Volcanics (also referred to as Lamington Volcanics group or North Coast Fractured Rock) may provide adequate yield and quality. However, the yield may vary significantly between locations within the same aquifer and test bores would need to be established to confirm actual yield. Units of the Clarence Moreton basin and the Neranleigh-Fernvale group which underlie the North Coast Volcanics and Coastal Sands aquifers may also provide potential groundwater sources and should be considered if test bores are to be drilled.

Brunswick River Floodplain Alluvial

Mullumbimby is situated within the Brunswick River Coastal Floodplain Alluvial Groundwater Source which extends from approximately 2 km east of the town to approximately 2 km west of the town. It primarily consists of fine grain sands, silts and clays ranging up to 2km wide and 20m in depth.

The background document (NSW DPI Water, 2016b) discusses the development of the rules in *The Water Sharing Plan for Brunswick Unregulated and Alluvial Water Sources*. It considers the following constraints on the yield and water quality of the groundwater source:

- Groundwater yields from this source are generally low and typically only suitable for stock use.
- Water quality from this source is variable with some areas producing fresh water and others more saline water.
- These coastal alluvial floodplains are often underlain by acid sulphate soils which further restricts the suitability of pumping the groundwater and can lead to poor water quality

Due to the poor/variable water quality and low yields this groundwater source is not considered a viable option for Mullumbimby town water supply.

New England Fold Belt

The Naranleigh-Fernvale beds of the New England Fold Belt form the geological basement of the area surrounding Mullumbimby and are overlain by the Clarence Moreton Basic and North Coast Volcanics groundwater sources and by the alluvial and coastal sand deposits further east. McKibbon (1995) indicated that this unit has generally low permeability and yields of typically around 0.5 L/s, however occasional yields of up to 5 L/s are recorded. Swann (1997) indicated that in Queensland the Neranleigh Fernvale beds rarely host significant groundwater sources except in areas associated with zones of structural deformation along drainage lines.

Despite high yields being obtained by bores extracting groundwater from this source in South-East Queensland, the low permeability and limited storage potential within the aquifer limits its potential and it is unlikely that this aquifer presents as a potential source for groundwater extraction.

Clarence Moreton Basin

The Clarence Morton Basin is a more extensive aquifer also located in north-east NSW. It is overlain by the North Coast Volcanics groundwater source and in the east it is overlain by alluvial and coastal sand deposits. Yields are typically low (most commonly 0.3 L/s and up to 1.5 L/s) and quality is variable (McKibbon, 1995). The shallowest and youngest part of the unit, the Grafton formation, is more saline and only suitable for stock. Older/deeper units generally have water which is suitable for domestic purposes (NSW DPI Water, 2016a).

Due to the typically low yields extracted from this aquifer it is unlikely to be a potential source for groundwater extraction.

North Coast Volcanics

Mullumbimby and Lavertys Gap weir are situated within the North Coast Volcanics Groundwater Source which is a fractured rock groundwater source bound by Lismore to the south, Mullumbimby to the east, Kyogle to the west and extends to the NSW-QLD border (NSW DPI Water, 2016). The geology of the North Coast Volcanics is made up of various volcanic formations with the Lismore basalts the most widespread formation of the Lamington Volcanics Group (Jacobs, 2015). The typical saturated thickness of the aquifer is 60 m (Jacobs, 2015).

The aquifer risk assessment (NSW DPI Water, 2016) for this groundwater source determined that changes in groundwater levels and the timing of fluctuations pose a high risk to GDEs such as springs, rainforests, dependant soils, seasonal drys and that extraction will reduce base flows for plateau streams. During dry periods, stream and spring flow is reliant on groundwater discharge and as a result GDEs are common within the water source. An assessment would be required to determine if there are high priority GDEs present which may be affected by extracting water from this source.

The basalt aquifers of the North Coast Volcanics have variable yields which can be attributed to the nature of the fractured rock sequence. Yields are generally moderate, up to 5 L/s and some bores may obtain yields up to 10 L/s when associated with highly fractured areas. The groundwater has excellent water quality, however deeper aquifers have better yield and quality potential than shallow aquifers (Jacobs, 2015). As such, deeper aquifers may be considered as a potentially viable option for augmenting the Mullumbimby town water supply. A structural lineament analysis may be used in prospective site selection to identify sites that are likely to be highly fractured as these areas are more likely to produce higher yields (Jacobs, 2015).

Tweed-Brunswick Coastal Sands

Northern NSW coastal sand aquifers typically consist of medium grained sands with the occasional interbedded indurated iron and clay layers. The water table is relatively close to the surface and is often connected to wetlands and swamps that sustain numerous groundwater dependant ecosystems. The water is typically fresh, however water quality issues may arise due to the high iron content and saline water from adjoining estuaries (NSW DPI Water, 2016c). Further, much of the land to the east of Mullumbimby is classified as having a high risk of containing potential acid sulphate soils which if exposed to oxygen can cause acidification events. The vast majority of coastal sand units is of “High” aquifer vulnerability due to their shallow, unconfined and highly permeable characteristics. The water tables were typically less than 5 m deep, combined with shallow soil depth, low slope and high to very high permeability, which placed them in the high-risk category for contamination and variation in yield.

Jacobs (2015) considered an area along the coast between Brunswick Heads and Byron Bay as not being viable for water supply development as the area could potentially encounter saline intrusion and high iron.

12.5.3 Water Sharing Plans

The potential groundwater sources are covered by the following water sharing plans (refer Table 48):

- *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources.*
- *Water Sharing Plan for the Brunswick Unregulated and Alluvial Water Sources.*
- *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources.*

These WSP provide the rules for extracting water from local aquifers to ensure their sustainable management.

12.5.4 Groundwater bore data

The Water NSW website provides data on groundwater bores (Figure 61). Table 49 gives a summary of groundwater works within 1.5 km of the WTP. The information was recorded by the driller at the time of drilling over a short time period and may not be an accurate representation of the sustainable yield or water quality.

Table 49: Local bores work summary

Bore ID	Year drilled	Water bearing zone (m below surface)	Yield (L/s)	Salinity (mg/L)	Rock type/ geological material
GW303878	2002	24-34	0.15	-	-
GW302784	2000	25-28	0.38	140	-
GW306146	2006	-	-	-	-
GW306234	2007	21-26	0.189	150	-
GW068295	1989	19-32	0.5	-	Fractured
GW067283	1991	53-69	0.6	“Good”	Fractured
GW0306233	2007	31-36	0.759	90	Fractured (basalt)
GW307448	2005	45-50	1.5		-
GW064558	1987	21-24	0.31		Shale/gravel/rock
GW049436	1979	7	0.38		Basalt
GW306147	2006	18-22 30-35	0.38 1.26	80 100	Basalt/red jasper Serpentine
GW303848	2002	21-39	0.45	-	Basalt
GW306483	2009	19-21 27-27.5 29-29.5	0.5 1.0 0.5	- - -	Basalt
GW058254	1982	23-27	0.52	-	Fractured (Shale)
GW052768	1980	9-11	0.39	-	Fractured (Basalt)
GW302356	-	-	-	“Good”	-

The bores near the WTP with the higher yields (> 0.6 L/s) are greater than 30 m in depth.

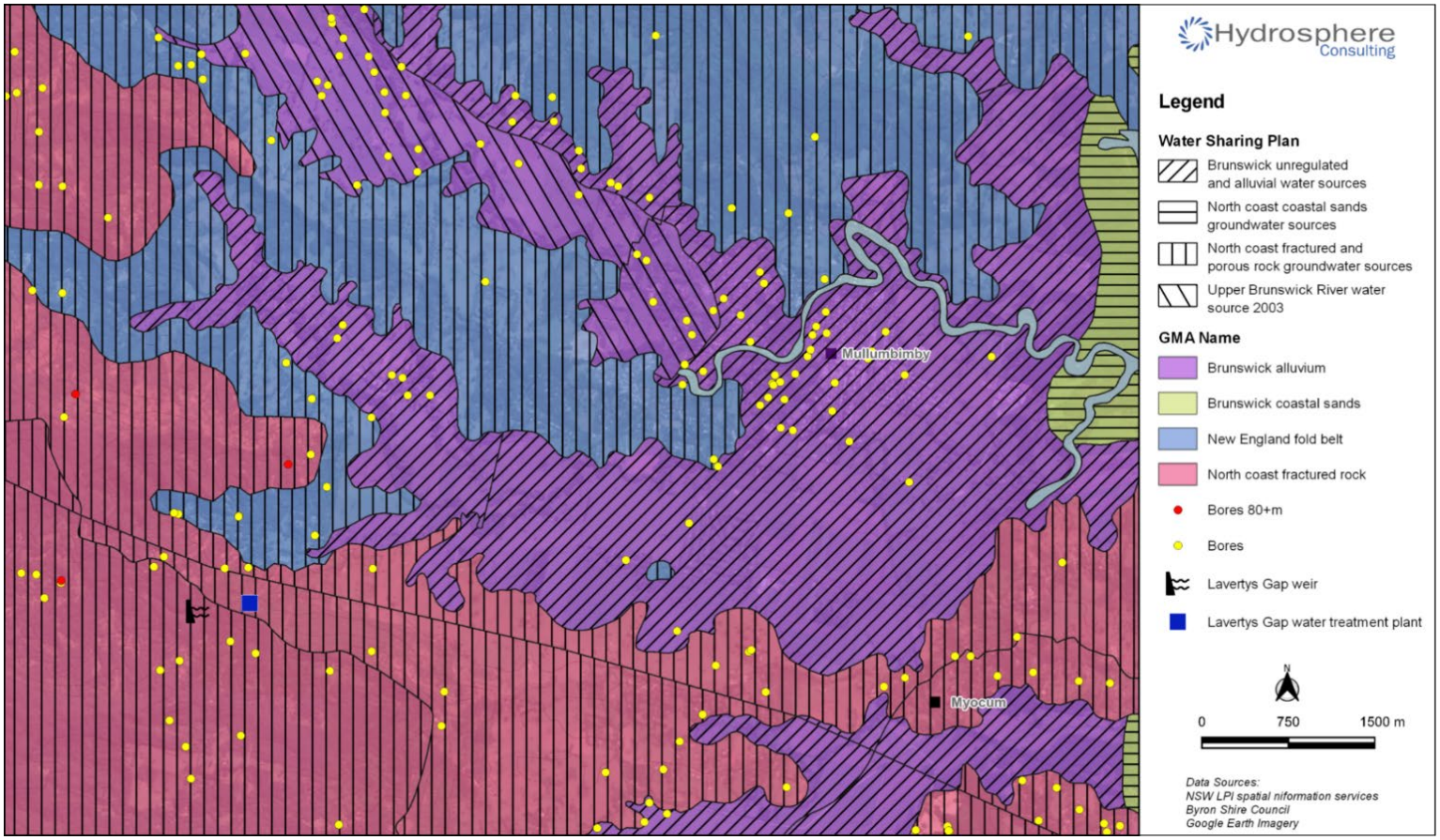

Figure 59: Water sharing plan areas and registered bores

12.5.5 Potential Environmental Impacts

The following potential environmental impacts would need to be taken into consideration for the extraction of groundwater:

- Extracting groundwater has the potential to impact GDEs such as wetlands that rely on spring or seepage water, terrestrial ecosystems that utilise water from shallow aquifers and aquatic and riparian ecosystems whose surface water supply is fed by groundwater. GDEs would be identified through a desktop exercise with all known records of GDEs from known databases, GIS records and other studies. Impacts on GDEs have not been assessed but it has been assumed that bore locations can be selected to minimise impacts.
- Acid sulphate soils are a potential concern for coastal sand aquifers.
- Contaminated lands (e.g. industrial sites, landfill, cattle dips and sewage disposal areas) have the potential to impact groundwater quality. Sites that are particularly at risk of contaminated groundwater are sites within urban areas with a shallow water table and permeable soils. Sites selected for groundwater investigation would need to be assessed for contamination.

12.5.6 Considerations for further investigation

Based on the preliminary desk-top investigations, the North Coast Volcanics (fractured rock groundwater source) is recommended for further investigation. The following factors will need to be considered if this option is considered further:

- Potential bore location - this will need to consider land ownership and acquisition, heritage constraints, local geology and environmental constraints. Once potential bore locations have been identified, test bores may be established and samples taken to determine the yield, salinity and other parameters of concern for drinking water supply.
- Licensing and legislative requirements.
- Infrastructure requirements - raw groundwater transfer, level of treatment required and distribution to the reservoirs.

12.5.7 Secure yield

There is currently no guidance on the assessment of secure yield of groundwater supplies with climate change. The yield of the bores is assumed to be influenced by rainfall. The reduction in annual rainfall with 1ºC warming indicated by the GCM data is 10% (on average) and this has been assumed to be the reduction in yield experienced at 2060. A current groundwater yield of 1.1 ML/d is required to achieve the future yield requirements (supplementing the weir supply to meet the 2050 demand). A groundwater supply with a yield less than 1.1 ML/d could be utilised if Council was to continue reliance on the RCC emergency supply. Higher groundwater yields would reduce reliance on the weir supply and increase the security of the groundwater option.

The secure yield of the water supply system with supplementary groundwater supply of 1.1 ML/d constructed by 2028 is shown in Figure 62.

Table 50: Secure yield estimates - groundwater (1.1 ML/d)

Secure yield (ML/a) for historic climate	Secure yield (ML/a) for 1°C warming[1]
408 (1.1 ML/d)	367

1. The climate change factor calculated for a groundwater supply with climate change is assumed to be 0.9 (based on a 10% reduction in rainfall).

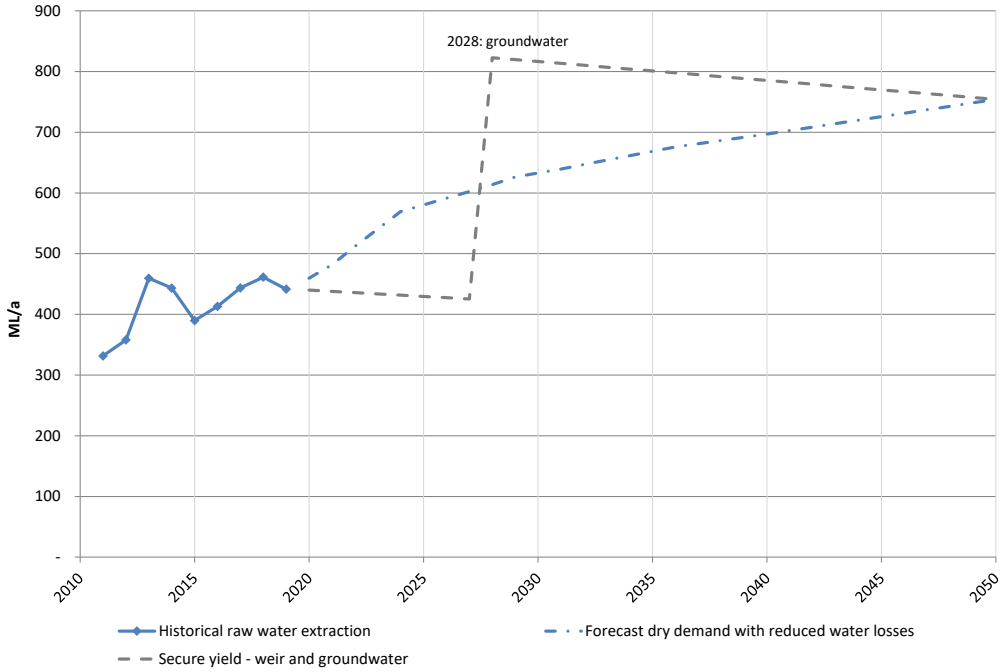

Figure 60: Secure yield with groundwater

12.5.8 Cost Estimates

The cost estimates for the groundwater supply option are shown in Table 51 based on cost estimates prepared for groundwater schemes for the RCC Future Water Project 2060 (Jacobs, 2020) for new bores in fractured basalt aquifers at Alstonville (2.5 ML/d), modified to reflect the reduced capacity. Groundwater treatment costs have not been included as it has been assumed that high level treatment (e.g. to remove salinity) will not be required. Costs associated with the raw water supply upgrade or new WTP are not included but will be addressed in scenarios where this would be required (Section 13).

Table 51: Cost estimate - groundwater supply

Item	Cost estimate (2025 $)
Capital cost	$6,442,000
Operation and maintenance	$241,000 p.a.

The cost of groundwater collection, treatment and distribution will vary depending on water quality, the yield and location of the bore/s and whether or not the water will be treated at the existing WTP or if new facilities need to be established.

12.6 Comparison of Options

The water supply options are compared below in Table 52 on the basis of yield benefit, infrastructure requirements, environmental and social outcomes. Community consultation was not undertaken as part of this assessment.

All options will require upgrade of the WTP (at least short-term improvements). All options apart from Option 4A - permanent connection to regional supply also require upgrade of the raw water supply from the weir and a new WTP.

Table 52: Comparison of options

Option		Description	Yield at 2050 and security	Other infrastructure required	Environmental	Social	Conclusion
1	Base case	No raw water supply upgrade. Emergency response actions will include water carting to service higher areas of town (in addition to the Rous emergency supply) as an interim measure until the emergency supply extension is completed.	560 ML/a (yield of weir and emergency supply). Secure until 2027.	Upgrade of raw water supply from weir. WTP upgrades (short-term). WTP replacement/ relocation. Heritage management requirements for current scheme.	No change	It is likely that restrictions will be imposed more frequently than at present and the weir supply will be depleted in a prolonged drought, requiring emergency measures including water carting to higher areas of Mullumbimby. Heritage management measures are required for continued use of the channel. Trunk main customers would not be served when the weir supply fails.	The supply is secure until 2027 (with additional emergency response actions potentially required). This option will be maintained for the short-term until augmentation options are implemented.

Option		Description	Yield at 2050 and security	Other infrastructure required	Environmental	Social	Conclusion
2	Raise Lavertys Gap weir	Raise Lavertys Gap weir by 5 m to provide additional storage of 322 ML.	632 (increase of 62 ML/a). Secure until 2035.	Upgrade of raw water supply from weir. WTP upgrades (short-term). WTP replacement/ relocation. Heritage management requirements for current scheme.	Environmental flow provisions are assumed to be required. With the environmental flow rule assessed, environmental flow releases are substantially lower than the overflows that occur at present (with the lower weir) although flow rules could be optimised. Loss of terrestrial biodiversity including remnant native forests, listed ecological communities and threatened species. Biodiversity offsets would be required. Decrease in diversity of aquatic species. Fishway or equivalent offsets is assumed to be required.	No identified impacts on Aboriginal cultural heritage. Heritage requirements for the weir (listed on State Heritage register) have not been considered. Heritage management measures are required for continued use of the channel. Restrictions and emergency response measures will still be required with the 5 m weir raising and environmental flow regime.	Although the environmental flow regime could be optimised to improve environmental outcomes, the yield benefit of this option is minimal (and expected to be further reduced with improved environmental flows) and costs are high. Impacts on terrestrial biodiversity are expected to be significant. Not recommended for further consideration.

Option		Description	Yield at 2050 and security	Other infrastructure required	Environmental	Social	Conclusion
3	Off-stream storage	Nominal 200 ML off-stream storage (location to be determined). Additional storage may be required to offset flow releases through the fishway.	879 (increase of 319 ML/a). Secure until 2060.	Upgrade of raw water supply from weir and extension to off-stream storage site. WTP upgrades (short-term). WTP replacement/ relocation. Heritage management requirements for current scheme.	Minimal impact on terrestrial ecology. A fishway at the weir or equivalent offset is expected to be required similar to the weir raising option. As environmental flows would be achieved through overflows from the current weir, additional environmental flow releases have not been assumed although further consultation with regulatory stakeholders is required to confirm requirements.	No identified impacts on Aboriginal cultural heritage associated with new infrastructure. Land would be acquired for the storage and would result in potential loss of farmland. Trunk main customers would require an alternative potable water supply arrangement.	A 200 ML storage is expected to provide significant yield benefit but at high cost. Environmental and social impacts are expected to be manageable. Recommended for further consideration to augment the weir supply.
4A	Permanent connection to RCC regional supply	Extend RCC emergency supply main to Azalea Street reservoir and convert to a permanent supply from RCC bulk water supply	754 (equivalent to demand) (increase of 194 ML/a, limited by RCC supply). Long-term security.	WTP upgrades (short-term). Heritage management requirements for current scheme.	Minimal impact as construction would be limited to road reserves in urban areas.	Mullumbimby residents consider that a loss of local identity would result from connection to the regional supply. Trunk main customers would require an alternative potable water supply arrangement.	The permanent regional connection provides virtually unlimited yield benefit. Environmental and social impacts are expected to be manageable. Further consideration is recommended.

Option		Description	Yield at 2050 and security	Other infrastructure required	Environmental	Social	Conclusion
4B	Full emergency connection to regional supply	Extend RCC emergency supply main to Azalea Street reservoir and emergency supply to all urban areas.	754 (equivalent to demand) (increase of 194 ML/a, limited by RCC supply). Long-term security.	Upgrade of raw water supply from weir WTP upgrades (short-term). WTP replacement/ relocation. Heritage management requirements for current scheme.	Minimal impact as construction would be limited to road reserves in urban areas.	It is likely that restrictions will be imposed more frequently than at present and the weir supply will be depleted in a prolonged drought. Trunk main customers would require an alternative potable water supply arrangement.	The supply is secure until 2027. It is recommended that this option is further considered for implementation in the short-term until other augmentation options are implemented.
5	Groundwater	Construction of new bores (one production, one standby) in fractured basalt aquifer (1.1 ML/d). Higher yields (if available) would reduce reliance on the weir supply.	754 (equivalent to demand) (increase of 194 ML/a). Secure until 2050.	Upgrade of raw water supply from weir. WTP upgrades (short-term) and replacement/ relocation. Groundwater distribution and treatment infrastructure. Heritage management requirements for current scheme.	Impacts have not been assessed but it has been assumed that bore locations can be selected to minimise environmental impacts.	Impacts have not been assessed but it has been assumed that bore locations can be selected to minimise impacts on other water users. Servicing of trunk main customers from the groundwater supply would depend on location of bores and groundwater treatment plant. An alternative potable water supply arrangement may be required.	A groundwater supply can be used as an emergency supply or a permanent supplement to the weir supply. Further consideration is recommended.

12.7 Additional Upgrade Requirements

12.7.1 Effluent reuse

Currently sewage from Mullumbimby is being treated at the Brunswick Valley sewage treatment plant (STP) and some of it is reused for agricultural irrigation. There are further opportunities to reuse effluent via direct reuse by connecting properties to a dual reticulation system, allowing reused water to partially substitute the potable supply to the properties.

Brunswick Valley sewerage treatment system

The Brunswick Valley STP comprises of a 3-stage Phoredox (oxidation ditch with anaerobic pre-reactor) tertiary treatment plant. Following treatment, the effluent is delivered to the Main Arm Recycled Water Scheme via the Mullumbimby recycled water facility storage lagoon and chlorine dosing unit. Recycled water is used on two farms for pasture and fodder irrigation. The remaining treated effluent is discharged to the Brunswick River on the ebb tide. The Main Arm recycled water scheme has the capacity to recycle 100% of the effluent produced at the Brunswick Valley STP and currently recycles 80% of the STP inflows (BSC 2017). The demand for the reused water fluctuates and is dependent on factors such rainfall and soil moisture content.

The *2017-2027 Byron Shire Effluent Management Strategy* (BSC, 2017) proposes that future treated effluent is used for further rural applications and a proposed sustainability project that would involve constructed wetlands, biomass cropping and renewable energy production including solar farming and co-generation (BSC, 2017). The strategy considered that the development of an urban reuse scheme was not the most beneficial reuse option due to the low volumes of recycled water expected to be used within the town.

Council is currently planning transfer of the sewage from Ocean Shores STP to the Brunswick Valley STP to address capacity issues at Ocean Shores STP, wet weather flow issues experienced in Mullumbimby and provide flexibility to the system including enhancement of reuse capacity as well as the capture and treatment of storm flows.

Recycled water planning

Currently, the demand for the available recycled water resource in Byron Shire has not matched supply resulting in the discharge of highly treated wastewater to the environment. This is regarded as a lost opportunity to utilise this resource. Recent drought conditions in the region have highlighted the community's desire for the use of recycled water as part of a portfolio of water sources to secure the region's future water supplies and its resilience to future droughts and climate change. Council is currently reviewing its recycled water strategy (BSC, 2017), taking a more proactive approach to harness the potential of recycled water to deliver broader community outcomes, while also maintaining the original focus of protecting waterways from effluent discharge and supporting environmental flows.

Council commissioned the Water Sensitive Cities Institute (WSCI) to develop an evidence-based urban water metabolism framework to support integrated urban water management decisions. 'Urban water metabolism' evaluation provides a big-picture perspective of urban water performance based on the concept of urban metabolism which has been operationalised to evaluate material and energy flows through urban areas and specifically adapted for evaluating urban water performance. The evaluation generates a

comprehensive account of all flows of water (natural and anthropogenic) between an urban area and the supporting environment to produce an urban water mass balance, from which indicators of water metabolism performance are derived. These indicators relate to metabolic aspects such as water efficiency, degree of supply internalisation, and the extent to which natural hydrological flow are altered (Renouf, *et al*., 2018).

The urban water metabolism evaluation project included (WSCI, 2020):

- Conceptual water mass balances for Mullumbimby to define the urban system boundaries to be applied for the township and identify the current urban water stocks and flows (including storages) and inter-connectivity.
- Numerical modelling of urban water mass balance.
- Identification of current and projected water cycle pressure points and short-, mid- and long-term drivers and associated strategies and actions for changes to the existing water cycle systems.
- Development of a long list of potential strategic management actions, in particular opportunities for recycled water, to address key stressors.
- Simulation of alternative future urban water cycle scenarios using the urban water metabolism evaluation approach.
- Evaluation of the economic costs and benefits of each scenario.

Based on the findings of this study, opportunities for potable water substitution including dual reticulation will be investigated.

Dual reticulation

Dual reticulation involves the construction of a recycled water pipeline which will supply recycled water from the Mullumbimby recycled water facility to future development areas for toilet flushing and garden use, open urban spaces such as sporting fields, parks, gardens, golf course, school ovals, public toilets, Council gardens and industrial users within the Mullumbimby township. The scheme would replace potable water sources with highly treated effluent that meets the criteria according to the *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006*, (AGWR). Council will consider the implementation of a dual-reticulation network to distribute fit-for-purpose recycled water as a focus for potable water substitution. To achieve this, the following opportunities will be pursued:

- Mandatory recycled water connections for all new residential developments (refer Section 8.4).
- Facilitation of an enabling environment for retrofitting recycled water connections into already established urban areas, with a focus on high water-using businesses on a voluntary basis.
- Maximising recycled water use for municipal purposes (including public spaces and amenities, green infrastructure, Council buildings, road works, standpipes etc.).

The current recycled water pipeline which delivers recycled water to rural customers at Main Arm could be extended and used as a recycled water reticulation system to deliver high quality treated effluent to greenfield and future development areas in the south and west of the township (Figure 63).

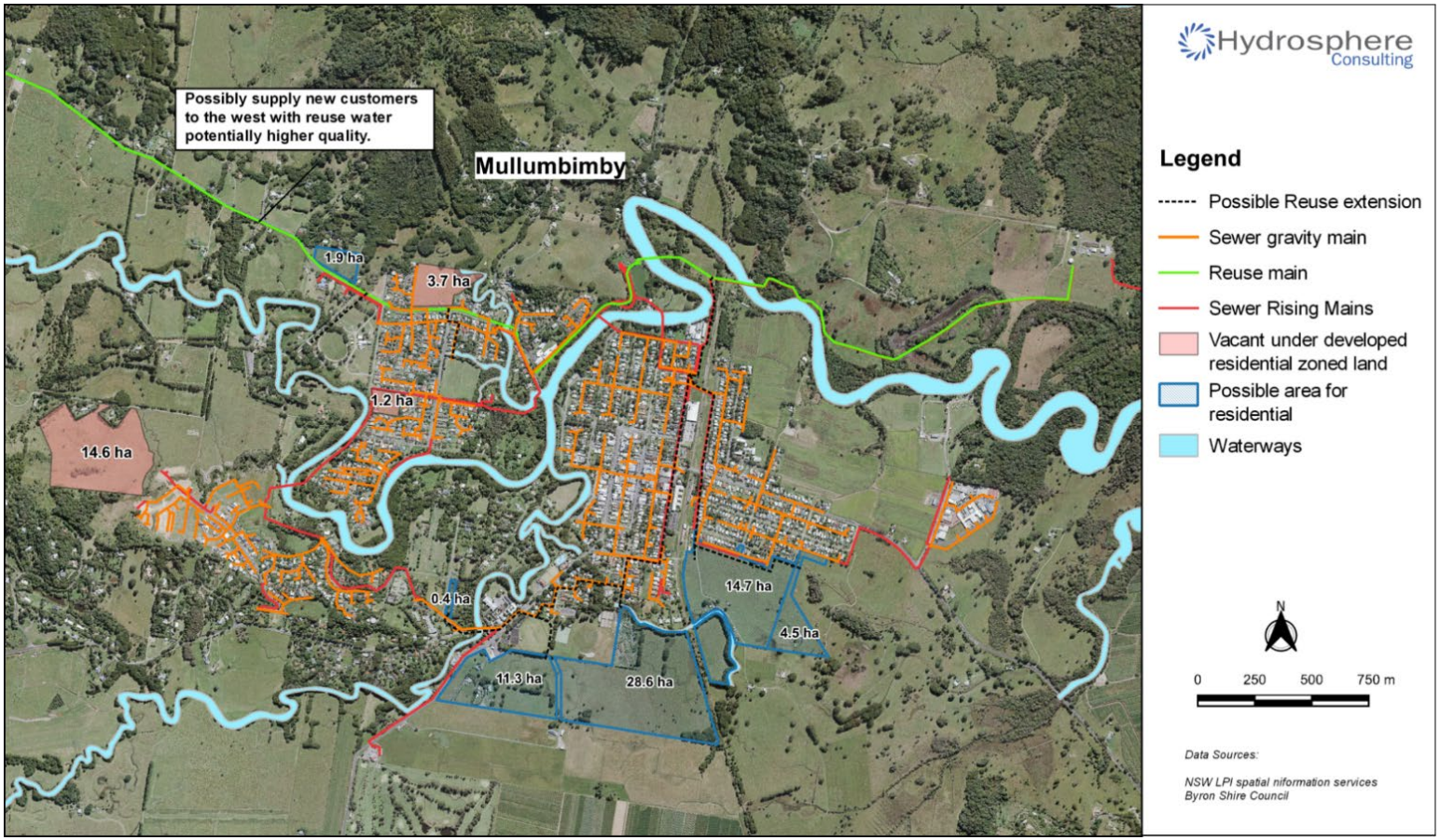

Figure 61: Mullumbimby sewerage network and possible reuse extension

12.7.2 Upgrade of raw water supply from the weir

The raw water channel is currently leaking and at risk of failure in several locations (Entura, 2018; Willow + Sparrow, 2020) as discussed in Section 6.2. Figure 17 (Section 5) shows that between 22/09/2019 and 24/12/2019 the weir level progressively dropped to a minimum level of 114.82 mAHD (1.34 m below the weir crest) despite a weir inflow of approximately 5 ML/d and an average WTP demand of 1.2 ML/d during the same period. Leakage is considered to be a significant component of this shortfall.

The GoldSim model has been used to assess the water level in the weir if channel leakage did not occur during the period September 2019 - December 2019. Figure 64 shows the modelled water level of the weir pool for this period and the theoretical water level assuming that the channel had not lost any water. This also assumes that restrictions were imposed in accordance with Section 3, the RCC emergency supply was used from 23/12/19 and the pump was used from 23/10/19 (mimicking the actual conditions). The channel would still have leaked until the stopboard was replaced in January 2020. The storage would not have been drawn down until the end of October when inflows reduced to an average of 0.93 ML/d (until the high rainfall experienced on Christmas day in 2019). Modelling suggests the water level would only have reduced to a level of 114.87 mAHD compared to 114.72 mAHD (15 cm higher). The weir level was not impacted by leakage once the water level fell below the channel invert. The volume of water lost to leakage over that time period was 301 ML or an average of 2.6 ML/d (Figure 65).

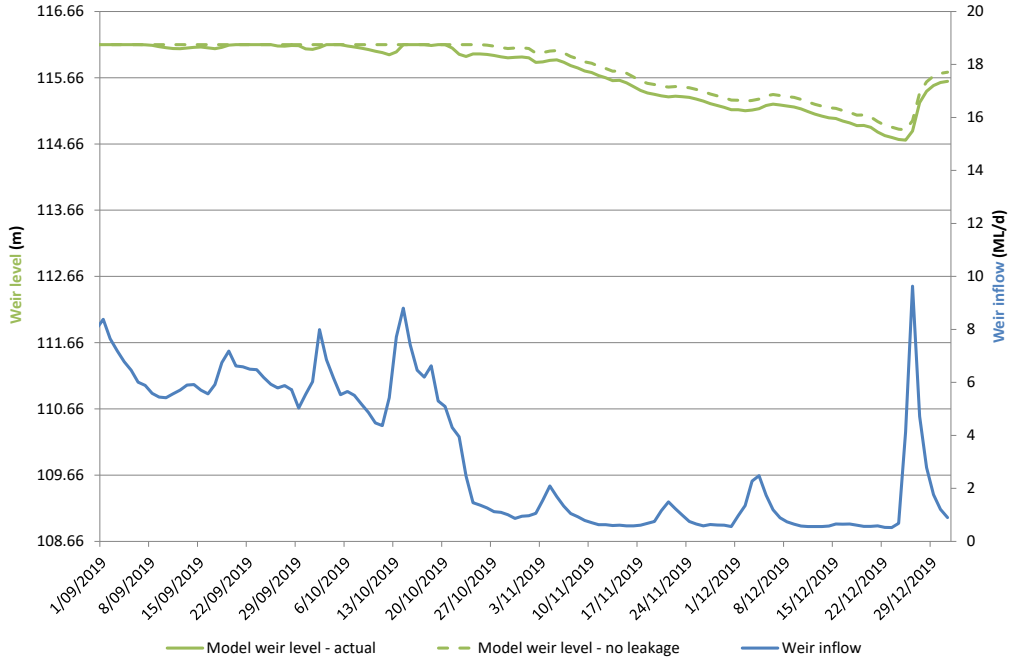

Figure 62: Weir level with no channel leakage

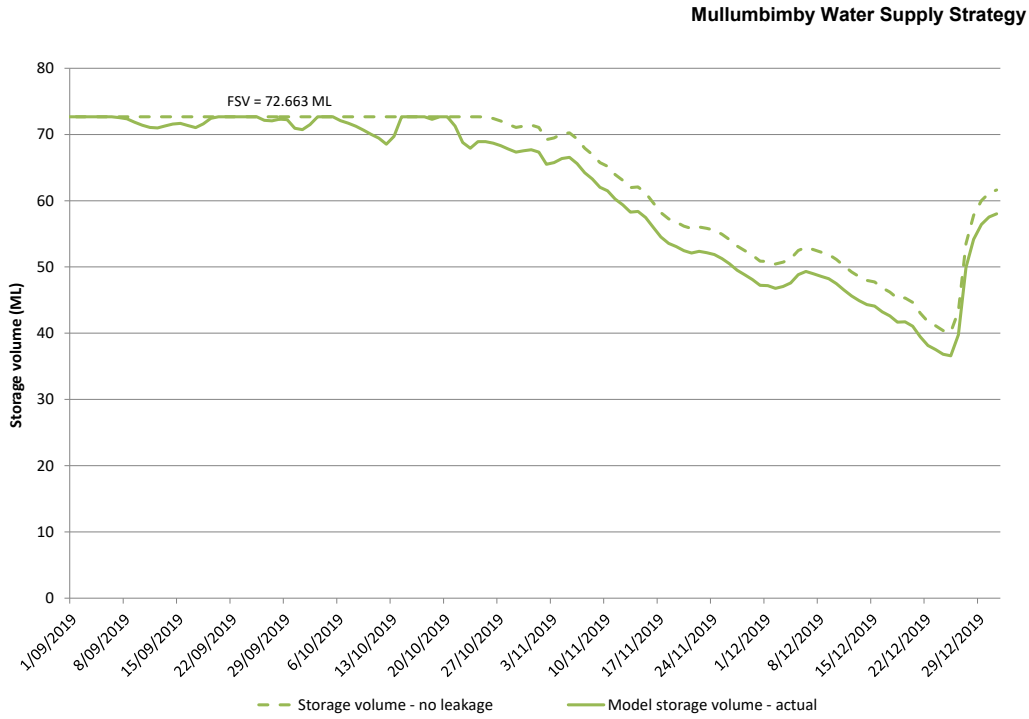

Figure 63: Storage volume with no channel leakage

Currently the downstream flow ceases when the water level falls below the level of the channel intake. Leakage from the channel acts as an environmental flow when the water level is above the channel intake. Downstream flows will be reduced when the weir is not overtopping which would occur when inflows are generally below water supply demand (currently 1.2 ML/d on average). Water available for downstream users will be reduced when the weir is not overtopping (during low inflows).

Raw water can also be pumped from the weir (at 15 L/s which is below peak demand) into the lower end of the channel with the stopboard (sluice gate) closed. A gravity pipeline delivers water from the lower end of the channel to the WTP. If the channel were to fail, raw water supply to the WTP will be compromised and the water level would fall to the channel invert level (approximately 860 mm below full supply level) which is similar to the level 3 water restrictions trigger. Given the serious consequences of channel failure and the increased extraction from the weir resulting from the current leakages, addressing this issue is recommended as a priority.

Willow + Sparrow (2020) identifies immediate works required for the raw water supply and considered the following options:

1. Refurbish and remediate the existing channel. This would require lining the channel to prevent leaking and water loss during drought seasons.

2. Replace the channel with a gravity feed pipeline along the existing channel alignment. This is a closed system that performs the same hydraulic function as the existing channel. This option is only of benefit if the existing channel is to be decommissioned.

3. New pumped pressure pipeline following the existing channel alignment. This option enables the hydraulic function of the channel to be retained, however the pipeline would need to be housed within the channel along certain sections.
4. New pumped pressure pipeline following an alternative alignment that is independent of the channel. The hydraulic function is similar to Option 3 however has additional pump pressure head demands. The channel would be retained under this option and operate in combination with the new main.
5. New pumped pressure pipeline following an alternative alignment with the inclusion of a header tank that enables gravity flow from the top of the hill to the WTP. This pipeline follows the same alternative alignment as with Option 4. Similar to Option 4, the channel would be retained under this option and operate in combination with the new main.

Options 1 and 2 are not recommended by Willow + Sparrow (2020) because of their impacts on the cultural heritage aspect of the channel and their inherent risks to Council. Heritage impacts are discussed further below. Of Options 3, 4 and 5, Option 4 (Figure 66) is recommended by Willow + Sparrow (2020) based on its balance of safe and secure supply and construction and operational cost. The capital cost of option 4 is estimated as $970,000 indexed to 2025$ (Willow + Sparrow, 2020). However, the operational cost of the new transfer system is likely to be high should it be relied upon to supply the WTP in lieu of the channel. Willow + Sparrow (2020) recommend that the pipeline is operated in conjunction with the channel. The benefits of operating both supply systems include:

- Low long-term operation costs.
- A completely independent and secure supply system.
- The channel retains its functionality.
- The supply channel can be taken out of service for maintenance while not interrupting supply to the WTP.
- The pipeline and booster pump station can be taken out of service without disrupting supply to the WTP.

The following tasks are required as part of the concept design for the transfer system:

- Heritage assessment be undertaken in conjunction with the environmental assessment and regulatory approval process.
- Investigation of the current WTP sludge tank processing and water quality testing of the supernatant water. Design an alternative arrangement to discharging supernatant water.
- Confirmation of design capacity.

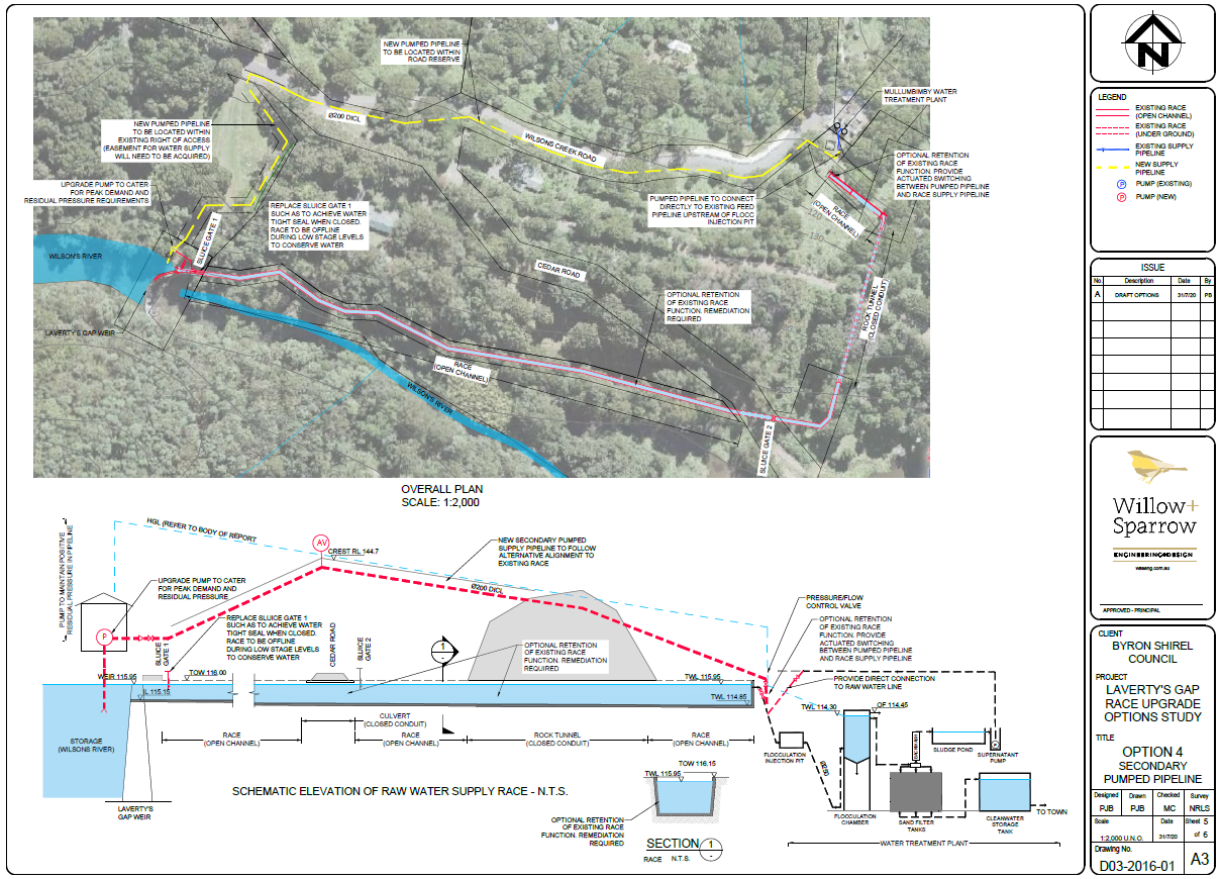

Figure 64: Preferred option for raw water transfer system upgrade

Source: Willow + Sparrow (2020)

The SoHI (Hill *et al*., 2021) assessed the impacts of the proposed options for upgrade of the raw water supply on heritage value. The options (Willow + Sparrow, 2020b) for an alternate pipeline which either substantially or completely removes the water supply from the channel (water race) have the least physical impact on the channel. Option 4 without the use of the channel (i.e. raw water always supplied via the alternate pipeline) is preferred provided the heritage value of the channel can be preserved (through adaptive reuse). The material changes on the water channel within the state significant site boundaries would be substantially avoided, however, it is anticipated that natural deterioration of weak spots in the channel would continue to breakdown and the erosion of surrounding soils will remain unmanaged and there is the potential for the channel to crack as a result. This may exacerbate further deterioration of weaker sections of the channel.

As a result of the heritage assessment, Hill *et al.* considered that an additional option should be considered which involves sole use of the alternate pipeline for the supply of water to the treatment plant. This option would reduce the load on the existing channel and reduce deterioration from water flows. The removal of the channel as a functional component of the water supply is preferred as it would allow for the removal of non-historical infrastructure associated with the water supply from the channel in the short term (crossings, fences, gates, pipes, valves etc), the requirements for maintenance and upgrades (leak sealing etc.) would be removed and this would provide opportunities for adaptive reuse in the medium to long term. The removal of the water supply infrastructure would have a positive benefit on the heritage values of the site and would provide an opportunity for a holistic planning process for the weir, water channel, treatment plant and generator sheds.

Standard Exemption clauses specified in the *Heritage Act 1977* would apply for works which do not have a significant material impact on the Heritage Item. Any form of adaptive reuse would need to be subject to an additional assessment.

12.7.3 Upgrade of water treatment plant

Several recommendations were made by CWT (2020) to upgrade the Mullumbimby WTP in the short term. The costs and priority for the short-term capital and operational upgrades are provided in Table 53 and Table 54. Other actions have also been recommended that will only require BSC labour to implement. The short-term upgrades in Table 53 and Table 54 are required regardless of the water supply augmentation scenario adopted.

Table 53: Required short-term WTP capital upgrades (2020 $)

Upgrade	High priority (1-2 years)	Medium priority (2-5 years)	Low priority (5-10 years)
General operation	$35,000	$210,000	-
Flocculation	-	$1,000	$20,000
Filtration	-	-	-
Supernatant return	$5,000	-	-
Chemical dosing	$49,000	$8,500	-
Chlorine dosing	$17,000	$5,000	
Clear water storage and chlorine contact time	-	$1,000	-

Upgrade	High priority (1-2 years)	Medium priority (2-5 years)	Low priority (5-10 years)
Totals	$106,000	$225,500	$20,000

Source: CWT (2020)

Table 54: Required short-term WTP operational upgrades (2020$)

Upgrade	Very high priority (< 6 months)	High priority (6-12 months)	Medium priority (1-2 years)
General operation		BSC labour	
Filtration	BSC labour	BSC labour	$19,000
Supernatant return		$12,000	
Chlorine dosing		$5,000 + BSC labour	
Clear water storage and chlorine contact time	BSC labour		$5,000
Distribution		BSC labour	BSC labour
Information management	BSC labour	$30,000	BSC labour
Totals	BSC labour	$47,000 + BSC labour	$24,000 + BSC labour

Source: CWT (2020)

12.7.4 Replacement of water treatment plant

The Mullumbimby WTP is regularly maintained but due to its age, it requires replacement in the next 5 - 10 years. Broad options for the future of Mullumbimby WTP were identified (CWT, 2020):

- Option 1 - Base case: The 'do nothing' approach would not meet the log reduction requirements and will lead to difficulty in meeting water quality targets in the medium - long term. The main risks associated with continued operation of the WTP are:
    - Work health and safety risks to operators within the plant and in chemical deliveries.
    - Risk of turbidity breakthrough/water quality risk.
    - Risk of failure due to ageing infrastructure.
    - Risk of spillage to the environment during chemical deliveries or from WTP.
- Option 2 - Refurbish the existing WTP including:
    - Addressing very high and high priority recommendations from Table 53 and Table 54.
    - Concrete remediation of flocculation tanks, filters, buildings, filter upgrades, potential upgrade of media design to dual media, addition of UV to meet log reduction requirements based on the health-based targets and automation/SCADA upgrade.
    - Log reduction requirements may be difficult to meet with a refurbished WTP in the long term.
- Option 3 - Construct a new WTP at the existing site or on a new site.

- Option 4 - Decommission the WTP and permanently connect to the regional bulk water supply (refer discussion in Section 12.4).

The preferred option for continued operation of a WTP at Mullumbimby is Option 3 - replacement of Mullumbimby WTP. Options 1 and 2 are not recommended based on the age of the existing WTP, the condition of the process units and the need to maintain components of the WTP to retain heritage value (CWT, 2020).

Potential options for the site of the new WTP include:

- Existing WTP site.
- At Lavertys Gap weir.
- Near the weir (towards Wilsons Creek Road).
- Along the raw water channel near Cedar Road.
- At the power station.
- A site in the vicinity of Yankee Creek Road/Wilsons Creek Road.

The new WTP is assumed to have a capacity of 3.9 ML/d. Further investigations are required to determine the requirements, process and preferred site of the new WTP:

- Peak demand analysis to confirm the required capacity of the plant.
- Site investigations to determine the preferred WTP site.
- Options assessment to determine preferred treatment process for the new WTP.
- Concept design and technical specification for preferred process.

The cost for a new 3.9 ML/d WTP is estimated at $9.1 million (2025$), not including land acquisition, engineering, approvals, heritage studies, project management and contingencies (CWT, 2020). While a new WTP is being designed and constructed, Mullumbimby WTP should be maintained and operated to consistently deliver microbially safe water. This includes addressing at minimum, the short-term upgrades in Table 53.

12.7.5 Trunk main customers

Approximately 13 customers along Wilsons Creek Road are connected to the trunk main and supplied with potable water from the WTP (Figure 10). All options except Option 4A (permanent connection to RCC regional supply) involve relocation of the WTP. This relocation is considered likely due to the site constraints at the current WTP site, require consideration on long-term supply for these customers. If a new WTP was constructed, these customers may continue to be serviced by a potable supply from a new WTP, however the feasibility of this would depend on the location of the new WTP and customer preference. Trunk main customers would not be served by the regional supply connection to the Azalea Street reservoirs (Options 4A and 4B) and an alternative potable water supply arrangement would be required.

An assessment of the existing assets has been undertaken and options for servicing the trunk main customers have been developed (Willow + Sparrow, 2024). Most of the customers can be served by reversing the flow from the Left Bank reservoir using the existing pipeline from the WTP. The remaining

properties at higher elevations are expected to require individual booster pumps. Pipeline modifications may be required to ensure suitable detention times and residual disinfection.

12.7.6 Implications of the reinstatement of the Hydro-electric power station

In 2018 a prefeasibility study was conducted which considers the reinstatement of a hydro-electric power plant at the Lavertys Gap weir (Entura, 2018). The mini-hydro-electric power station was commissioned in 1926 and was operational until 1989. The study concludes that there is potential to reinstate the mini-hydro scheme providing that a suitable water licence can be obtained to allow water to be transferred from the Wilson's Creek catchment to the Yankee Creek catchment. According to the study, the scheme would utilise up to 44 ML/day requiring approximately 7,874 ML/a of water which would be released into the Yankee Creek. If the project were to proceed it would only be able to extract water from Lavertys Gap weir that is surplus to the water required for the by Mullumbimby water supply. Upgrade of the water supply channel would also need to be considered.

13. SCENARIO DEVELOPMENT AND ASSESSMENT

13.1 Supply Scenarios

Supply scenarios have been developed from combinations of options that achieve the required secure yield over the long-term (754 ML/a, an increase of 377 ML/a at 2050). All scenarios include the following common components in the short-term:

- Continued use of the weir supply and Mullumbimby WTP.
- Short- term WTP upgrades to ensure consistent supply of microbially safe water.
- Extension of the RCC emergency bulk water supply connection to service all Mullumbimby water supply customers to be used as a secure emergency response measure when required to supplement the weir supply (Option 4B).
- An increase in the Lavertys Gap weir licence extraction limit (likely to be required from 2023 unless an alternative source is implemented).
- Review and update of the drought management plan based on the performance of the supply and drought management regime during the recent drought.
- Implementation of the demand management measures in the RDMP.
- Water loss reduction measures.
- Continued investigation of the long-term impacts of climate change on the secure yield of the weir supply.
- Resolution of the heritage management requirements for the weir, channel an WTP.
- Development of potable supply options for the trunk main customers.
- Continued identification and implementation of urban effluent reuse opportunities (future demand will be reduced with potable water savings and yield deficit will be reduced accordingly).

The weir supply is at risk of failure during prolonged drought and/or structural failure of the raw water channel to the WTP. Therefore, all options also include full emergency connection to the regional supply (extension of the pipeline to service all areas of Mullumbimby) included as an emergency response measure to provide scheme resilience. Without this, there is a risk that the higher elevation areas of Mullumbimby will not be serviced by a water supply and water would need to be carted to these areas. Until the pipeline extension is completed, the predicted water carting demand would be 250 kL/d (10-20 tanker loads each day). No other suitable emergency response measures have been identified (Section 12.1.1).

Servicing of trunk main customers is yet to be resolved for all options. Council will consult with these customers as part of the assessment of supply options.

The following scenarios have been developed:

- Scenario S1: Base case: Improvements to the existing raw water transfer system, a new WTP and full emergency connection to the regional supply. This scenario would provide secure yield until 2027. Beyond 2027, restrictions may become more frequent and/or more severe.

- Scenario S2: Off-stream storage: Improvements to the existing raw water transfer system, full emergency connection to the regional supply, construction of a 200 ML off-stream storage, fishway and new WTP. High stream flows would be transferred to fill the off-stream storage. Water from the storage will be treated at the new WTP and transferred to the township.
- Scenario S3: Permanent connection to RCC regional supply: In this scenario, Mullumbimby would form part of the RCC regional supply network with bulk treated water transferred to the Azalea Street reservoirs.
- Scenario S4: Supplementary groundwater: Improvements to the existing raw water transfer system, a new WTP, full emergency connection to the regional supply, construction of new bores to the south-west of Mullumbimby with raw water transferred either to the weir or the new WTP for treatment and distribution to the township.

Scenarios S1, S2 and S4 are all local scenarios as they rely on local infrastructure to service Mullumbimby. No local options have been identified for Mullumbimby that do not require major infrastructure solutions. Scenario S3 is a regional scenario fully relying on the Rous regional water supply.

The scenarios are illustrated on the following figures and Table 55.

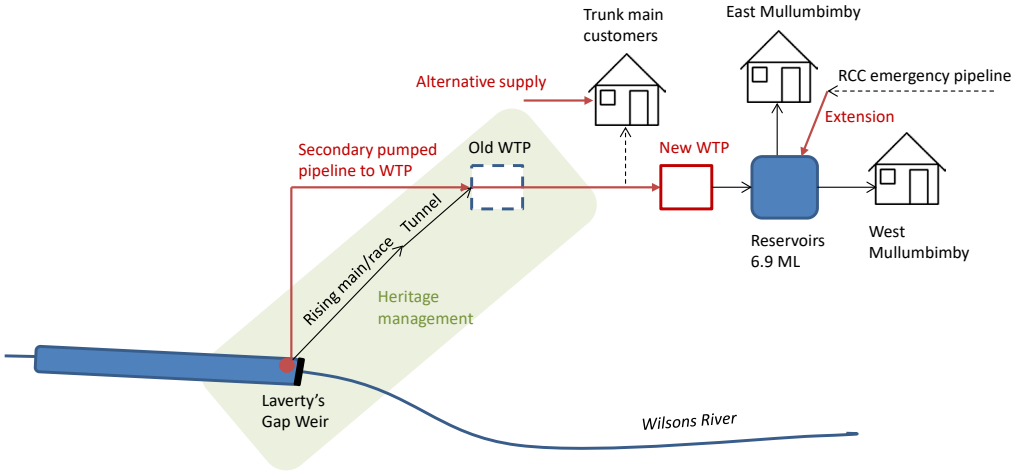

Figure 65: Scenario S1: Base Case

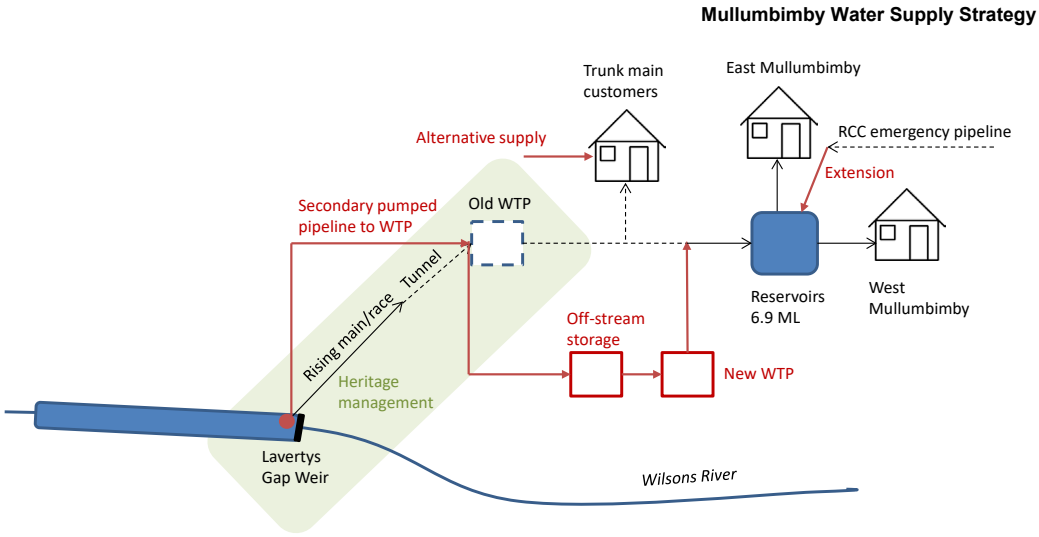

Figure 66: Scenario S2: Off-stream Storage

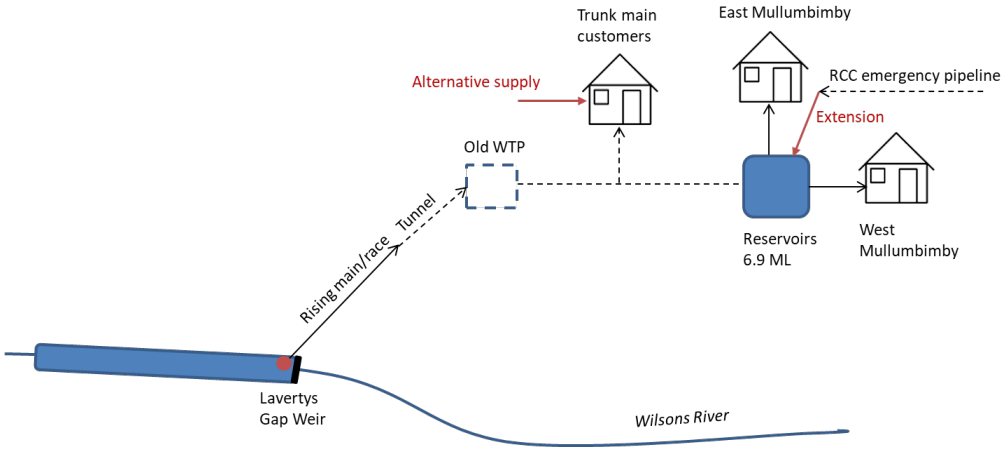

Figure 67: Scenario S3: Permanent connection to RCC regional supply

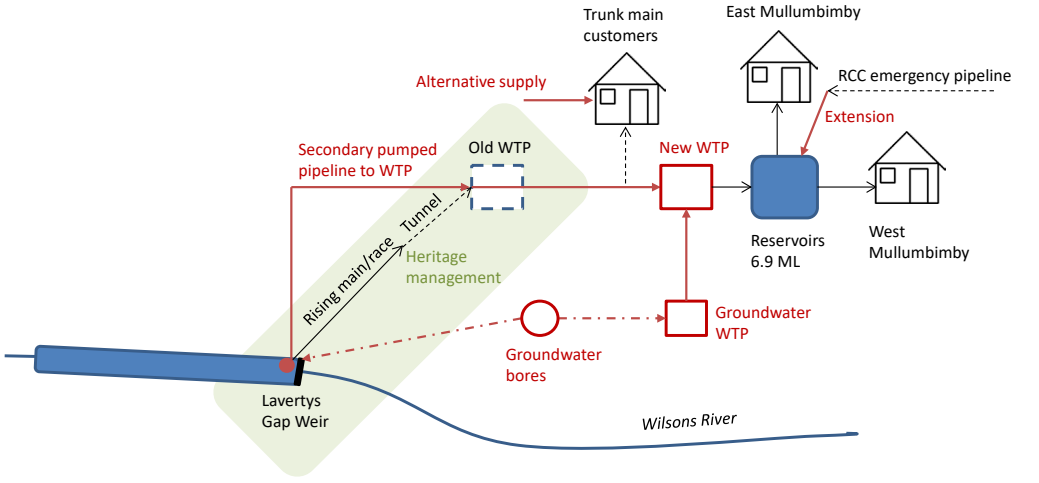

Figure 68: Scenario S4: Supplementary groundwater

Table 55: Water supply scenarios

Scenario	S1	S2	S3	S4
Upgrade raw water transfer system from weir[1]	✓	✓		✓
WTP relocation and replacement	✓	✓		✓
Fishway		✓		
Option 1 – Base case	✓			
Option 3 - Off-stream storage		✓		
Option 4A - RCC (permanent)			✓	
Option 4B - RCC (emergency extension)	✓	✓	✓	✓
Option 5 - Groundwater				✓

1. The preferred option to upgrade the raw water transfer system from the weir (for S1, S2 and S4) is a new pumped pressure pipeline following an alternative alignment that is independent of the channel.

13.2 Scenario Comparison

13.2.1 Methodology

The scenario comparison methodology used in this project has been developed with consideration of the comparison of options (Section 12.6) 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 56.

Table 56: 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	Energy requirements	Operational energy consumption (comparative).
Social		
Community acceptance	Predicted community acceptance	The outcomes of community consultation were not available at the time of the TBL assessment.
Security of supply	Year of augmentation required (following implementation of the scenario)	Secure yield assessment of each option.

Criteria	Description	Information used
Economic		
Net present value (NPV)	NPV of capital and operating costs (30 years) at 5% discount rate.	Estimated capital and operating costs.
Life-cycle cost (30 years)	Total cost over 30 years	Estimated capital and operating costs.

A weighted score (higher is better) 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.

13.2.2 Environmental Criteria

Terrestrial and aquatic biodiversity impacts have been assessed using the available information as summarised in this report. A summary of impacts on hydrology and ecology for each scenario is provided in Table 57. All surface water options (Wilsons Creek extraction for S1 and S2 and Rocky Creek extraction for S3) rely on existing river regulation (weir/dam) and extraction from the Richmond River system.

Surface water supplies require major infrastructure that results in significant direct impacts at the infrastructure site, interruption of longitudinal fauna passage by instream structures, large-scale inundation of terrestrial and riverine habitats as well as alteration of downstream flow regimes. Following the initial impacts of dam construction and filling, an altered ecology will establish within the storage area and the downstream ecosystem will eventually equilibrate to the changed hydrological regime. Despite the inevitable colonisation of new habitats by new biota, it is often the case that the species which originally utilised the site can no longer persist and therefore a shift in the species assemblage is likely to occur. This often results in the loss of local native species. Despite the significant initial impacts, once established, the incremental environmental cost of increasing the extraction from a large instream dam is relatively low, providing that there is not continued reduction in any environmentally significant downstream flows. In contrast, the construction of a new storage, or raising of an existing smaller storage, has significant additional environmental impact and should generally only be considered when a large increase in yield is required.

To reduce overall environmental impact, the utilisation of existing water infrastructure (within sustainable limits) should be considered in preference to the exploitation of new resources. The connection to the RCC bulk supply system provides the opportunity to utilise existing dam/treatment infrastructure and reduce the potential for over-extraction from the Wilsons River at Lavertys Gap. It is recognised that the RCC regional water supply also requires augmentation due to the reduction in yield that will result from climate change and predicted growth in the existing regional supply area. The RCC bulk water supply system requires future augmentation with or without the permanent connection to Mullumbimby and S1 and S3 will only incrementally increase any impacts of the regional supply. S1 (with the existing emergency supply) represented approximately 0.1% of the total regional demand in 2019/20, whereas S3 (with permanent connection) would be approximately 4.7% of the total regional demand by 2030 and 5.0% by 2050. As a

result of this minor increase in demand, the Rous system would continue to operate within the approved operational parameters for the system.

The harvesting of flood flows and utilisation of off-stream storages is often regarded as a viable strategy for surface water extraction. Typically, this results in the preservation of the low-flow hydrological regime downstream, with a relatively small proportion of the highest flows being affected. Whilst this may have geomorphological implications due to reduction of scouring flows, and hence long-term effects on downstream habitats, the impact on instream waterways can be minimised. If a suitable site, with minimal inherent environmental values can be used for the off-stream storage, the ecological impacts of S2 can be minimised. Other environmental factors such as water losses (due to evaporation), pumping costs/ energy/ carbon emissions, loss of agricultural land etc. become more important.

Scenarios relying on groundwater supplies (S4 – potentially a local fractured rock groundwater supply and S3 – proposed future coastal sand aquifer supply at Tyagarah as part of the regional water supply) have the potential to impact on GDEs. However, these impacts are expected to be adequately managed through site selection and extraction regimes, although this needs to be undertaken with a clear understanding of the aquifer hydrology and the degree of connectivity to GDEs. The environmental response of aquifers and GDEs to extraction can be long-term, hence the impacts of over-extraction tend to be masked and more difficult to detect in monitoring. For this reason, it is prudent to build groundwater extraction schemes incrementally to ensure that there is time to detect impacts on GDEs and adjust extraction accordingly. Any impacts on the terrestrial environment at groundwater extraction sites are expected to be adequately managed through site selection.

The predicted impacts on the aquatic and terrestrial environment for all four scenarios are similar in magnitude. The dominant impacts are largely related to the existing water supply arrangements and are not expected to be significantly altered with ongoing use of these supplies. The impacts of proposed system augmentation to achieve secure yield requirements (off-stream storage in S2 and groundwater in S3 and S4) are also expected to be adequately managed.

While limited environmental investigations have been undertaken, the predicted impacts on biodiversity for each scheme are low and impacts are considered to be manageable for each scenario. Actions to reduce these impacts (e.g. an environmental flow regime and terrestrial biodiversity offsets) will be developed for each local scenario where required and suitable measures will potentially be put in place to obtain planning approval and ensure stakeholder acceptance of each scenario although detailed investigations and consultation are required to confirm this. RCC is responsible for the offset of biodiversity impacts for the regional scenario (S3) and is incorporating these considerations in the development of the groundwater supply options.

In terms of energy consumption, the most favourable option is the regional scenario (S3) as no additional energy consumption would be required. The energy requirements for the other scenarios including pumping systems, bores, aeration system and WTP operations as relevant.

There has been no assessment undertaken of the cumulative impact of the options for Mullumbimby involving connection to RCC supplies, however it is considered that connection to a regional water supply scheme would result in lower environmental impact than development of an additional local supply source and infrastructure in Mullumbimby. In addition, reduced extraction from Lavertys Gap weir and potentially

taking the weir out of service may improve environmental outcomes for the Wilsons River system over the long-term. Other beneficial uses of the weir may also be identified by Council.

The environmental benefits of centralisation of water supplies and regional interconnection were recognised in a previous study undertaken by NOROC (Hydrosphere Consulting, 2013) which noted that the development of significant infrastructure raises extensive planning and approval challenges and a regional approach allows access to a wider range of options to improve environmental outcomes.

As the environmental impacts of the four scenarios are expected to be adequately managed, assessment of the scenarios focused on security of supply and economic considerations (refer Sections 13.2.3 and 13.2.4).

Table 57: Summary of environmental impacts of each scenario

Option	Supply source/s	Entitlement	Storage	Hydrology and environmental flows	Aquatic ecology	Terrestrial ecology
S1: Base case	Lavertys Gap weir, Wilsons Creek (existing)	535 ML/a (increase required from 2023)	73 ML	The weir impacts on all flow components in Wilsons Creek, except for the highest flood flows. Inflow to the weir storage is generally high and the weir frequently overflows to Wilsons Creek. However, during low rainfall, inflows are significantly reduced and the weir level falls below the crest. As there is no environmental flow release (not a requirement of the licence), there is no dedicated flow downstream of the weir when the water level is below the weir crest. These conditions have been in place since the weir was constructed in the 1920s. However, leakage from the raw water channel to Wilsons Creek downstream of the weir in more recent years would have provided some minor flow. During the drought of 2019/20, there was no downstream flow for 118 days between September 2019 and February 2020. With climate change, the frequency and duration of droughts (and storms) is expected to increase.	Wilson's Creek is likely to support a diverse assemblage of both native and introduced fish species. Upstream migration is blocked by the weir and diadromous species (e.g. Australian Bass) would no longer be expected upstream of the weir. Although the weir pool is an altered habitat, the aquatic ecology is likely to have reached a new equilibrium given the age of the structure. Platypus (vulnerable) have been sighted within the vicinity of the weir. Platypuses require access to pool and riffle habitat as the major source of food and to firm banks for the construction of burrows and the nest used for rearing young. The ecology of the weir pool is vulnerable to over-extraction as significant drawdowns have the potential to dewater important shallow water habitats. The ecology in the weir pool and downstream has been modified by the weir but downstream fauna would rely on at least intermittent flows.	The weir pool is within a wider area of high natural biodiversity with both temperate and tropical species and a significant number of species that are endemic to the region. However, most of the vegetation surrounding the weir pool is dominated by camphor laurel with other weed species and rainforest remnants. The catchment includes rural developments including on-site sewage management systems, roads and waterway crossings which have impacted on terrestrial ecology through sediment and nutrient runoff. Continued use of the water supply is not expected to alter the terrestrial environment.

Option	Supply source/s	Entitlement	Storage	Hydrology and environmental flows	Aquatic ecology	Terrestrial ecology
S1: Base case (cont.)	Emergency Rous connection	0.5 ML/d (service level agreement)	-	Supplied from St Helena reservoir (Rocky Creek Dam and Wilsons River Source supply) – refer S3.		
S2: Off-stream storage	Lavertys Gap weir, Wilsons Creek (existing)	535 ML/a (increase required from 2023)	73 ML	High flows (i.e. above those flows that overtop the weir with allowance for environmental flows) would be transferred from the weir to fill the new off-stream storage. There would be a slight modification to the high flow regime downstream of the weir and low flows would be unchanged (with potentially long periods of no flow downstream) - refer S1.	Refer S1. Reducing the incidence or magnitude of peak flows has the potential to reduce geomorphic scouring downstream. Scouring is important to reduce stream bed siltation and maintain habitat structure. These impacts can be minimised through the design of a suitable extraction regime.	Refer S1.
	Off-stream storage		Nominal 200 ML			Potential locations for the off-stream storage reservoir are predominantly cleared grazing land. As such the construction of the dam is expected to have minimal impact on terrestrial ecology.

Option	Supply source/s	Entitlement	Storage	Hydrology and environmental flows	Aquatic ecology	Terrestrial ecology
S3: Permanent connection to RCC regional supply	Rocky Creek Dam, Rocky Creek (existing)	12,358 ML/a	14,000 ML	There are no provisions for environmental flow releases from the dam (not a requirement of the 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 (approximately 0.7 ML/d). These conditions have been in place since the dam was constructed in the early 1950s. The dam impacts on all flow components in Rocky Creek, except for the highest flood flows (> 500 ML/d). The dam spills very infrequently from late winter, through spring into early summer when the only downstream flow can be seepage through the wall (Hydrosphere Consulting, 2022b). The additional impacts resulting from the connection to Mullumbimby would not be significant as this would not result in any change to the operating regime.	Previous assessments have identified that there are downstream ecological impacts due to the dam and that these impacts are exacerbated by modified catchment conditions downstream of the dam. 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 (Hydrosphere Consulting, 2022b). The additional impacts resulting from the connection to Mullumbimby would not be significant.	The catchment is dominated by largely pristine forest protected within the Nightcap National Park and Whian Whian State Conservation Area. Catchment lands are managed by NPWS and RCC (Hydrosphere Consulting, 2021). Continued use of the water supply is not expected to alter the terrestrial environment. The pipeline route is expected to follow existing roads within urban areas of Mullumbimby and terrestrial impacts are expected to be minimal.

Option	Supply source/s	Entitlement	Storage	Hydrology and environmental flows	Aquatic ecology	Terrestrial ecology
S3: Permanent connection to RCC regional supply (cont.)	Wilsons River Source	5,400 ML/a	-	Environmental flow requirements are built into the water access licence pumping rules based on Wilsons River flows. Abstractions from the tidal pool cause changes to flow rates in the Wilsons River below the abstraction point creating a slight decrease in the volume/rate of low to moderate flows (Parsons Brinkerhoff, 2006).	The Environmental Impact Statement for the abstraction proposal (Parsons Brinckerhoff, 2006) concluded that the regime was not likely to have a significant impact on any species of conservation significance or on the survival of any species within the catchment.	The catchment has largely been cleared for cattle grazing, horticulture and urban development (Hydrosphere Consulting, 2021). Continued use of the water supply is not expected to alter the terrestrial environment.
S3: Permanent connection to RCC regional supply (cont.)	Tyagarah groundwater (proposed)	N/A	-	The groundwater source is a deep sandy unconfined aquifer with fresh rainwater recharge. Further assessment of hydrogeological impacts is required although the development of this groundwater source is considered likely to be feasible (Hydrosphere Consulting, 2022b).	Limited environmental investigations have been undertaken for groundwater options and potential impacts on groundwater dependent ecosystems require further assessment (Hydrosphere Consulting, 2022b).	Terrestrial impacts are limited to the sites required for bore, treatment and transfer system infrastructure and are expected to be minimal.
S4: Supplementary groundwater	Lavertys Gap weir, Wilsons Creek (existing)	535 ML/a	73 ML	Refer S1.	Refer S1.	Refer S1.
	Groundwater	At least 400 ML/a required	-	Potential supply from North Coast Volcanics groundwater source (fractured rock). Groundwater hydrology has not been investigated. Further assessment of hydrogeological impacts is required if this option is considered further.	Limited environmental investigations have been undertaken for groundwater options and potential impacts on groundwater dependent ecosystems require further assessment.	Terrestrial impacts are limited to the sites required for bore, treatment and transfer system infrastructure and are expected to be minimal.

13.2.3 Social Criteria

Community consultation was not undertaken during the initial drafting of this report. Instead, the predicted community acceptance was compared based on the expected frequency, duration and severity of restrictions, the extent of investment, infrastructure modifications, energy requirements and service delivery required for each scenario. The combination of these factors was expected to influence community opinion on the scenarios.

The security of supply criterion considers the long-term requirement to service customers beyond the life and secure yield of each option when considering climate change. While the infrastructure solutions (WTP, transfer systems, bores and off-stream storage) can generally be upsized to meet longer-term demand, the impact of larger schemes (beyond what is required for the 2050 planning horizon) has generally not been considered in this report (the nominal 200 ML size of the off-stream storage is expected to provide security until 2060). The regional scenario (S3) provides a security of supply equivalent to the regional scheme and as with the remainder of the Byron Shire water supplies, BSC would delegate the responsibility for water supply security to RCC if the regional scenario is adopted.

For the draft report, the impact on customer bills was represented by the life cycle cost of each scenario. It was assumed that any expenditure would be funded through customer bills, water supply fund reserves and potentially external grant funding (depending on eligibility and availability).

13.2.4 Economic Criteria

Cost estimates were included in the 2021 draft of this report and used in the TBL assessment.

Council resolved at its Planning Meeting on 1 August 2022 (Res 24-366) the following:

That Council receives a report prior to the Ordinary Council meeting on 15 August 2024 which updates the costings in the Hydrosphere report from 2021 so that a more current NPV comparison can be obtained between the off-stream storage/new water treatment plant and connecting to Rous options.

Revised cost estimates for S2 and S3 reported to Council in August 2024 are included in Table 58. The revised cost estimates were updated to reflect current estimates of costs (including construction, land acquisition, materials, labour, bulk water supply, operations and maintenance), NPV analysis with three different discount rates (3%, 5% and 7%) and a sensitivity analysis to account for unknown economic factors that may impact future costs.

The cost estimates do not include current operating costs, staff costs or costs of infrastructure modifications for heritage preservation as these are common to all scenarios. Cost estimates and NPV calculations are included in Appendix 2. To enable comparison with S2 and S3, cost estimates for the S1 and S4 were also updated and are included in Table 58.

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

Table 58: Scenario cost estimates (2025$)

Scenario component	S1: Base case	S2: Off-stream Storage	S3: RCC regional supply	S4: Groundwater
Capital items – new works				
New WTP	12,958,000	12,958,000	-	12,958,000
Pipeline from weir to WTP site	2,688,000	2,688,000	-	2,688,000
Emergency supply main[1]	-	-	-	-
Off-stream storage	-	47,625,000	-	-
Fishway	-	12,025,000		-
Groundwater bores	-	-	-	6,442,000
Pipeline from bore to WTP site	-	-	-	2,688,000
Servicing trunk main customers	-	500,000	500,000	500,000
Asset renewals (30 years)				
WTP	2,592,000	2,592,000	-	2,592,000
Pipelines	1,525,000	1,525,000	1,000,000	2,050,000
Bores	-	-	-	1,288,000
Total capital cost	*19,763,000*	*79,913,000*	*1,500,000*	*31,205,000*
Operating costs (30 years)				
Emergency supply	7,884,000	771,000	137,000	771,000
Bulk supply	-	-	88,705,000	-
WTP	31,286,000	31,286,000	-	31,286,000
Off-stream storage	-	6,250,000	-	-
Fishway	-	4,888,000	-	-
Groundwater	-	-	-	6,016,000
Pipelines	1,879,000	1,879,000	940,000	2,818,000
Total operating cost	*41,049,000*	*45,074,000*	*91,282,000*	*40,891,000*
Life cycle cost (30 years)	60,812,000	124,987,000	89,964,000	72,096,000
NPV (30 years @ 3%)	42,301,000	100,275,000	56,718,000	52,336,000
NPV (30 years @ 5%)	34,551,000	89,022,000	42,957,000	43,902,000
NPV (30 years @ 7%)	28,989,000	80,339,000	33,502,000	37,746,000
Yield (2050) ML/a[2]	754	879	754	754
NPV(5%) per ML secure yield p.a. (2050)	46,000	101,000	57,000	58,000

1. The extension of the existing emergency trunk water main from the RCC regional supply to Azalea Street reservoir will be fully funded as a flood resilience project under the Disaster Recovery Fund (DRF) and nil initial capital cost has been included for each scenario.
2. The secure yield of S1, S3 and S4 is equal to the demand at 2050.

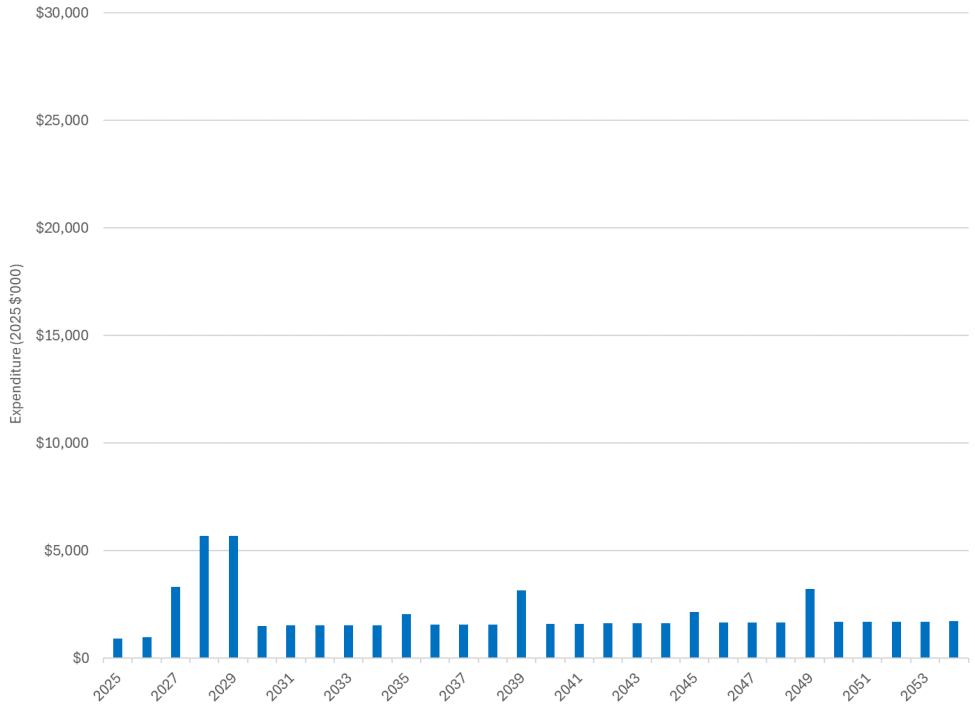

Figure 69: Expenditure profile - Scenario S1: Base Case

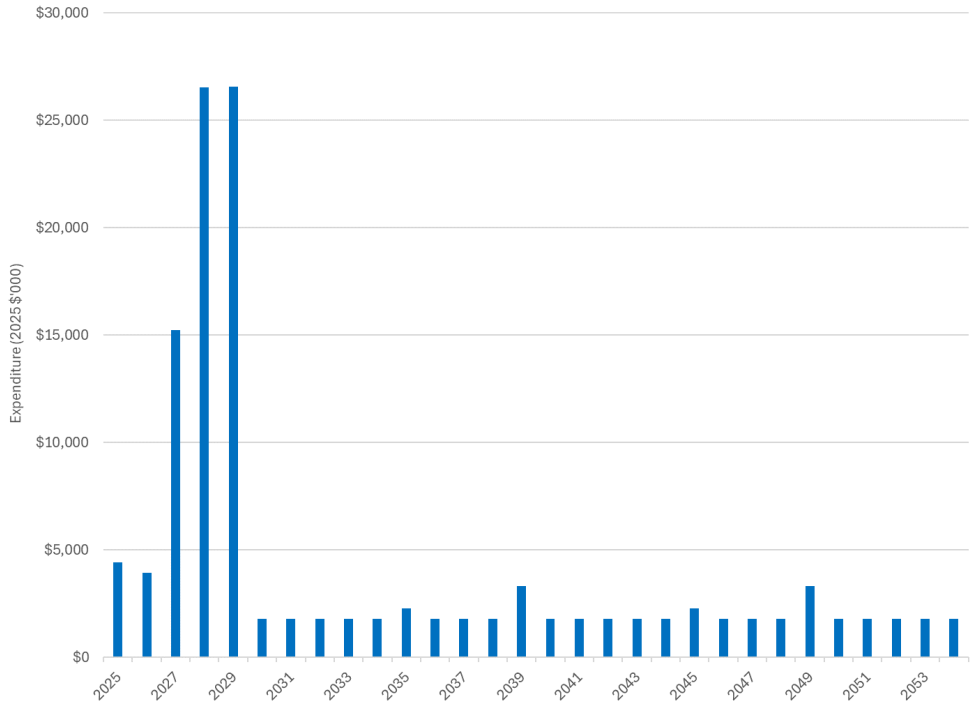

Figure 70: Expenditure profile - Scenario S2: Off-stream Storage

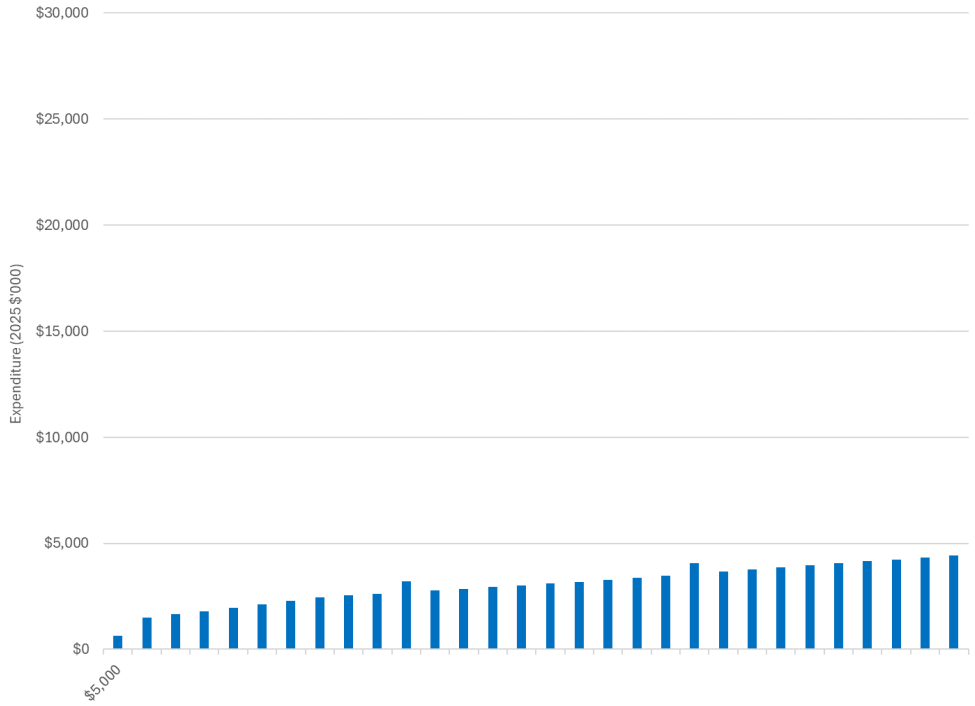

Figure 71: Expenditure profile - Scenario S3: Permanent connection to RCC regional supply

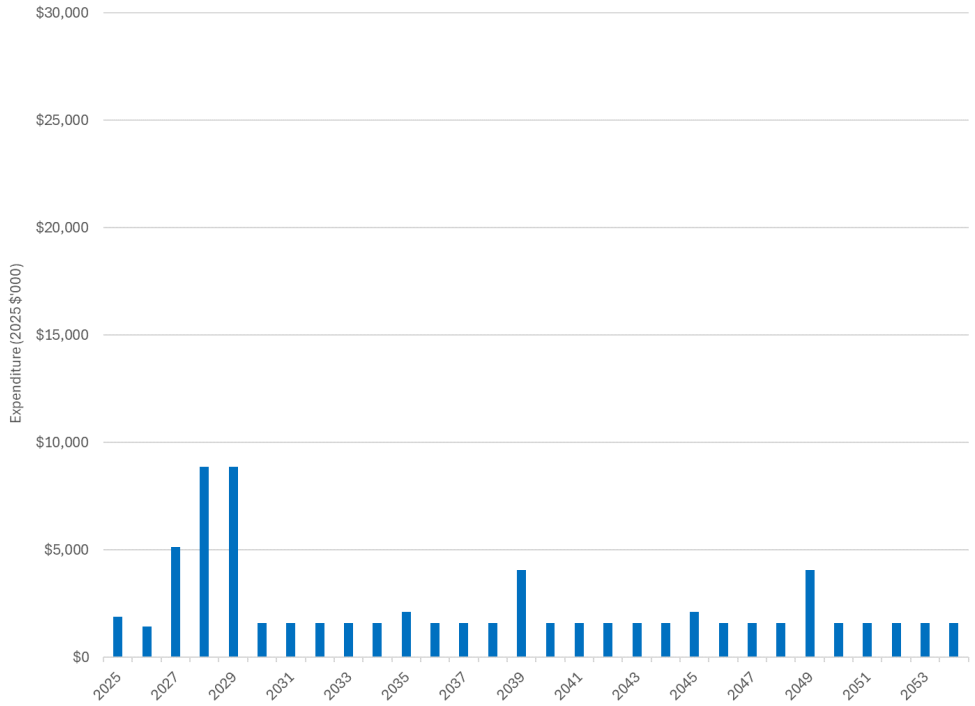

Figure 72: Expenditure profile - Scenario S4: Groundwater

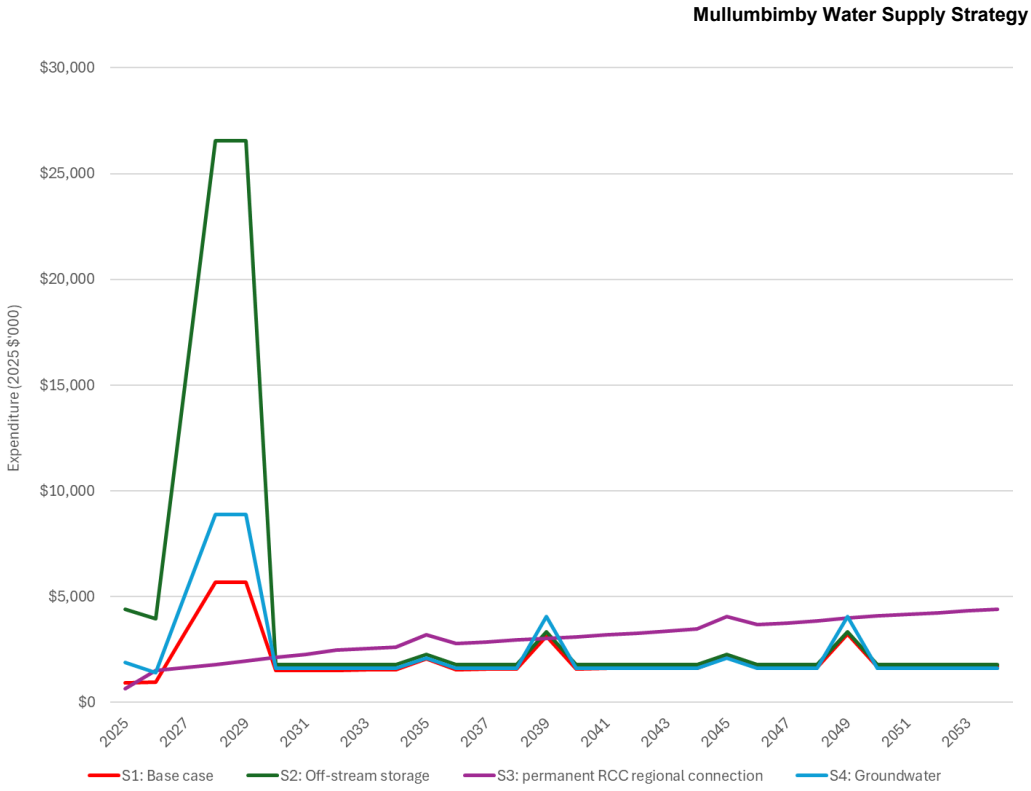

Figure 73: Expenditure profile - scenario comparison

Sensitivity Analysis

The current volatile economic environment continues to impact local and global economies. Local government is no exception, and due consideration of this risk should be made for long term financial planning activities. In particular, the construction industry has been impacted with significantly higher costs. Standard contingency allowances of 20% used in the cost estimates may not be reflective of current market forces. There is considerable risk of cost changes for large construction projects.

A sensitivity analysis was undertaken for S2 and S3 to consider possible outcomes of the current volatile economic environment assuming:

- S3 (Rous regional supply): Bulk supply price increases published in the RCC LTFP (RCC, 2024b) to 2034, then 7% p.a. increase until 2040 and 2% p.a. to 2054 (rather than 2% p.a. to 2054 assumed in Table 58). This results in 15% higher bulk supply costs over 30 years.
- S2 (off-stream storage) and S3 (Rous regional supply): 15% increase in capital and other operating costs over 30 years.

The revised cost estimates and NPV for the sensitivity scenarios are provided in Table 59. Using the sensitivity cost estimates, the life cycle cost and NPV for S3 remains significantly lower than S2.

Table 59: Sensitivity analysis cost estimates (2025$)

Scenario component	S2: Off-stream storage	S3: Permanent connection to RCC supply
Capital items – new works		
New WTP	14,902,000	-
Pipeline from weir to WTP site	3,091,000	-
Emergency supply main[1]	-	-
Off-stream storage	54,769,000	-
Fishway	13,829,000	-
Servicing trunk main customers	575,000	575,000
Asset renewals (30 years)		
WTP	2,980,000	-
Pipelines	1,725,000	1,150,000
Total capital cost	*91,900,000*	*1,725,000*
Operating costs (30 years)		
Emergency supply	887,000	157,000
Bulk supply	-	109,579,000
WTP	35,979,000	-
Off-stream storage	7,188,000	-
Fishway	5,621,000	-
Pipelines	2,161,000	1,081,000
Total operating cost	*51,835,000*	*110,817,000*
Life cycle cost (30 years)	143,735,000	111,542,000
NPV (30 years @ 5%)	102,375,000	50,770,000
Yield (2050) ML/a	879	754
NPV/ML secure yield p.a. (2050)	116,500	67,300

13.2.5 Recommended Scenario

A summary of the TBL assessment (with equal weighting for each criterion) is provided in the following table. Changing the weightings does not change the outcomes of the ranking. The TBL assessment is included in Appendix 4.

Table 60: Summary of MCA outcomes

Scenario	Weighted environmental score (/5)	Weighted social score (/5)	Total score (per $ NPV)	Rank (based on MCA)
S1: Base Case	4.50	1.00	80	3
S2: Off-stream Storage	3.67	3.50	40	4
S3: Permanent connection to RCC regional supply	4.67	4.00	101	1
S4: Groundwater	3.67	3.25	72	2

Based on the TBL assessment, the most favourable scenario is S3: Permanent connection to the RCC regional supply (Figure 3). This scenario would have minimal incremental environmental impact and the security of supply is only limited by the security of the RCC regional supply. The addition of Mullumbimby to the regional supply is unlikely to affect RCC's overall bulk supply strategy and the major environmental impacts associated with the regional scheme are fixed regardless of the inclusion of Mullumbimby in the regional scheme.

The NPV of the regional scenario is the lowest of all scenarios. There are significant capital cost savings in avoiding the need to replace the Mullumbimby WTP, upgrade the weir supply and construction of new infrastructure however the ongoing costs of a regional supply are higher than local scenarios.

The groundwater scenario ranked second in the MCA. While a suitable groundwater supply may be identified and the costs of a groundwater scheme are lower than S2 (off-stream storage), there are considerable risks with a groundwater scheme which need to be resolved before this approach is considered to be acceptable. These include local geology and environmental constraints, sustainable yield, water quality (salinity and other parameters of concern for drinking water supply) and the need for advanced treatment. Large scale groundwater schemes have not yet been investigated in the Mullumbimby area. The risk that a feasible and cost-effective groundwater source cannot be established within the short-term (to provide a secure water supply by 2027) is considered to be high and therefore this scenario is not recommended.

13.2.6 Risk Management

The implementation risks associated with the recommended scenario are considered to be less significant than the other scenarios. RCC is currently investigating options for augmenting the regional supply and has adopted a preferred strategy utilising Marom Creek and new groundwater sources. RCC has considered the connection of local water supplies such as Mullumbimby in the development of its long-term strategy. BSC should continue to liaise with RCC regarding the security of the regional supply. Risk management considerations are discussed in Table 61.

Table 61: Risk management measures

Risk	Description	Mitigation
Drought conditions are experienced in the near future (prior to full connection to the RCC regional supply)	Secure yield modelling suggests the existing supply (including the RCC emergency supply) can meet demand until 2027 in a repeat of the worst drought on record. The weir supply will fail in a worse or more prolonged drought than has been experienced in the past.	The RCC emergency supply can service customers in East Mullumbimby (at a cost of approximately $2,700 per day). Water would be carted to other customers in Mullumbimby (at a cost of up to $17,300 per day). The supply pipeline should be extended to the Azalea Street reservoirs as soon as possible to service the entire town.
The scenario costs are higher than assumed in this report.	The current volatile economic environment continues to impact both local and global economies. Local government is not immune from these impacts, and due consideration of this risk should be made for long-term financial planning activities. In particular, the construction industry has been impacted with significantly higher costs. There is considerable risk of cost changes for large construction projects.	Financial information in this report has been updated to reflect current estimates of cost inputs including construction, land acquisition, materials, labour, bulk water supply costs, operations and maintenance. Sensitivity analysis indicates the regional supply scenario has the lowest NPV even with increased bulk supply costs. BSC has commenced consultation with RCC regarding review of the service level agreement to incorporate the outcomes of this strategy.
Community acceptance of the recommended scenario is low.	Feedback from the public exhibition phase suggests that some customers do not support a connection to the regional supply in preference to remaining independent with a local supply.	BSC communicated the proposed strategy during 2024 and responded to community concerns (Section 14.1). BSC will continue to liaise with water supply customers.
RCC is unable to provide a secure supply over the long-term.	RCC is currently developing its long-term strategy and will continue to investigate actions required to implement its preferred strategy.	BSC should continue to liaise with RCC regarding implementation of the Future Water Project 2060 for the whole Byron Shire.

14. PUBLIC EXHIBITION OF THE DRAFT STRATEGY

14.1 Stakeholder Consultation

Draft outcomes of this report were presented to Council staff and the Executive Team prior to presentation to the Water and Sewer Advisory Committee in April 2021. The study was also discussed at subsequent meetings of the Committee in September 2022, June 2023 and a Council workshop in November 2023. Council resolved at its August 2023 meeting to undertake community consultation on the findings of the draft report prior to deciding on a course of action.

In June 2024, Council conducted public consultation to measure community opinion about the findings of a draft of this report and the recommended scenario. Information was published on the Your Say section of Council's website and a survey was created for submissions during the public exhibition period from June 3 to June 30, 2024. The public exhibition and survey were promoted via Council newsletter, social media, print and radio advertising, media releases, market stalls and public information sessions. Stakeholder engagement included media interviews, public information sessions and meetings with representatives of the Mullumbimby Residents' Association and Water Northern Rivers. Further information is available in the consultation report (Trute, 2024).

During the public exhibition period, additional information was provided to Committee members and Councillors including:

- Revised cost estimates.
- Analysis of impact on water supply customer bills.
- Links to the NSW Government's Regional Water Strategy and BSC's local strategic planning.
- RCC's Future Water Strategy.
- The methodology adopted for the assessment of options.
- The benefits of a regional approach.

This information has been incorporated into this report. Common themes raised during the public exhibition period are discussed in the following sections.

14.1.1 Common themes raised during the community survey

A number of questions and concerns emerged during the public exhibition phase. The following information was provided in a report to Council in response to these issues (Trute, 2024) and in response to Councillor queries.

Dunoon Dam

Many comments received during the public exhibition period for the draft *Mullumbimby Water Supply Strategy* express concern that connecting Mullumbimby to the Rous regional water supply will support the case for construction of Dunoon Dam. BSC sought advice from RCC on this issue and has been advised that there would be no requirement to augment its supply to connect Mullumbimby to the regional supply. A report to RCC's June 19 2024 meeting noted "There would be no requirement/s to augment the Rous bulk

distribution network to enable the permanent connection of Mullumbimby." The report concluded "The additional demand on the Rous bulk water supply that would be created through a permanent connection to Mullumbimby would represent approximately 4 % of current bulk water supplies to the region. Considering the projected population growth of the region, the portion Mullumbimby represents would be expected to be closer to 5 per cent by 2050".

Fluoride

A number of comments express a concern that water supplied by RCC to Mullumbimby, in the event of connection to the regional supply, would be fluoridated. This is not true. RCC does not add fluoride to water supplied to Byron Shire.

Climate Change

The supply yield for each scenario was determined using the NSW Government's security of supply methodology including climate change considerations (1 degree warming) in accordance with the *Guidelines on Assuring Future Urban Water Security* (NSW Office of Water, 2013). These were the accepted guidelines available at the time of preparation of the draft strategy and although climate change modelling is continually evolving, there is no other industry-based approach advocated by the NSW Government at this time. The NSW Government's *Far North Coast Regional Water Strategy Implementation Plan* (DPE, 2023b) proposed the future development of regional-scale, adaptive decision-making modelling methodologies and assessment methods to underpin water supply options assessments. BSC will continue to review and incorporate updated climate change data in its strategic planning.

Multi-criteria analysis

The MCA used in the draft report (Section 13.2) was based on integrated water cycle management planning principles advocated by the NSW Government for this sort of project.

The draft strategy acknowledged that community consultation was not undertaken at the time of the assessment as it was Council's preference to present the draft report to the public for feedback. For the draft report, the predicted level of community acceptance was compared based on the expected frequency, duration and severity of restrictions, the extent of investment (cost to ratepayers), infrastructure modifications, energy requirements and service delivery required for each scenario.

Supply scenarios based on the short-listed options were developed to identify feasible supply arrangements, infrastructure requirements, costs and key considerations. The scenario comparison methodology used in this project and TBL assessment criteria were developed with consideration of the comparison of options and the IWCM Information Sheet 2 - *Evaluation of integrated water cycle management scenarios* (NSW Department of Industry, 2019).

Economic criteria included capital and operating cost and 30-year net present value. All capital costs were presented as budget estimates based on market rates from comparable projects. All operating costs were presented as budget estimates based on the cost rates applicable at the time. All costs are subject to price escalation, changing market forces, availability of materials and detailed design. The costs estimates were reviewed and updated in 2024 and revised cost estimates are included in this final report.

Weightings were assigned to each criterion based on relative importance so that the sensitivity of the weightings can be tested. Changing the weightings does not change the outcomes of the MCA ranking. In all criteria, scenario 3 (regional connection) ranked the highest.

The predicted impacts on biodiversity for each scheme are low and impacts are considered to be manageable for each scenario. Actions to reduce these impacts (e.g. an environmental flow regime and terrestrial biodiversity offsets) would be developed for each local scenario where required and suitable measures would be put in place to obtain planning approval for each scenario, although detailed investigations and consultation are required for S1, S2 and S4. RCC is responsible for the offset of biodiversity impacts for the regional scenario (S3) and is incorporating these considerations in the development of its groundwater supply options.

There has been no assessment undertaken of the cumulative impact of the options for Mullumbimby involving connection to RCC supplies, however it is considered that connection to a regional water supply scheme is likely to result in lower environmental impact than development of an additional local supply source and infrastructure in Mullumbimby. The addition of Mullumbimby to the regional supply is unlikely to affect RCC's overall bulk supply strategy and the major environmental impacts associated with the regional scheme are fixed regardless of the inclusion of Mullumbimby in the regional scheme.

In addition, reduced extraction from Lavertys Gap weir and potentially taking the weir out of service may improve environmental outcomes for the Wilsons River system over the long-term. Other beneficial uses of the weir may also be identified by Council (e.g. recreational opportunities, heritage features). As the environmental impacts of each scenario are considered to be manageable, selection of the recommended scenario focused on social and economic considerations.

Diversity of supply

Connection of Mullumbimby customers to the regional supply provides access to a more diverse range of sources than a local supply and therefore increased resilience. The regional supply includes multiple surface water and groundwater surfaces, and additional groundwater sources are being developed as part of RCC's *Future Water Strategy 2060* implementation in addition to the transfer of surface water supplies at Marom Creek to RCC. The outcome of the *RCC Future Water Strategy* Stage 1 (2025) will result in a regional supply with four surface water supplies (Rocky Creek Dam, Wilsons River, Emigrant Creek Dam and Marom Creek), augmented groundwater supplies at Alstonville and Woodburn and three treatment plants. Scenario 2 (off-stream storage) for Mullumbimby relies on a single surface water source (Wilsons Creek), with emergency supply from the regional system available when there are low flows but at a high cost. Scenario 4 (groundwater) would include an additional supply source but is likely to rely on a single WTP. Therefore, a local supply option is heavily reliant on Wilsons Creek stream flows as well as the WTP and pipeline infrastructure operability and suitability which increases the risk of system failure.

Benefits of regional approaches

The benefits of centralisation of water supplies and regional interconnection include improved financial outcomes through economies of scale, access to a wider range of options to improve efficiency, system resilience and operational flexibility. Financial benefits would result from regional opportunities for staging of water source development, increased flexibility in scheme development, reduced duplication of infrastructure and sharing of costs over a larger customer base. There is also the potential to reduce the risk of supply

shortage in the region through supply diversity, supply redundancy, climate resilience and system flexibility. A regional scheme also allows access to a wider range of options to improve environmental and social outcomes than a local scheme. The benefits of regional supplies (compared to local supplies) have been recognised in the NSW Government's *Far North Coast Regional Water Strategy Implementation Plan* (2023b), particularly Action 4.3 (Support regional-scale, adaptive decision-making for town water supplies in the Far North Coast) which includes connecting smaller systems in the Richmond/Brunswick catchments (Casino, Nimbin, Mullumbimby) to the RCC bulk water supply on a permanent basis as well as development of other regional supply sources such as desalination.

To reduce overall environmental impact, the utilisation of existing water infrastructure (within sustainable limits) should be considered in preference to the exploitation of new resources. The connection to the RCC bulk supply system provides the opportunity to utilise existing surface water and groundwater sources and treatment infrastructure and reduce the potential for over-extraction from the Wilsons River at Lavertys Gap. The strategy recognises that the RCC regional water supply also requires augmentation due to the reduction in yield that will result from climate change and predicted growth in the existing regional supply area. The RCC bulk water supply system requires future augmentation with or without the permanent connection to Mullumbimby and S1 and S3 will only incrementally increase any impacts of the regional supply. S3 (with permanent connection) would be approximately 4.7% of the total regional demand by 2030 (5.1% by 2060). As a result of this minor increase in demand, the Rous system would continue to operate within the approved operational parameters for the system, regardless of the connection of Mullumbimby.

Integrated environmental assessment of water systems

The draft strategy considered the impacts on the Wilsons River system for all scenarios. River systems rely on the full range of flows (from flood flows to low flows) to function naturally.

The connection to the regional supply has many advantages for the local Wilson's River water supply - reduced extraction, increased environmental flows and the potential to return the system to a more natural state without flow reductions and blockage of fish passage.

Connection to a regional water supply scheme would result in lower environmental impact than development of an additional local supply source and infrastructure in Mullumbimby. The addition of Mullumbimby to the regional supply is unlikely to affect RCC's overall bulk supply strategy and the major environmental impacts associated with the regional scheme are fixed regardless of the inclusion of Mullumbimby in the regional scheme. In addition, reduced extraction from Lavertys Gap Weir and potentially taking the weir out of service may improve environmental outcomes for the Wilsons River system over the long-term. Other beneficial uses of the weir may also be identified by Council (e.g. recreational opportunities, heritage features).

The OSS option would require increased extraction (high flows extracted to be stored in the OSS) and therefore reduced environmental flows. While a fishwaywould need to be installed as part of the OSS option, this is costly and less desirable that facilitating natural fish passage. It is much more environmentally friendly to remove the fish passage barrier and restore full river flow regime – which is possible with the regional supply option but not with the local OSS option.

Demand management, leakage management and recycled water strategy

Demand side options are the same for all supply scenarios and do not change the need for a new source. Council has a demand management program, water loss management program and is developing recycled

water strategies across the Shire. Council commissioned the Water Sensitive Cities Institute (WSCI) to develop an evidence-based urban water metabolism framework to support integrated urban water management decisions. Based on the findings of this study and other council investigations, opportunities for potable water substitution are being developed.

Consistency with NSW Government Policy and Direction

S3: Permanent connection to the RCC regional supply is consistent with the *Far North Coast Regional Water Strategy* (DPE, 2023a; 2023b). While the NSW government strategy was prepared after Council's investigations for Mullumbimby water supply, the two strategic plans are consistent in that:

- Actions in the *Far North Coast Regional Water Strategy* are consistent with the recommended approach for Mullumbimby as demonstrated through Action 4.2: Support local councils to provide a secure and affordable water supply for towns and Action 4.3: Support regional-scale, adaptive decision-making for town water supplies in the Far North Coast (DPE, 2023b).
- The benefits of regional supplies (compared to local supplies) have been recognised in *Far North Coast Regional Water Strategy Implementation Plan* (2023b), particularly Action 4.3 (Support regional-scale, adaptive decision-making for town water supplies in the Far North Coast) which includes connecting smaller systems in the Richmond/Brunswick catchments (Casino, Nimbin, Mullumbimby) to the RCC bulk water supply on a permanent basis as well as development of other regional supply sources such as desalination (Rous and Tweed Shire Council).

The outcomes of the Mullumbimby Water Supply Strategy were discussed with NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) representatives in August 2022 and feedback was considered in the subsequent investigations e.g. the emergency water supply pipeline design and related discussions with RCC. In consultation with DCCEEW, Council has also reviewed its requirements under the NSW Government's new regulatory and assurance framework for local water utilities. Council is continuing to work towards effective, evidence-based strategic planning that is sufficient, appropriate and robust as required by this new regulatory framework. This includes development of this Mullumbimby Water Supply Strategy.

Consistency with Council strategic planning

BSC's strategic planning (including integrated water cycle management strategy, strategic business plans and project-specific plans such as this Mullumbimby Water Supply Strategy) identify the local risks to water services and options to address those risks. The Mullumbimby Water Supply Strategy is referred to in BSC's Local Strategic Planning Statement (LSPS, BSC, 2020) as a "relevant land use strategy, plan or policy". The strategy aligns with the key priorities and actions in the LSPS relating to infrastructure needs (A Connected Shire) ensuring infrastructure delivery is aligned with planned growth. The future demand for water supply included the latest growth projections for Mullumbimby.

14.2 Preliminary Financial Analysis

As a follow up to the information provided to Report 13.26 – Mullumbimby Water Strategy at the Council Meeting on 15 August 2024, Council staff received requests from Councillors on the cost implications and impact on water supply customers under Scenario 2 and 3.

Currently, all Council water supply customers pay the same water usage charge per kL. Water availability charges are fixed according to the meter size. The typical residential bill in 2024/25 is approximately $960 per year.

Council staff plan to review and update water supply financial planning during 2024, which will inform the adoption of water supply charges for 2025/26. This will include detailed assessments of all water supply operating and capital costs as well as review and update of development servicing plans. Staff have been developing a Shire-wide capital works program based on detailed hydraulic modelling and are currently finalising the long-term renewals plan for this purpose. Once this is available, the financial plan can be updated, and the funding strategy (including loans and a water supply price path) can be determined. The water supply fund financial outcomes for the 2023/24 financial year, planned works and the adopted approach for Mullumbimby water supply (including increased bulk supply costs) will be included in the financial analysis.

As part of the review of options for Mullumbimby water supply, a preliminary financial analysis using FINMOD (financial planning software developed by the NSW Government for water supply and sewerage funds) comparing the off-stream storage (S2) and regional supply (S3) scenarios was undertaken to estimate the increase in customer bills that would be needed to fund each scenario. This analysis was updated with the revised cost estimates and other financial assumptions. This preliminary analysis has not considered all other capital or operating costs, which are currently being finalised, and should be treated as a guide only. The outcomes of this preliminary analysis are indicative and could change. The detailed financial plan as discussed above is required to confirm the funding strategy.

As part of the preliminary financial analysis the BSC Manager Finance:

1. Considered the Council report from the 15 August 2024 Ordinary Council Meeting (including the NPV assessment).
2. Obtained more information from staff and Hydrosphere Consulting (including matters raised at the Council Meeting).
3. Reviewed the number of water customers in Mullumbimby from Council's billing records using the last bill issued in May 2024.
4. Used the revised cost information in the financial analysis.

The information provided below is based on the following scenarios as reported to Council on 15 August 2024:

- Scenario 2 – Off-stream storage providing improvements to the existing raw water transfer system, full emergency connection to the regional supply and construction of a 200 ML off stream storage and new WTP. This will also require land acquisition.
- Scenario 3 – Permanent connection to the RCC regional water supply with bulk treated water transferred to the Azalea Street reservoirs.

There are two scenarios regarding Scenario 2 and 3:

1. Cost impact to Mullumbimby customers only.

2. Cost spread across the whole Shire given all consumers pay the same water charges and would all be supplied by RCC.

Given the timing and available information, future events may change the outcomes as presented but at this point in time, they represent a possible outcome and are a product of various assumptions. The major assumption is that water operations of Council will remain unchanged and the proposed Mullumbimby water supply options will impact on customers due to the additional costs from the respective options in addition to current costs. The analysis is based purely on new costs created by the scenarios.

Based on the analysis the following outcomes are provided:

1. Scenario 2 – off-stream storage funded by Mullumbimby customers only – an annual increase of at least $2,175 per assessment in addition to the current typical residential bill for ten years before any potential reduction.
2. Scenario 2 – off-stream storage – an annual increase of at least $345 per assessment across all Shire customers, not just Mullumbimby, in addition to the current typical residential bill for ten years before any potential reduction.
3. Scenario 3 - RCC regional supply option funded by Mullumbimby customers only – an annual increase of at least $662 per assessment in addition to the current typical residential bill for twelve years before any potential reduction.
4. Scenario 3 - RCC regional supply option – an annual increase of at least $105 per assessment across all Shire customers, not just Mullumbimby, in addition to the current typical residential bill for twelve years before any potential reduction.

The differences in outcomes can be attributed to the following: -

- Mullumbimby makes up approximately 16% of the Shire customer base.
- Loans would be taken in one lump sum. The maximum loan term Council can borrow for a fixed term is 20 years. Whilst Council can ask for a 30-year loan, it would need to be refinanced after 20 years at the prevailing interest rate at the time. For the minimisation of risk, locking the loan in provides certainty in repayments for such a long-term intergenerational project. The latest 20-year loan borrowing indicative rates for Council as of 2 September 2024 is 5.46%. Any unexpended loan funds from the original borrowing would be invested with interest proceeds to offset the cost of scenario 2 as the works are completed and the loan funds are exhausted. The borrowing required based on new costs is $65.86 million assuming no cash (refer below).
- The calculations used current billing data (assessments) as the start point then added a growth factor to that annually.
- Based on the 2024/25 budget, the capital works reserve in the Water Fund as reported to Council on 15 August 2024 as part of the options report, is essentially exhausted. The amount of available Developer Contributions for Mullumbimby for Water at 30 June 2024 is at around $650,000 so that amount in the scheme of this analysis is not material. Therefore, the Water Fund does not have existing cash to apply to this project.

15. COUNCIL RESOLUTION

At its Ordinary Meeting of 15 August 2024, Council resolved [24-411] that Council:

1. *Notes the outcomes of the public consultation on Mullumbimby Future Water Strategy.*
2. *Notes the revised NPV comparison analysis for the Water Supply Options for Scenarios 2 and 3.*
3. *Adopts Scenario 3 - permanent, full connection to the Rous regional water supply.*
4. *Maintains its extraction licence at Lavertys Gap.*
5. *Requests staff to investigate and report back to Council options for Lavertys Gap water treatment infrastructure and associated land use.*
6. *Commits to continuing to reticulate current volumes of potable water to properties already connected between the Laverty's Gap Water Treatment Plant and Azalea Street reservoirs.*

16. IMPLEMENTATION

The Mullumbimby Water Supply Strategy includes a diversified portfolio of actions to meet the community's water needs based on connection to the RCC regional supply:

- Priority actions: improved drought resilience and treatment performance.
- Ongoing actions: reducing potable water demand including water loss management and the increased use of recycled water.

These components are discussed further in the following sections.

16.1 Priority Actions

16.1.1 Pipeline extension

The priority action is to extend/augment the existing RCC emergency supply pipeline to the Azalea Street reservoirs to enable supply to the whole town on a permanent basis. This will require (Planit, 2022; 2024):

- Replacement of the existing RCC DN150 main (Pacific Highway to Tandy's Lane) with DN300.
- New DN400 main from Mann's Rd to Azalea St reservoir.
- Booster pump station at Azalea Street reservoir.
- Environmental assessment and approvals.
- Construction of the pipeline extension.
- Liaison with RCC to modify the existing service level agreement to reflect the increased/ permanent demand.

Future duplication of the existing BSC DN250 main (emergency supply main Tandy's Lane to Mann's Rd) will be required to service future demands.

16.1.2 Asset management planning

To enable implementation of the preferred long-term strategy, the long-term asset management options for BSC's existing assets (including the weir, channel, WTP and trunk mains) should be investigated including removal from service, potential adaptive reuse options and decommissioning/ removal over various timeframes.

16.1.3 Drought management and emergency response planning

Operating the existing emergency pipeline servicing East Mullumbimby and/or transferring to pumped flow from the weir soon after the weir ceases to overtop will conserve water during a dry period.

Once the permanent connection to the regional supply is established, the restriction regime for Mullumbimby will be updated to be consistent with the other water supplies in the Byron Shire and the region.

16.1.4 Ongoing consultation

To enable implementation of the adopted strategy, the following consultation actions are required:

- Liaison with RCC regarding connection to the regional water supply including:
    - Long-term security.
    - Costs of connection to the regional supply.
    - Revision of service level agreement.
- Liaison with trunk main customers to develop potable water supply options.
- Consultation with Essential Energy regarding assets associated with the hydroelectric facility.
- Consultation with relevant agencies such as DPI, Heritage NSW, DCCEEW and NSW Health regarding management of the redundant assets.
- Continuation of the water extraction licence.

16.1.5 Heritage

To enable implementation of the adopted strategy, the following heritage management actions are expected to be required:

- Revision of the Conservation Management Plan to provide a holistic assessment and policies/ guidance on adaptive re-use and the long-term maintenance and management of the assets.
- Approvals under the *Heritage Act 1977* (potentially S60 application for any adaptive reuse proposal).

16.1.6 Financial planning

A financial analysis of the BSC water supply funds is required to provide information to BSC on the required revenue to be recovered through residential bills. The main output of the financial plan is the typical residential bill (TRB) which is defined as the annual bill paid by a customer who is not a pensioner and not a vacant lot and uses the average water demand. The financial modelling provides an indication of the relative cost to BSC and its customers of the water supply services.

BSC's water supply financial plan will be updated to consider the adopted water supply strategy including:

- Confirmation of capital and operating cost estimates following investigation of the actions discussed in the previous sections. Current capital cost estimates are provided in Section 16.3.
- Confirmation of the required implementation program.
- Review and update of other water supply expenditure requirements.
- Updated financial modelling to determine medium-term impact on the water supply TRB.

16.2 Ongoing Actions

16.2.1 Demand management

The RDMP provides a series of demand management measures to be implemented by RCC and the constituent councils between 2023 and 2026 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 ongoing reporting of action implementation. Annual review of the RDMP will be undertaken by 30 September of each year including:

- A review of demand data.
- An evaluation of the completeness and effectiveness of RDMP actions.
- Feedback from the customers and the constituent councils.
- 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 December 2026). It is expected that the next version of the RDMP will consider Mullumbimby and Wardell customers as part of the regional supply.

16.2.2 Effluent reuse opportunities

Continued identification and implementation of urban effluent reuse opportunities to reduce potable water demand is a key component of the Mullumbimby water supply strategy.

16.3 Implementation Plan

The expected delivery of the adopted scenario (capital and operating cost estimates and timing) is shown in Table 62. These estimates are based on available information and will be continually reviewed. The cost estimates do not include staff time or existing strategic planning or operational expenditure which are not influenced by the adopted strategy for Mullumbimby. The implementation plan assumes that the permanent connection to the regional supply will be available from June 2025.

Strategic planning actions such as financial planning and demand management would be undertaken for all BSC water supplies as part of existing budgets and have not been included here. Effluent reuse opportunities are currently unknown and costs have not yet been estimated. These actions are part of Council's shire-wide water supply strategic planning and delivery. Future costs related to redundant assets that are no longer required as part of the water supply (e.g. WTP, weir, channel) such as re-purposing, relocation or decommissioning have not yet been identified.

Table 62: Mullumbimby water supply strategy implementation - cost estimates

Delivery Program year		DP 3	DP 4	DP 1	DP 2	DP 3	DP 4	DP 1	DP 4	DP 1	DP 2
Action/cost estimate (2025 $'000)	**Ten-year cost**	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**2028/29**	**2029/30**	**2030/31**	**2029/30**	**2030/31**	**2031/32**
Pipeline extension to Azalea Street reservoirs[1]	*DRF*	DRF									
Emergency water supply - purchase of water (allowance)	*137*	137									
Regional water supply - purchase of water	*18,618*		1,480	1,613	1,759	1,921	2,077	2,246	2,430	2,507	2,585
Pipeline operation/ maintenance	*292*		32	32	32	32	32	32	32	32	32
Servicing trunk main customers	*500*	500									
Asset management planning	*200*	100	100								
Drought management plan review	*20*	20									
Consultation	*100*	50	50								
Heritage management	*100*	50	50								
Totals	***19,963***	**857**	**1,712**	**1,645**	**1,791**	**1,953**	**2,109**	**2,278**	**2,462**	**2,539**	**2,617**

Planning and approvals	Construction	Operation

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GLOSSARY AND ABBREVIATIONS

ADD	Average day demand
ADWG	Australian Drinking Water Guidelines
AGWR	Australian Guidelines for Water Recycling
AWBM	Australian Water Balance Model
BASIX	Building Sustainability Index
BLEP	Byron local environmental plan
BSC	Byron Shire Council
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
ET	Equivalent tenement
FSL	Full supply Level
FSV	Full supply volume
GCM	Global Climate Model
GDE	Groundwater dependant ecosystems
IPR	Indirect potable Reuse
IWCM	Integrated Water Cycle Management
kL	Kilolitres
kL/a	Kilolitres per annum
kL/d	Kilolitres per day
KPI	Key performance indicator
L	Litres
L/s	Litres per second
MCA	Multi-criteria analysis
ML	Megalitres (one thousand litres)
ML/a	Megalitres per annum
ML/d	Megalitres per day
NPV	Net present value - the present value of a series of future payments
NRAR	National Resources Access Regulator
PDD	Peak day demand
RCC	Rous County Council
RDMP	Regional Demand Management Plan
SA	Surface area
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'

STP	Sewage treatment plan
TBL	Triple bottom line
TRB	Typical residential bill
UV	Ultraviolet
WSCI	Water sensitive cities institute
WTP	Water Treatment Plant

Appendix 1. LEGISLATIVE CONSIDERATIONS

Table 63 and Table 64 outline the legislative requirements and approvals required relevant to the augmentation options.

Table 63: Summary of legislation and regulatory requirements

Legislation	Summary of requirements/approval required
NSW Weir Policy	The policy states that: "Proposals to enlarge an existing weir should not be approved unless it can be demonstrated that the primary component of the proposal is necessary to maintaining the essential social and economic needs of the affected community." and "An increase in town water supply for the purposes of meeting projected population demand cannot be used as a justification to approve a proposal to build a new, or expand an existing weir, if environmentally friendlier alternatives to meeting that demand exist, which are also economically feasible"
Environmental Planning and Assessment Act 1979	An assessment of the likely impacts of a proposal which may have an impact on the environment is required under the Act prior to a decision to proceed with the proposal. The Act imposes requirements for controlling development. The proposed works may require consent under the Act.
Water Management Act 2000	The *Water Management Act 2000* recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water licences from land. The main tool in the Act for managing the state's water resources are water sharing plans. These are used to set out the rules for the sharing of water in a particular water source between water users and the environment and rules for the trading of water in a particular water source. Section 90 of the Act requires an approval to undertake water supply work including work for the purpose of capturing or storing water or any work that has, or could have, the effect of impounding water in a water source. Approval would be required from the Department of Planning, Industry and Environment (DPIE) - Water for the raised weir, either in the form of a new works approval/licence or an amendment to the existing works approval/licence.

Legislation	Summary of requirements/approval required
Fisheries Management Act 1994	All proposals for the construction of, or modification to, dams, weirs or similar structures are required to be referred to DPI - Fisheries for assessment. For the construction or the major modification or alteration of dams, weirs and regulators the construction of a fishway may be required. Under Section 200 of the Act a local government authority must not carry out dredging work or reclamation work except under the authority of a permit. The definition of dredging work includes any work that involves excavating water land, or any work that involves moving material on water land or removing material from water land. The definition of reclamation work includes any work that involves: • Using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land; or • Depositing any such material on water land for the purpose of constructing anything over water land. Water land means land submerged by water either permanently or intermittently. The proposed works are considered to constitute dredging and reclamation work and therefore require a dredging and reclamation permit issued under Section 200 of the Act. The Act contains schedules of species, populations and ecological communities that have been listed as 'threatened'. Where a proposed development is in the potential range of a listed threatened species, population or ecological community under the Act and/or the Environment Protection and Biodiversity Conservation Act 1999 and the area has not been declared a critical habitat, then the preparation of the 'test of significance' on the subject species, population or community is required. The 'test of significance' is used to determine whether the proposed development is likely to significantly affect threatened species, population or ecological communities. If the determining/consent authority determines that the project will not have a significant impact after considering the test of significance, then the proposal may be accepted. If the determining/consent authority determines that the proposed project will have a significant impact via the 'test of significance', then a Species Impact Statement (SIS) is required to be prepared, or the proposal may require modification where possible.
National Parks and Wildlife Act 1974	Under the Act it is an offence to cause harm or desecration to any Aboriginal heritage items, objects or places discovered during operations.
Biodiversity Conservation Act 2016	The Act provides provisions for the protection of threatened or protected animal and plant species, threatened ecological communities and areas of outstanding biodiversity value. The Biodiversity Values Map identifies land with high biodiversity value that is particularly sensitive to impacts from development and clearing. The map forms part of the Biodiversity Offsets Scheme Threshold which is one of the triggers for determining whether the Biodiversity Offset Scheme applies to a clearing or development proposal. Wilsons River at Lavertys Gap is mapped as high biodiversity value.
Protection of the Environment Operations Act 1997	Under the Act it is an offence to cause pollution. The Act enables the issue of environment protection licences (EPL) for scheduled and non-scheduled development work or activities. The licence provides a defence against a pollution of waters offence for those pollutants specifically regulated under the licence as long as the pollutants discharged to waters are within the limits specified in the licence. In general, the EPA will not issue a non-scheduled activity licence where there is a low likelihood of impact on waters and where pollution should not occur if the activity is carried out in a competent manner. The need for an EPL is subject to final design and construction methodology.

Legislation	Summary of requirements/approval required
Local Government Act 1993	Under Section 60 of the Local Government Act 1993 a Council must seek approval of the Minister for Primary Industries to construct or extend a dam for the impounding or diversion of water for public use or any associated work.
NSW Heritage Act 1977	All non-Aboriginal archaeological relics across NSW (including NPWS estate) over 50 years old are managed under the Heritage Act 1977. Any works or activities that may disturb non-Aboriginal archaeological relics must have an Excavation Permit, which is a separate approval under the Heritage Act 1977.
Dam Safety Act 2015	The Objectives of the Dam Safety Act are to ensure that any risks that may arise in relation to dams (including any risks to public safety and to environmental and economic assets) are of a level that is acceptable to the community, as well as regulating the management and risks associated with dam safety.
Environmental Protection Biodiversity Conservation Act 1999	The Act lists threatened species or ecological communities that are recognised as a matter of national environmental significance. Under the EPBC Act an action will require approval from the Commonwealth Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. In order to determine whether an action is likely to have a significant impact, an assessment of significance on relevant matters is required.

Table 64: Relevant Environmental Planning Instruments

Instrument	Summary of requirements/approval required
State Environmental Planning Policy (Transport and Infrastructure) 2021	Under Part 2.3, Division 24, Clause 2.159 “Development for the purpose of water storage facilities may be carried out without consent if it is carried out by or on behalf of… any public authority on land in Zone RU1 Primary Production, Zone RU2 Rural Landscape, Zone SP1 Special Activities, Zone SP2 Infrastructure or an equivalent land use zone”. Water storage facility means “a dam, weir or reservoir for the collection and storage of water and includes associated monitoring or gauging equipment”.
SEPP - State and Regional Development 2011	Under Schedule 3 of the Policy development for the purpose of water storage or water treatment facilities (not including desalination plants) carried out by or on behalf of a public authority that has a capital investment value of more than $30 million is considered to be state significant infrastructure. If the project was projected to exceed the $30 million threshold, then the project would be considered as state significant infrastructure and require the preparation of an Environmental Impact Statement.
State Environmental Planning Policy (Biodiversity and Consideration) 2021	This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The SEPP requires a plan of management for areas of more than one hectare that contain koala habitat and for which a development application has been lodged under Part 4 of the EP&A Act. If koala habitat was found to be impacted by the proposed works it would be assessed under the requirements of the *Biodiversity and Conservation Act 2016* and *Environment Protection Biodiversity Conservation Act 1999*.

Instrument	Summary of requirements/approval required
Byron Local Environmental Plan (BLEP) 1988 and 2014	The weir and the entire area of inundation for all modelled raising scenarios (refer Section 12.2.4) is contained within land zoned as Deferred Matter, Environmental Conservation and Environmental Management in the BLEP 2014. The location and zoning for other infrastructure has not been identified.

Appendix 2. SCENARIO COST ESTIMATES

Capital and operating components:

WTP replacement 3.9 ML/d	Assume OSS site 1				
2025$					
Item	**Rate**	**Unit**	**Quantity**	**Cost**	**Source of data**
Construction					
Site preparation - clearing, earthworks, drainage, service connections	$200,000	item	1	$200,000	Estimate
Replacement WTP (equipment and installation)	$8,434,529	item	1	$8,434,529	CWT (2020) Section 10.2
SCADA programming, telemetry	$100,000		1	$100,000	Estimate
Transfer to reservoirs	$200,000		1	$200,000	Estimate
Commissioning		2%		$168,691	Estimate
Sub-total: construction				***$9,103,220***	
Concept design and REF		2.5%		$227,580	
Tendering and documentation		1.0%		$91,032	
Detailed design		4.0%		$364,129	
Survey and geotech		2.0%		$182,064	
Sub-total: design				***$864,806***	
Sub-total: design and construction				***$9,968,026***	
Contingency		20%		$1,993,605	
Project management		10%		$996,803	
Total capital cost				**$12,958,433**	
Operation and maintenance					
WTP operation	p.a.			$1,010,985	Estimate based on cost of existing WTP operation and maintenance
UV operation	p.a.			$240,447	CWT (2020) cost estimates
Total O&M cost				**$1,251,432**	

OSS 200 ML					
Average storage surface area	5.8	ha			
Required additional site area					
Required site area	54	ha	Assume site 1		
includes WTP and pipelines etc					
Capital cost - OSS 200 ML					
2025$					
Item	**Rate**	**Unit**	**Quantity**	**Cost**	**Source of data**
Land acquisition					
Land rezoning		item	1	$0	included in WTP cost
Landholder negotiations, legals		item	1	$0	included in WTP cost
Land purchase	$625,000	per ha	54	$33,750,000	Required site area
Sub-total: land acquisition				***$33,750,000***	
Contingency		20%		$6,750,000	
Total land acquisition				***$40,500,000***	
Construction					
Site preparation - clearing, earthworks, drainage, service connections	$200,000	item	1	$200,000	Estimate
Cut and fill	$10	per m^3	178,232	$1,782,323	Construction contractor recent rates
Bedding/liner protection construction	$30	per m^3	20,778	$623,346	Construction contractor recent rates
Bedding/liner material	$30	per m^2	69,261	$2,077,821	Construction contractor recent rates
Water line erosion protection	$200,000	item	1	$200,000	Estimate
Spillway	$50,000	item	1	$50,000	Estimate
Access road	$100,000	item	1	$100,000	Estimate
Pipework to WTP	$100,000	item	1	$100,000	Estimate
Water quality/ aeration	$200,000	item	1	$200,000	Estimate
Sub-total: construction				***$5,333,490***	
Concept design and REF		2.5%		$133,337	
Tendering and documentation		1.0%		$53,335	
Detailed design		4.0%		$213,340	
Survey and geotech		2.0%		$106,670	
Sub-total: design				***$506,682***	
Sub-total: design and construction				***$5,840,171***	
Contingency		20%		$1,168,034	
Project management		10%		$116,803	
Total capital cost				**$47,625,009**	
Operation and maintenance					
OSS operation and maintenance including energy	p.a.			$250,000	Estimate
Total O&M cost				**$250,000**	

Mullumbimby Water Supply Strategy

Pipeline from weir to OSS site	also	**Pipeline from groundwater bore to WTP site**				also	**Pipeline from weir to WTP site**
Pipeline to existing WTP: Willow & Sparrow (2020) Option 4		Length	560	m	Additional length: existing WTP to OSS site	673	m
Item			**Cost estimate (2020$)**		**Additional cost (2020$)**		
Preliminaries			$67,500				
Tree removal			$1,500		$1,803		
Pipework			$44,200		$53,119		
Bends			$4,155		$4,993		
Air valves			$2,506		$3,012		
Live connections			$10,000		$12,018		
Concrete			$6,900		$8,292		
Pump station and shed			$125,000		no increase		
Quarry products			$25,600		$30,766		
Labour			$428,000		$514,364		
Electrical and instrumentation			$25,000		$30,045		
Reinstatement			$30,000		$36,054		
Sub-total			**$770,361**		**$694,465**		
Land acquisition							
Land rezoning		item	1	$0	included in WTP cost		
Landholder negotiations, legals		item	1	$0	included in WTP cost		
Land purchase	#######	per ha	0.1	$62,500	Easement through private property section, not including roadway		
Sub-total: land acquisition				***$62,500***			
Sub-total: construction			***$1,464,826***				
Concept design and REF	2.5%		$36,621				
Tendering and documentation	1.0%		$14,648				
Detailed design	4.0%		$58,593				
Survey and geotech	2.0%		$29,297				
Sub-total: design			***$139,158***				
Sub-total: design and construction			***$1,603,985***				
Contingency	20%		$320,797				
Project management	10%		$160,398				
Total design and construction (2020$)			**$2,085,180**				
Indexing			1.26				
Total design and construction (2025$)			**$2,625,002**				
Total capital cost (2025$)			**$2,687,502**				
Operation and maintenance							
Mains operation	p.a.	1,233	$6,449		Estimate based on cost of existing mains operation and maintenance		
Power cost	p.a.		$31,110		Willow & Sparrow (2020)		
Total O&M cost			**$37,558**				
Emergency supply pipeline							
Operation and maintenance							
Mains operation	p.a.	6,200	$32,426		Estimate based on cost of existing mains operation and maintenance		
Total O&M cost			**$32,426**				

Fishway at Lavertys Gap weir

Fishways under 6 m high are very successful in transferring fish in this region of Australia. Fishways over a greater height are typically more complicated and expensive to design. FRC Environmental (2003) concluded that developing and maintaining an effective fishway may be a major constraint to the development of this option. In eastern Australia, rock-ramp fishways, vertical slot fishways, bypass channel fishways and fishlocks have been successfully used to circumvent instream obstructions. Rock ramp fishways are generally used for low barriers (up to two metres high), vertical slot fishways for medium sized barriers (up to six metres high), bypass channels for dams and weirs up to eight metres high and fish locks for high barriers (typically over eight to ten metres high).

Laverty's Gap is 7 m high weir

PWA (2012) concept design for Jabour Weir fishway - vertical slot converted to fish lock

Cost estimate (2012$) including construction, contingency and design			$6,803,742		
Indexing			1.44		
Total capital cost (2025$)			**$9,775,326**		
Item	**Rate**	**Unit**	**Quantity**	**Cost**	**Source of data**
Land acquisition					
Land rezoning		item	1	$0	included in WTP cost
Landholder negotiations, legals		item	1	$0	included in WTP cost
Land purchase	$625,000	per ha	3	$1,875,000	bypass
Sub-total: land acquisition				***$1,875,000***	
Added contingency		20%		$375,000	
Total land acquisition				***$2,250,000***	
Total capital cost				***$12,025,326***	
Operation and maintenance					
Mains operation	2%	p.a.	$195,507		
Total O&M cost					

Estimate for fish lift includes inspections, clearing of debris/cleaning, repairs/maintenance on gates/valves/control systems, fish monitoring, SCADA systems, sensors, energy (Sunwater, 2023)

Groundwater 1.1 ML/d (duty and standby)					
2025$					
based on Jacobs (2020) Alstonville 2.5 ML/d costs					
Land acquisition					
Land rezoning		item	1	$0	included in WTP cost
Landholder negotiations, legals		item	1	$0	included in WTP cost
Land purchase	$625,000	per ha	2	$1,250,000	2025$
Sub-total: land acquisition				***$1,250,000***	
Contingency		20%		$250,000	
Total land acquisition				***$1,500,000***	
Construction					
Test bores	$500,000	item	1	$629,442	
Bore pump station	$110,000	item	2	$276,955	indexed, 25% higher than difference in yield
Bore construction	$475,000	item	2	$1,195,941	
Bore head enclosure	$100,000	item	2	$251,777	
Bore pad	$93,750	item	2	$236,041	
Power supply	$600,000	item	1	$755,331	
Civil works	$100,000	item	1	$125,888	
Sub-total: construction				***$3,471,375***	
Concept design and REF		2.5%		$86,784	
Tendering and documentation		1.0%		$34,714	
Detailed design		4.0%		$138,855	
Survey and geotech		2.0%		$69,428	
Sub-total: design				***$329,781***	
Sub-total: design and construction				***$3,801,156***	
Contingency		20%		$760,231	
Project management		10%		$380,116	
Total capital cost				**$6,441,503**	
Operation and maintenance					
Maintenance	0.50%			$629	
Staffing				$100,000	
Utilities				$100,000	
Licences				$25,000	
Support				$15,000	
Total O&M cost				**$240,629**	p.a.

Mullumbimby Water Supply Strategy

S1: Base case																														
2025 $'000																														
Spread of initial costs	*100%*	*5%*	*5%*	*20%*	35%	35%																								
	Total cost (30 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
Capital Expenditure		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**
WTP replacement 3.9 ML/d	**$12,958**	$648	$648	$2,592	$4,535	$4,535																								
WTP renewal (10% of capital every 10 years)	**$2,592**															$1,296										$1,296					
Pipeline from weir to WTP site	**$2,688**	$134	$134	$538	$941	$941																								
Pipeline renewal (10% of capital every 10 years)	**$525**															$263										$263					
Extension and duplication of emergency supply main	**$5,000**	$5,000																												
Grant for extension and duplication of emergency supply main	**-$5,000**	-$5,000																												
Emergency supply main renewal (10% of capital every 10 years)	**$1,000**											$500										$500								
Total capital cost	**$19,763**	**$782**	**$782**	**$3,129**	**$5,476**	**$5,476**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$1,558**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$1,558**	**$0**	**$0**	**$0**	**$0**	**$0**
Operational expenditure																														
Emergency supply	**$7,884**	$137	$146	$154	$163	$172	$180	$189	$198	$206	$215	$224	$232	$241	$250	$258	$267	$276	$285	$293	$302	$311	$319	$328	$337	$345	$354	$363	$371	$380	$389
WTP replacement 3.9 ML/d	**$31,286**						$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251
Pipeline from weir to WTP site	**$939**						$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38
Emergency supply main	**$940**		$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32
Total operating cost	**$41,049**	**$137**	**$178**	**$187**	**$195**	**$204**	**$1,502**	**$1,510**	**$1,519**	**$1,528**	**$1,536**	**$1,545**	**$1,554**	**$1,563**	**$1,571**	**$1,580**	**$1,589**	**$1,597**	**$1,606**	**$1,615**	**$1,623**	**$1,632**	**$1,641**	**$1,649**	**$1,658**	**$1,667**	**$1,675**	**$1,684**	**$1,693**	**$1,702**	**$1,710**
Total cost	***$60,812***	***$919***	***$960***	***$3,316***	***$5,671***	***$5,680***	***$1,502***	***$1,510***	***$1,519***	***$1,528***	***$1,536***	***$2,045***	***$1,554***	***$1,563***	***$1,571***	***$3,138***	***$1,589***	***$1,597***	***$1,606***	***$1,615***	***$1,623***	***$2,132***	***$1,641***	***$1,649***	***$1,658***	***$3,225***	***$1,675***	***$1,684***	***$1,693***	***$1,702***	***$1,710***
2025$																														
Life-cycle cost (30 years)	$60,812,076																													
30 year NPV	$34,550,773	5% Discount rate																												
Secure yield at 2050	754 ML/a																													
NPV/ ML yield	$45,823 /ML/a																													

Mullumbimby Water Supply Strategy

S2: Off-stream storage																															
2025 $'000																															
Spread of initial costs	*100%*	*5%*	*5%*	*20%*	*35%*	*35%*																									
	Total cost (30 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
Capital Expenditure		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**
WTP replacement 3.9 ML/d	**$12,958**	$648	$648	$2,592	$4,535	$4,535																									
WTP renewal (10% of capital every 10 years)	**$2,592**															$1,296										$1,296					
OSS 200 ML	**$47,625**	$2,381	$2,381	$9,525	$16,669	$16,669																									
Pipeline from weir to OSS site	**$2,688**	$134	$134	$538	$941	$941																									
Pipeline renewal (10% of capital every 10 years)	**$525**															$263										$263					
Fishway at Lavertys Gap weir	**$12,025**	$601	$601	$2,405	$4,209	$4,209																									
Extension and duplication of emergency supply main	**$5,000**	$5,000																													
Grant for extension and duplication of emergency supply main	**-$5,000**	-$5,000																													
Emergency supply main renewal (10% of capital every 10 years)	**$1,000**											$500										$500									
Servicing trunk main customers (estimate)	**$500**	$500																													
Total capital cost	**$79,913**	**$4,265**	**$3,765**	**$15,059**	**$26,354**	**$26,354**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$1,558**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$1,558**	**$0**	**$0**	**$0**	**$0**	**$0**
Operational expenditure																															
Emergency supply	**$771**	$137	$146	$154	$163	$172																									
WTP replacement 3.9 ML/d	**$31,286**						$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251
OSS 200 ML	**$6,250**						$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250
Pipeline from weir to OSS site	**$939**						$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38
Fishway at Lavertys Gap weir	**$4,888**						$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196	$196
Emergency supply main	**$940**		$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32
Total operating cost	**$45,074**	**$137**	**$178**	**$187**	**$195**	**$204**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**	**$1,767**
Total cost	***$124,987***	***$4,402***	***$3,943***	***$15,246***	***$26,549***	***$26,558***	***$1,767***	***$1,767***	***$1,767***	***$1,767***	***$1,767***	***$2,267***	***$1,767***	***$1,767***	***$1,767***	***$3,325***	***$1,767***	***$1,767***	***$1,767***	***$1,767***	***$1,767***	***$2,267***	***$1,767***	***$1,767***	***$1,767***	***$3,325***	***$1,767***	***$1,767***	***$1,767***	***$1,767***	***$1,767***
2025$																															
Life-cycle cost (30 years)	$124,986,774																														
30 year NPV	$89,021,613	5%	Discount rate																												
Secure yield at 2050	879	ML/a																													
NPV/ ML yield	$101,276	/ML/a																													

Mullumbimby Water Supply Strategy

S2: Off-stream storage - Sensitivity with 15% increased in costs																															
2025 $'000																															
Spread of initial costs	*100%*	*5%*	*5%*	*20%*	*35%*	*35%*																									
	Total cost (30 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
Capital Expenditure		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**
WTP replacement 3.9 ML/d	**$14,902**	$745	$745	$2,980	$5,216	$5,216																									
WTP renewal (10% of capital every 10 years)	**$2,980**															$1,490										$1,490					
OSS 200 ML	**$54,769**	$2,738	$2,738	$10,954	$19,169	$19,169																									
Pipeline from weir to OSS site	**$3,091**	$155	$155	$618	$1,082	$1,082																									
Pipeline renewal (10% of capital every 10 years)	**$604**															$302										$302					
Fishway at Lavertys Gap weir	**$13,829**	$691	$691	$2,766	$4,840	$4,840																									
Extension and duplication of emergency supply main	**$5,750**	$5,750																													
Grant for extension and duplication of emergency supply main	**-$5,750**	-$5,750																													
Emergency supply main renewal (10% of capital every 10 years)	**$1,150**											$575										$575									
Servicing trunk main customers (estimate)	**$575**	$575																													
Total capital cost	**$91,900**	**$4,905**	**$4,330**	**$17,318**	**$30,307**	**$30,307**						**$575**				**$1,792**						**$575**				**$1,792**					
Operational expenditure																															
Emergency supply	**$887**	$157	$167	$177	$187	$197																									
WTP replacement 3.9 ML/d	**$35,979**						$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439	$1,439
OSS 200 ML	**$7,188**						$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288	$288
Pipeline from weir to OSS site	**$1,080**						$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
Fishway at Lavertys Gap weir	**$5,621**						$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225	$225
Emergency supply main	**$1,081**		$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37
Total operating cost	**$51,835**	**$157**	**$205**	**$215**	**$225**	**$235**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**	**$2,032**
Total cost	***$143,735***	***$5,062***	***$4,534***	***$17,533***	***$30,531***	***$30,541***	***$2,032***	***$2,032***	***$2,032***	***$2,032***	***$2,032***	***$2,607***	***$2,032***	***$2,032***	***$2,032***	***$3,824***	***$2,032***	***$2,032***	***$2,032***	***$2,032***	***$2,032***	***$2,607***	***$2,032***	***$2,032***	***$2,032***	***$3,824***	***$2,032***	***$2,032***	***$2,032***	***$2,032***	***$2,032***
2025$																															
Life-cycle cost (30 years)	$143,734,790																														
30 year NPV	$102,374,855	5%	Discoun	115%																											
Secure yield at 2050	879	ML/a																													
NPV/ ML yield	$116,467	/ML/a																													

S3: permanent RCC regional connection																															
2025 $'000																															
	Total cost (30 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
Capital Expenditure		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**
Extension and duplication of emergency supply main	**$5,000**	$5,000																													
Grant for extension and duplication of emergency supply main	**-$5,000**	-$5,000																													
Emergency supply main renewal (10% of capital every 10 years)	**$1,000**											$500										$500									
Servicing trunk main customers (estimate)	**$500**	$500																													
Total capital cost	**$1,500**	**$500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Operational expenditure																															
Emergency supply	**$137**	$137																													
Bulk water purchase	**$88,705**		$1,480	$1,613	$1,759	$1,921	$2,077	$2,246	$2,430	$2,507	$2,585	$2,666	$2,749	$2,826	$2,905	$2,986	$3,069	$3,156	$3,245	$3,337	$3,431	$3,527	$3,626	$3,728	$3,832	$3,938	$4,048	$4,129	$4,211	$4,296	$4,382
Emergency supply main	**$940**		$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32
Total operating cost	**$89,782**	**$137**	**$1,513**	**$1,646**	**$1,792**	**$1,953**	**$2,109**	**$2,278**	**$2,463**	**$2,539**	**$2,618**	**$2,698**	**$2,781**	**$2,858**	**$2,937**	**$3,018**	**$3,102**	**$3,189**	**$3,278**	**$3,369**	**$3,463**	**$3,560**	**$3,659**	**$3,760**	**$3,864**	**$3,971**	**$4,080**	**$4,161**	**$4,244**	**$4,328**	**$4,414**
Total cost	***$91,282***	***$637***	***$1,513***	***$1,646***	***$1,792***	***$1,953***	***$2,109***	***$2,278***	***$2,463***	***$2,539***	***$2,618***	***$3,198***	***$2,781***	***$2,858***	***$2,937***	***$3,018***	***$3,102***	***$3,189***	***$3,278***	***$3,369***	***$3,463***	***$4,060***	***$3,659***	***$3,760***	***$3,864***	***$3,971***	***$4,080***	***$4,161***	***$4,244***	***$4,328***	***$4,414***
2025$																															
Life-cycle cost (30 years)	$91,281,692																														
30 year NPV	$42,956,518	5%	Discount rate																												
Secure yield at 2050	754	ML/a																													
NPV/ ML yield	$56,972	/ML/a																													

Mullumbimby Water Supply Strategy

S3: permanent RCC regional connection - Sensitivity with increased future bulk supply cost																														
2025 $'000																														
	Total cost (30 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
Capital Expenditure		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**
Extension and duplication of emergency supply main	**$5,000**	$5,000																												
Grant for extension and duplication of emergency supply main	**-$5,000**	-$5,000																												
Emergency supply main renewal (10% of capital every 10 years)	**$1,150**											$575										$575									
Servicing trunk main customers (estimate)	**$575**	$575																												
Total capital cost	**$1,725**	**$575**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$575**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$575**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Operational expenditure																														
Emergency supply	**$157**	$157																												
Bulk water purchase	**$109,579**		$1,480	$1,613	$1,759	$1,921	$2,077	$2,246	$2,430	$2,507	$2,585	$2,797	$3,025	$3,262	$3,518	$3,793	$4,090	$4,206	$4,325	$4,447	$4,572	$4,701	$4,832	$4,967	$5,106	$5,248	$5,394	$5,502	$5,612	$5,724	$5,839
Emergency supply main	**$1,081**		$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37	$37
Total operating cost	**$110,817**	**$157**	**$1,518**	**$1,651**	**$1,796**	**$1,958**	**$2,114**	**$2,283**	**$2,467**	**$2,544**	**$2,622**	**$2,834**	**$3,062**	**$3,299**	**$3,555**	**$3,830**	**$4,127**	**$4,243**	**$4,362**	**$4,484**	**$4,609**	**$4,738**	**$4,870**	**$5,005**	**$5,143**	**$5,286**	**$5,431**	**$5,539**	**$5,649**	**$5,762**	**$5,876**
Total cost	***$112,542***	***$732***	***$1,518***	***$1,651***	***$1,796***	***$1,958***	***$2,114***	***$2,283***	***$2,467***	***$2,544***	***$2,622***	***$3,409***	***$3,062***	***$3,299***	***$3,555***	***$3,830***	***$4,127***	***$4,243***	***$4,362***	***$4,484***	***$4,609***	***$5,313***	***$4,870***	***$5,005***	***$5,143***	***$5,286***	***$5,431***	***$5,539***	***$5,649***	***$5,762***	***$5,876***
2025$																														
Life-cycle cost (30 years)	$112,542,388																														
30 year NPV	$50,770,488	5% Discount rate																													
Secure yield at 2050	754 ML/a																														
NPV/ ML yield	$67,335 /ML/a																														

S4: Groundwater																														
2025 $'000																														
Spread of initial costs	*100%*	*5%*	*5%*	*20%*	*35%*	*35%*																								
	Total cost (30 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
Capital Expenditure		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**
WTP replacement 3.9 ML/d	**$12,958**	$648	$648	$2,592	$4,535	$4,535																									
WTP renewal (10% of capital every 10 years)	**$2,592**															$1,296										$1,296					
Groundwater 1.1 ML/d (duty and standby)	**$6,442**	$322	$322	$1,288	$2,255	$2,255																									
Bore renewal (10% of capital every 10 years)	**$1,288**															$644										$644					
Pipeline from weir to OSS site	**$2,688**	$134	$134	$538	$941	$941																									
Pipeline renewal (10% of capital every 10 years)	**$525**															$263										$263					
Pipeline from groundwater bore to WTP site	**$2,688**	$134	$134	$538	$941	$941																									
Pipeline renewal (10% of capital every 10 years)	**$525**															$263										$263					
Extension and duplication of emergency supply main	**$5,000**	$5,000																													
Grant for extension and duplication of emergency supply main	**-$5,000**	-$5,000																													
Emergency supply main renewal (10% of capital every 10 years)	**$1,000**											$500										$500									
Servicing trunk main customers (estimate)	**$500**	$500																													
Total capital cost	**$31,205**	**$1,739**	**$1,239**	**$4,955**	**$8,671**	**$8,671**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$2,465**	**$0**	**$0**	**$0**	**$0**	**$0**	**$500**	**$0**	**$0**	**$0**	**$2,465**	**$0**	**$0**	**$0**	**$0**	**$0**
Operational expenditure																															
Emergency supply	**$771**	$137	$146	$154	$163	$172																									
WTP replacement 3.9 ML/d	**$31,286**						$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251	$1,251
Groundwater 1.1 ML/d (duty and standby)	**$6,016**						$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241	$241
Pipeline from weir to OSS site	**$939**						$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38
Pipeline from groundwater bore to WTP site	**$939**						$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38
Emergency supply main	**$940**		$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32	$32
Total operating cost	**$40,891**	**$137**	**$178**	**$187**	**$195**	**$204**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**	**$1,600**
Total cost	***$72,096***	***$1,876***	***$1,417***	***$5,142***	***$8,867***	***$8,875***	***$1,600***	***$1,600***	***$1,600***	***$1,600***	***$1,600***	***$2,100***	***$1,600***	***$1,600***	***$1,600***	***$4,065***	***$1,600***	***$1,600***	***$1,600***	***$1,600***	***$1,600***	***$2,100***	***$1,600***	***$1,600***	***$1,600***	***$4,065***	***$1,600***	***$1,600***	***$1,600***	***$1,600***	***$1,600***
2025$																															
Life-cycle cost (30 years)	$72,095,771																														
30 year NPV	$43,901,674	5% Discount rate																													
Secure yield at 2050	754 ML/a																														
NPV/ ML yield	$58,225 /ML/a																														

Appendix 3. CLIMATE CORRECTION METHODOLOGY AND RESULTS

Daily water demand patterns are highly variable and are likely to be influenced by a broad range of factors. Despite variability in the demand data there is an intuitive connection between climate and water demand which has been considered in the analysis of the Mullumbimby demand.

Using the current NSW Security of Supply Methodology, 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). Modelling has been undertaken to attempt to correlate key climate influencing factors such rainfall, temperature and evaporation to changes in demand. This has been used to estimate the unrestricted dry year annual demand.

Daily correlation of climate factors to daily water demand is difficult due to factors such as:

- Variable household demand patterns, overall water requirements and thresholds for water use.
- Variable thresholds for factors that may trigger increased water use.
- Variable timing of response to climatic factors.
- Complex inter-actions between climatic factors.

Correlation of a broad range of factors, over variable timeframes, for variable thresholds etc. is not practical and is likely to be very specific to a particular data set. For a methodology that can be applied to multiple situations, it is considered more appropriate to determine whether broad combinations of climatic factors can be used to predict periods of increased water usage.

The adopted methodology has been developed with the following assumptions:

- Dry weather (indicated by low rainfall or low net rainfall) will increase outdoor water use (mainly irrigation) once a duration threshold has been reached. This is likely to be due actual or perceived low soil moisture or visible signs of plant stress.
- Hot weather will increase water usage. This is likely to be due to increased use of pools, showers after visiting the beach etc. and perceived garden irrigation needs during periods of high temperature. This is likely to be a shorter-term effect than dry weather and is not necessarily linked to soil moisture.
- High evaporation rates will increase outdoor water use when there is no rainfall. Such conditions would occur during periods of low humidity, high wind, high temperatures etc. This is considered to be linked to actual or perceived plant evaporation stress.

A simplified method has been adopted which investigates the ability of a sub-set of environmental factors to predict periods of increased water usage. A tool (excel macro) has been developed which allows identification of time periods where combinations of the following factors occur for a user-specified period:

- Rainfall.
- Temperature.
- Evaporation.
- Net rainfall.
- Humidity.

Various combinations of climate factors and thresholds are tested to determine whether these can independently identify the water usage peaks. The simplest combination which is considered to adequately predict these peaks is then used as the basis for further analysis.

Water usage data for peak usage periods are identified and the average water usage during these periods is compared to average water usage for periods of non-peak use. The additional usage is calculated as a percentage increase which is applicable to these dry/hot weather events.

Data used in the analysis and results are shown in Table 65 and Figure 76.

Utilising the same thresholds and analysis techniques, it is possible to identify the extent of climate occurrences for predicted future data sets with application of the daily climate factor. However, at this time, there are no available data on future climate parameters and future prediction of climate corrected demand has not been undertaken.

In this demand forecast, the increase in demand due to dry weather (from Table 65) has been applied to the average consumption for each connection type. The average for the previous eight years (since 2012) has been used to remove any influences due to pricing and water efficient behaviour over longer periods. Due to the expected increase in outdoor use the residential consumption, is likely to increase during hot/dry weather, although due to the lack of short-term consumption data and the expected influence of other factors (such as pricing, demographics, lot type and size and soil types), the impact on consumption for each customer type, particularly non-residential customers is not quantifiable. Hence as a conservative approach, the increase in consumption during a dry year has been applied to all customer types.

In some cases, the maximum metered demand per connection over the previous eight years is higher than the dry year demand. This may be due to the other factors that influence demand as discussed above but may also be a result of the lack of short-term consumption data available for the analysis.

Table 65: Climate correction data, parameters and results

Location	Climate data[1]	Bulk supply data[2]	Average % of time with hotter/drier weather events (%)[3,4]	Additional usage during peak times compared to non-peak usage (%)[3,5]	% correlation of prediction[6]	% of time with hotter/drier weather events in "worst case" year[4,7]	Predicted "dry weather" increase in demand in a "worst case year" (%)[8]
Mullumbimby	Lat: - 28.55 Long: 153.49	1/7/2011 - 7/11/2019	22%	22%	75%	36% (2019)	3.24%

1. Sourced from Queensland Government (2020) from 1/1/1970 to 2020.

2. Restrictions were imposed from 7 November 2019, therefore only data before 7 November 2019 have been used.

3. For all years of climate and bulk supply data.

4. "Hotter/drier weather events" are the days which meet the climate variables which best predict usage increases for Mullumbimby.

5. 'Peak' usage defined as when the 14-day average daily demand per connection is greater than the average demand per connection for the entire data set and the 90-day average demand is greater than the 360-day average demand per connection.

6. % of time that "hotter/drier weather events" (based on the climate variables selected) accurately predict periods of increased water demand.

7. "Worst case" year is the year with the highest number of days of "hotter/drier weather events".

8. Additional usage during peak times x additional time with hotter/drier events

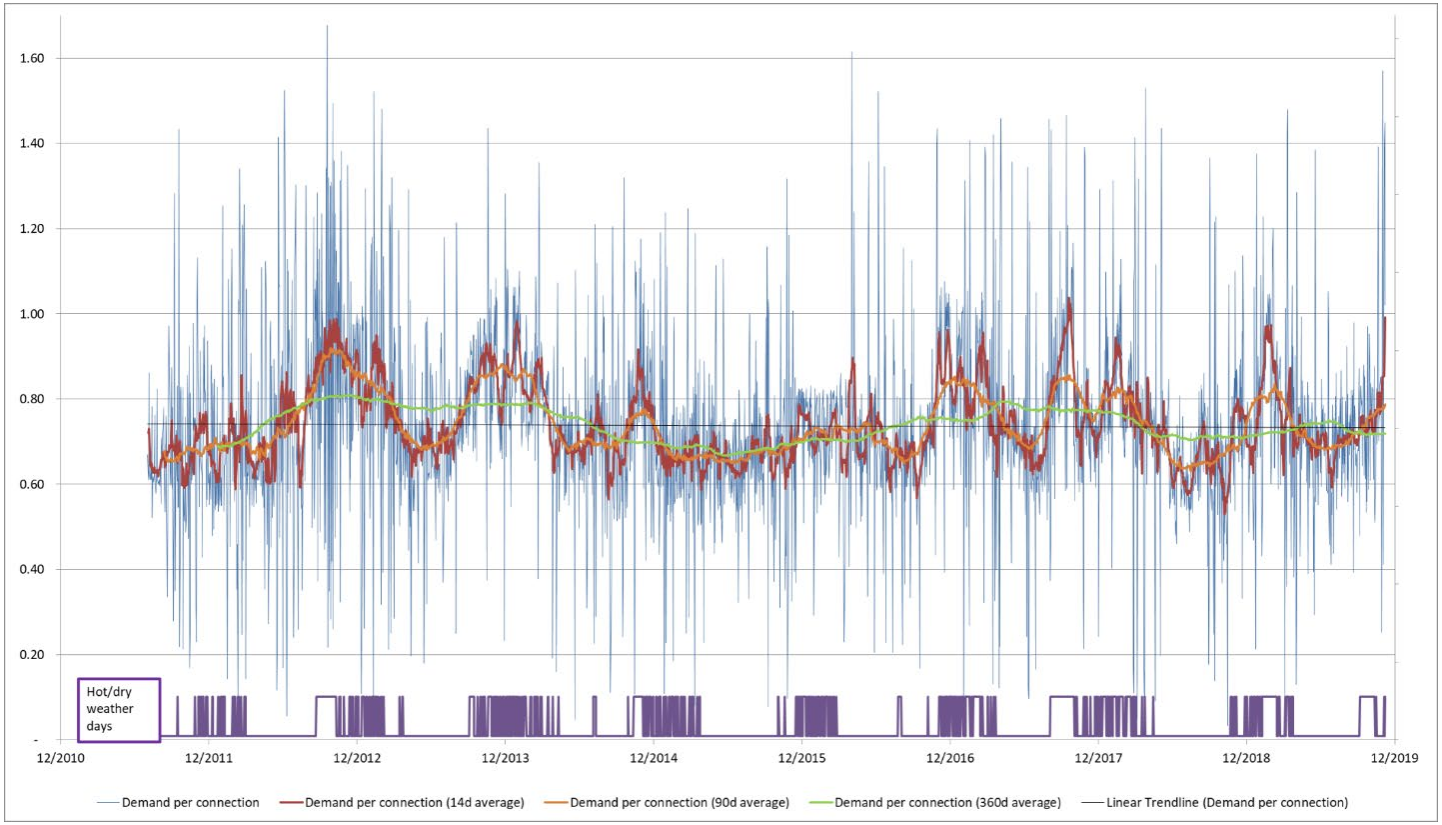

Figure 74: Climate correction analysis - Mullumbimby

Appendix 4. TRIPLE-BOTTOM LINE ASSESSMENT

Mullumbimby Water Supply Strategy

	Environmental Criteria			Environmental Score	Environmental Weighting	Social Criteria		Social Score	Social Weighting	Net present value ($ million)	Life-cycle cost ($ million)	Total Score per $NPV
	Aquatic	Terrestrial	Energy consumption			Community acceptance	Security of supply					
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.	Energy requirements	Weighted criteria score	Weighting compared to social criteria	Predicted community acceptance	Year of augmentation required (following implementation of the scenario)	Weighted criteria score	Weighting compared to environmental criteria	NPV of capital and operating costs (80 years) at 5% discount rate	Total cost over 30 years	(weighted environmental score + weighted social score)/NPV
Criteria weighting	33%	33%	33%	100%		50%	50%	100%				
Scenario S1: Base Case												
Result	No additional impacts	No additional impacts	Raw water upgrade, WTP replacement	**4.50**		Moderate investment, energy requirements, restrictions	2027	**1.00**		34.6	60.8	**79.5**
Score	5.0	5.0	3.5			1.0	1.0					
Scenario S2: Off-Stream Storage												
Result	No additional impacts	Minimal	Raw water upgrade, WTP replacement, raw water transfer to storage	**3.67**		High investment, infrastructure modifications, energy requirements	2060	**3.50**		89.0	125.0	**40.3**
Score	4.0	4.0	3.0		50%	2.5	4.5		50%			
Scenario S3: Permanent connection to RCC regional supply												
Result	No additional impacts	Minimal	Minimal	**4.67**		Modified service delivery	Equivalent to RCC security	**4.00**		43.0	91.3	**100.8**
Score	5.0	4.5	4.5			3.0	5.0					
Scenario S4: Groundwater												
Result	Impacts can be minimised through site selection	Minimal	Raw water upgrade, WTP replacement, groundwater transfer and treatment	**3.67**		Moderate investment, energy requirements, potential for competing use of groundwater	2050	**3.25**		43.9	72.1	**78.8**
Score	4.0	4.0	3.0			2.5	4.0					
Score out of 5	5 - highest											

Byron Shire Council

FOR ACTION

Report No 14.26 - Mullumbimby Water Supply Strategy

TO: Clark, Cameron - Manager Utilities

COPY TO:

DATE: 19 August 2024

MEETING: Council Meeting of 15 August 2024

RESOLUTION NUMBER: 24-411

Action is required for this item as per the Council Resolution outlined below.

Resolved that Council:

1. Notes the outcomes of the public consultation on Mullumbimby Future Water Strategy (Attachment 1 and 2);
2. Notes the revised NPV comparison analysis for the Water Supply Options for Scenarios 2 and 3;
3. Adopts Scenario 3 - permanent, full connection to the Rous regional water supply;
4. Maintains its extraction licence at Lavertys Gap;
5. Requests staff to investigate and report back to Council options for Lavertys Gap water treatment infrastructure and associated land use; and
6. Commits to continuing to reticulate current volumes of potable water to properties already connected between the Laverty's gap Water Treatment Plant and Azalea Street reservoirs.

(Lyon/Hunter)

The motion was put to the vote and carried unanimously.

SPECIFIC ACTIONS REQUIRED:

Byron Shire Council

This action sheet has been automatically produced by the administrator using **InfoCouncil**, the agenda and minutes database.

Click the 

button on the InfoCouncil Toolbar to update the outstanding actions.

For completed actions: Please update the notes and update the finalisation date.

For ongoing actions: Please update the notes and the expected completion date.

Please continue to update the comments until the matter has been finalised.

Please note:

- The notes that you record against *Actions* in InfoCouncil are reported to Council and are therefore **public and should not be used for internal comments**
- When a resolution has multiple parts (i.e. 1., 2., 3.) **each update should address each of the points**, with the corresponding number
- The default *target date* is 1 month from the meeting – you can **change the target date** and provide a reason (again… this will be public)
- Only mark as complete once **ALL parts are complete**
- Once you have marked complete, your **Director** will receive an email requesting authorisation for the action be marked as complete. Directors can either:
    a. **Approve completion** – This marks it as complete and notifies the action owner; OR
    b. **Return the action** – This can be selected where the action notes provided by the officer are insufficient or if the action shouldn't have been marked complete yet. The officer will have the action returned to them and it will stay incomplete. If the action is returned to you, you will need to action any feedback from your Director and redo the steps to mark the action as complete when appropriate.
- If for some reason the resolution cannot be completed (e.g. budget, legislation, or competing priorities) you can reallocate the action to the user called '**No Action, Closed'** and provide a detailed reason. This will be reported to Council to endorse the closure of the resolution.
- Reference **CM9 doc numbers** in notes whenever possible
- You can add notes at any time, but at a minimum **all actions should be updated before the end of the quarter** (30 Sept, 31 December, 31 March, 30 June).

Further information can be found on the Intranet and in the Resolution Reporting Guidelines.

Supporting information for the WSAC

This is an attachment to the report titled **"Mullumbimby water supply strategy - High-level project plan"** (Record # I2025/395), submitted for the WSAC meeting on 17 April 2025 report. It provides a summary of progress done with regards to the action items of Council **Resolution 24-477**.

The resolution's action items and relevant progress updates are presented below:

1. *The decision to pursue a permanent connection to Rous be deferred for up to two years.*

   Staff response:
   Delivery of evidence-based recommendations to Council for deciding on a Water Supply Strategy for Mullumbimby is expected to be completed before October 2026.

2. *Council continues with the emergency connection to Rous as planned and **investigates operational regimes to minimise the risk of water quality incidents**, as has been done for the existing emergency line.*

   Staff response:
   Utilities staff is undertaking two initiatives aimed at maintaining the reliability of the Lavertys Gap weir and Mullumbimby WTP water supply systems until a decision for a long-term water supply strategy is achieved.

   - **Lavertys Gap weir condition assessment, monitoring and remediation:** With the support of NSW Public Works, Council is undertaking actions to address bank erosion issues that put at risk the weir's structural integrity, and consequently, its storage capacity. The key focus is on condition monitoring and emergency repairs (if necessary, based on regular condition inspections). Final remediation works have been planned and designed, but will only be possible once the upgraded Rous Emergency Water Supply Line is operational, as the weir's water level will need to be dropped. Wet weather events can hinder these efforts.

   - **Mullumbimby WTP short-term improvements**: Following advice from NSW Health, Council staff are investigating changes to treatment processes, operational procedures and data quality controls to manage regulatory non-compliance risks at Mullumbimby WTP. This relates to the NSW Health classification of the Lavertys Gap water source as having a "High Risk" for Cryptosporidium[1], and the shortfalls of the WTP to address the risk due to its design and end-of-life condition. Council is investigating upgrades to ultra-violet treatment, while undertaking refinement of raw water filter operations and related water turbidity data monitoring. For the latter, the Water Operations team have

[1] Cryptosporidium is a microorganism found in water that can cause serious gastrointestinal disease. Livestock and sewage can be sources of Cryptosporidium that can infect humans. Cryptosporidium is of particular concern for water supplies because it is not controlled by normal doses of chlorine. A high standard of filtration or an alternative disinfection, such as ultraviolet light, is needed to control Cryptosporidium.

substantially increased operators' time on-site to implement, monitor and finetune these changes.

3. *Council seeks to **renegotiate an interim agreement for a reduced cost for emergency supply during this period** with Rous.*

   Staff response:
   Executives from Rous Water and Council met on 21 February 2025 to discuss this issue. A letter from the General Manager requesting a reduction to the emergency supply charge has been delivered to Rous on 9 April 2025.

4. *That a **staged investigation into integrated water supply options be continued**, including off stream storage and a hybrid solution with Lavertys Gap and Rous, and:*
   a. *the investigation includes **an options workshop** with community, and direct **community input** to multi-criteria weightings to compare options;*
   b. ***regular progress reports** be provided to the Council during this investigation period; and*
   c. *investigations into the **possible reinstatement of the hydroelectric plant** be explored.*
   (Ndiaye/Hauge)

   Staff response:
   The report submitted for the WSAC meeting of 17 April 2025 outlines a high-level project design to address these actions.

Report No. 4.3 Byron STP Wetlands Monitoring Report

Directorate: Infrastructure Services

Report Author: Cameron Clark, Manager Utilities

File No: I2025/470

Summary:

This report provides a summary of Byron STP wetlands performance in accordance with the STP Operations Environmental Management Plan.

RECOMMENDATION:

That the committee note the report.

Report

Australian Wetlands Consulting (AWC) have been engaged by Byron Shire Council (BSC) to provide operational support and management for the Byron Bay Integrated Water Management Reserve, (BBIWMR). This report summarises the key activities, actions and key findings.

The BBIWMR includes 15 ha of constructed treatment wetlands and the 24 ha Melaleuca regeneration system within a total site area of 106 ha. In addition to the managed wetland and regeneration areas are lands specifically designated for biodiversity in particular areas managed for frog and grass owl habitat. Refer to Attachment 1 for a plan showing the OEMP management zones

In 2022 AWC reviewed and updated the BBIWMR Operation and Environmental Management Plan (OEMP). During this review of the OEMP the various monitoring and reporting requirements as related to the Byron STP conditions of approval, legislative requirements and environmental management obligations were identified. The key reporting and frequency requirements are summarised in Table 1 – Documentation and Reporting. .

Summary of Key Activities Undertaken 2022-2025

1. Monthly checklists have been recorded since July 2022, providing knowledge of the site conditions and how it responds to operational and seasonal changes
2. A comprehensive asset register has been compiled determining the condition of all the components within the treatment wetland complex and Melaleuca regeneration area
3. A scientific trial of salvinia weevils (Cyrtobagous salviniae) for the control of Salvinia molesta is ongoing with the NSW Department of Primary Industries. December 2022 to June 2026
4. Development and collaboration with Rous County Council, BSC Bush Regeneration Team and AWC to detect, monitor and control an outbreak of Amazonian Frogbit (Limnobium laevigatum)
5. A review and update to the Byron STP Biodiversity Management Plan

6. A review of Bird monitoring activities in collaboration with Byron Bay Bird Buddies (BBBB)
7. Bird Surveys (Australasian Bittern, bimonthly bird surveys)
8. Grass Owl Survey
9. Cane Toad surveys
10. Feral Animal detection and management
11. Clearing of access and drains
12. Frog Survey (Wallum Sedge Frog and Wallum Froglet)
13. Anabat Survey
14. Installation of Nest boxes (BBBB and Wild BnB)
15. Vegetation Mapping and Monitoring (2023, 2024 and 2025)
16. Development of maintenance and repair lists

Table 1 Documentation and reporting requirements

Reporting	Frequency
Site inspections recorded in Water Outlook	Weekly
Annual return on environmental protection licences	Annually
Compliance report for this OEMP to satisfy consent condition 45, 49 and 60	Every 5 years
Bird survey – undertaken by Byron Bird Buddies	Annually
Threatened species report	Every 5 years
Flora and fauna survey	Every 5 years
Revision of the Effluent Management Strategy (in consultation with the EPA)	Every 5 years
Staff training and induction records to be kept	Following training
Annual performance report	Every 3 years

Summary of Key Management Activities

Table 2 summaries the key management activities and actions in relation to the OEMP and Biodiversity Management Plan and their current status as in April 2025.

Table 2 Management tasks, frequency, location and status April 2025

Management Task	Frequency	Location	Actions and Remediation	Status April 2025
Routine inspection (refer checklist in Appendix D) Ensure operational areas and public walkways are safe and accessible.	Weekly	Designated monitoring and observation points	Schedule mowing. Mowing undertaken as required by external contractor. Notify Operations Engineer of need for any works (e.g. stabilisation works)	Completed June 2022 to March 2025
Maintain dense cover of low grasses and sedges on berm surfaces	Monthly	Constructed wetland cells	Bush regeneration and weed management undertaken as required by external contractor or the BSC regen team	Ongoing condition of edge vegetation has significantly improved
Weed management and bush regeneration)	Monthly	Whole site	Bush regeneration and weed management undertaken as required by external contractor or the BSC regen team (Refer to *West Byron Sewerage Treatment Plant Weed Management Strategy* (DM530123))	Ongoing work with DPI as part of weevil trial for Salvinia control. Ongoing work with BSC Bush Regen Team to control Frogbit. Successful control on Salvinia in Cell H
Facilitate the annual Bird Survey	Annual	Whole site	Ensure records are kept and reports provided to NPWS	Ongoing
Create mudflat habitat and manage water levels in Cell H	Ongoing	Whole site	Refer to Section 4.8 of OEMP	In progress

Management Task	Frequency	Location	Actions and Remediation	Status April 2025
for bird habitat				
Communication and engagement with relevant stakeholders	Ongoing	Whole site	Refer to Section 5 of OEMP	Ongoing
Record and monitor plant health and growth	Weekly	Cells D, E, F, G Cells I and J	Identify areas of poor plant growth or health	Ongoing - completed June 2022 to March 2025
Seasonal drying of wetland cell floors to allow oxygenation of sediments and germination of wetland plants	Annual	Cells D, E, F, G Cells I and J	Drain cells slowly and carefully via all outlet valves to prevent erosion, scour and suspending sediments Close cells requiring maintenance during dry season. Cells D or E may need to be drained in mid June – July to create mudflats for habitat when wet weather prevents this within Cell H (refer Section 4.8 of OEMP).	Partial success (Cells D and E) Cells I and J have not been possible due to operational constraints (weather conditions, weed management requirements and no ability transfer to effluent reuse area)
Replanting of vegetation at outlets[1], in areas of poor growth and open water.	Bi-annually	Cells D, E, F, G Cells I and J	Schedule and arrange for replanting and translocation of healthy plants to areas of poor growth Ensure appropriate	Ongoing some trials have been undertaken but the main focus has been weed control

Management Task	Frequency	Location	Actions and Remediation	Status April 2025
			water levels can be provided in planting areas and consider bird protection	
Routine inspection of wetland cells for presence and growth of weeds (refer checklist in Appendix D)	Monthly	Cells D, E, F, G Cells I and J	Identify and prioritise weed management within the treatment wetland cells	Completed June 2022 to March 2025 Ongoing
Routine inspections (refer checklist in Appendix D)	Monthly	Cell H	Identify, record, and monitor any maintenance works	Completed June 2022 to March 2025
Maintain water level	When water levels drop to 0.45m	Cell H inlet	Maintain water level >0.45m and <1.0m Top-up cell to 0.65m when water level reaches 0.45m	Completed June 2022 to March 2025 No top ups required
Create mudflat habitat	Annually (in mid June – July)	Cell H or alternatively Cells C and D	1. Open valves to lower water level to approximately 0.4m to expose mudflats 2. Allow area to dry 3. Slash vegetation 4. Raise water level to 0.8m – 1.0m to kill remaining vegetation If wet weather	Ongoing has been partially completed. Increase in waders and waterbirds in Cells D and E

Management Task	Frequency	Location	Actions and Remediation	Status April 2025
			prevents the creation of mudflats in Cell H, Cell D or E shall be drained to create mudflats.	
Maintain wet season water level of 0.8m	Wet season (~Nov-Mar)	Cell H	To prevent inundation of plants and loss of habitat	Complete
Maintain water quality	As required	Cell H	Top up cell following significant rainfall events (>25mm/day)	Not required due to climatic conditions
Remove weeds	3 monthly	Cell H	Refer to *West Byron Sewerage Treatment Plant Weed Management Strategy* (DM530123)	Ongoing
Routine inspection (refer checklist in Appendix D)	Monthly	24ha area	Identify, record, and monitor any maintenance works	Completed June 2022 to March 2025 Ongoing
Manage weeds within the 24ha	Monthly	24ha area	Identify, record, and monitor any required weed management tasks	Completed June 2022 to March 2025 Ongoing
Monitor groundwater quality	Continuously	Groundwater monitoring wells Refer Appendix C	Record pH, conductivity and temperature	Completed June 2022 to March 2025 Ongoing
Monitor groundwater levels	Continuously	3 x Groundwater monitoring wells Refer Appendix C	Record groundwater levels to inform irrigation application and to manage ASS	Completed June 2022 to March 2025 Ongoing
Maintain groundwater levels above	Monthly	Groundwater monitoring wells	Increase irrigation when ground water level drops below	Completed June 2022 to March 2025 Ongoing

Management Task	Frequency	Location	Actions and Remediation	Status April 2025
600mm below ground level (BGL)		Refer Appendix C	600mm	
Fluctuate the water table level by 300mm increments	3 monthly	Groundwater monitoring wells Refer Appendix C	Reduce surface pyrite formation during periods of waterlogging 1. Raise water table to 300mm (BGL) for one month 2. Raise to surface and maintain for three months	Completed June 2022 to March 2025 Ongoing
Minimise surface ponding	Monthly	Irrigation area	Avoid irrigating following rainfall events	Not applicable
Maintain pH below 5.2		Groundwater monitoring wells	Lower the water table when pH approaches 5.2	Completed June 2022 to March 2025 Ongoing
Maintain pH above 3.5		Groundwater monitoring wells	Raise the water table when pH approaches 3.5	Completed June 2022 to March 2025 Ongoing
Record observations of threatened species	During site inspection or when sighted	All areas of the BBIMWR	Record and document threatened species occurrence on the site	Completed June 2022 to March 2025 Ongoing
Ensure contractors and visitors receive the necessary training and communicate the requirement to protect frog	Ongoing	All areas of the BBIMWR	Provide induction and training to contractors and site visitors	Ongoing

Management Task	Frequency	Location	Actions and Remediation	Status April 2025
and owls on the site				
Manage weeds and feral species to prevent impacts to habitat	Ongoing	All areas of the BBIMWR	Bush regeneration and weed management undertaken as required by external contractor or the BSC regen team (Refer to *West Byron Sewerage Treatment Plant Weed Management Strategy* (DM530123))	Completed June 2022 to March 2025 Ongoing
Ensure that works are ceased in the event of grass owl detection	Ongoing	All areas of the BBIMWR	Follow Grass Owl Protection Procedure as detailed in 4.10.1	Completed June 2022 to March 2025 Ongoing
Undertake required monitoring of threatened fauna	Annually	Targeted Locations in the BBIWMR	Update Biodiversity Management Plan	Complete June 2022 to March 2025

Category	Performance criteria	Status April 2025
Constructed Wetlands (D, E, F, G, I & J)	• Emergent weeds and invasive natives are controlled and comprise ≤5% total cover within each cell • Native macrophyte vegetation is dense and healthy (>80% coverage of native macrophytes >80% of the time) • Cell batters where access to operational infrastructure is	• Emergent and floating weed cover in Cells D and E <5% total • Emergent and floating weed cover in Cells F ang G and I and J exceed performance criteria • Cells batters where access is not required are densely vegetated • Native macrophytes dominate Cells D and E

Category	Performance criteria	Status April 2025
	not required are densely vegetated	
Cell H	• Contains all of the following wetland habitats: ○ Open water with floating macrophytes (bottom and middle of cell) ○ Native emergent macrophytes (top and edges of cell) ○ Native woody vegetation on the north-eastern berm only ○ Mudflats (from August – March inclusive)* • Emergent weeds and invasive natives are controlled and comprise ≤5% total cover within each cell • No decline in plant species diversity • Cell batters where access to operational infrastructure is not required are densely vegetated • Predatory native fish populations such as Eel and Mullet are present • Minimum water depths required for Comb-crested Jacana are maintained • Works avoided in Cell H during Jacana breeding season	• Open water in bottom and middle of cell with floating macrophytes • Emergent weeds (including floating) and invasive natives cover in cell H <5% total • Native emergent macrophyte coverage (top and edges of cell) stable and healthy • Native woody vegetation on the north-eastern berm only • Mudflats to be developed from August 2025 • No observed decline in plant species diversity • Cell batters where access is not required are densely vegetated • Predatory native fish populations such as eel and mullet present • Minimum water depths required for comb-crested Jacana present • Works avoided in cell H during Jacana breeding season
24 Hectare Melaleuca Regeneration Habitat	• Emergent weeds controlled and comprise ≤5% total cover • Optimal water use to maintain plant health and evapotranspiration	• Emergent weeds controlled and compromise <10% total cover • Water use in 24Ha impacted by loss of critical infrastructure and downstream drain condition

Category	Performance criteria	Status April 2025
Frog and Grass Owl Habitat	• Emergent weeds controlled and comprise ≤5% total cover • Native vegetation continues to persist and structurally provide suitable Grass Owl habitat which is not degraded or disturbed • Water chemistry is between a pH range of 3 – 5	• Emergent weeds controlled and compromise <5% total cover • Native vegetation present and healthy providing suitable Grass Owl habitat • Water pH between 3-5
Acid Frogs	• Existing/known habitat areas continue to be utilised by Acid Frog species • Native vegetation within Acid Frog habitat areas (constructed wetlands, Frog and Grass Owl Habitat) continues to persist and is not degraded or disturbed	• Existing/known habitat areas for Acid Frogs continue to be utilized • Native vegetation within Acid Frog habitat areas has continued to persist and has not degraded or disturbed
Grass Owl	• Existing/known habitat areas continue to be utilised by Grass Owls • Native vegetation within Frog and Grass Owl Habitat areas continues to persist and structurally provide suitable Grass Owl habitat which is not degraded or disturbed	• No Grass Owls detected during monitoring surveys • Habitat areas persist and further vegetation survey required
Bats	• Existing/known habitat areas continue to be utilised by insectivorous bats • Native vegetation within suitable habitat areas (constructed wetlands, Frog and Grass Owl Habitat and 24ha Melaleuca Habitat) continues to persist and is not degraded or disturbed	• Bat survey complete • Native vegetation supports bat presence on the site
Feral Animals	• Feral species, particularly	• Feral Species, cane toads

Category	Performance criteria	Status April 2025
	Cane Toads do not become established within cells • Densely vegetated cell batters maintained • Feral animal trapping/control actions are initiated should populations be observed within the BBIWMR	present on the site • Densely vegetated cell batters maintained • Feral animal trapping/control actions are in place
Threatened Birds (Comb-crested Jacana, Australasian Bittern, Black-necked Stork, Black Bittern)	• Populations distributions and abundances of threatened waterbird species are monitored annually, particularly during breeding events	• Monthly Bird surveys carried out annually to monitor population distributions and abundances of threatened waterbird species, particularly during breeding events
Threatened shorebirds	• Populations distributions and abundances of threatened waterbird species are monitored annually, particularly during breeding events	• Monthly Bird surveys carried out annually to monitor population distributions and abundances of threatened waterbird species, particularly during breeding events

Significant Events 2022-2025

A number of significant events occurred at the BBIWMR during the period 2022 to April 2025. These include complete removal of Salvinia from the biodiversity wetland Cell H. (see Figures 1 and 2)

Figure 1 Cell H December 2022 Complete Salvinia Cover

Figure 2 Cell H January 2023 Salvinia clearance due to weevil control

In October 2023 a large bushfire occurred impacting a significant portion of the site (Figure 3 Extent of fire 2023). Since this time operation of the effluent reuse area has not been possible.

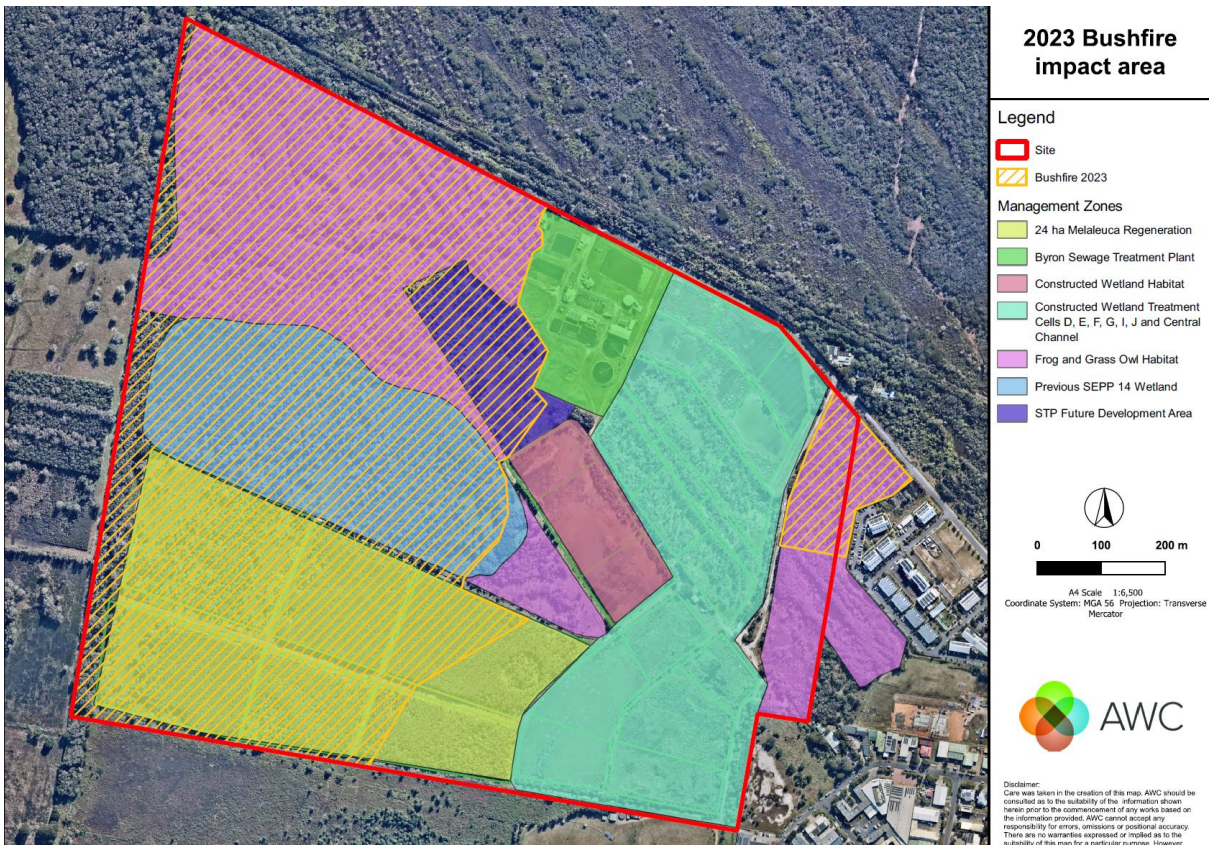

Figure 3 Extent of fire 2023

A comprehensive audit and assessment of the condition of all site infrastructure was undertaken 2023 -2024 (See Figure 4)

Figure 4 Undertaking asset condition assessment in the 24ha regeneration area September 2024

Amazonian frogbit was detected in Cell H and Cells D and E in 2024.

A number of significant rainfall events occurred during the period with conditions generally being wetter than average limiting the maintenance activities that could be undertaken on the site.

Works to be undertaken 2025 – 2026

The following points identify tasks to be undertaken in the next 12-18 months

- Workshop with BBBB Review of Monitoring (20 years of data, key trends, review of monitoring strategy)
- Installation of Automated Logging System 24ha and Cell J (Water level, pH)
- Downstream drain management

- Assessment of Acid Sulphate Soils and review of ASS Management Plan for the BBIWMR
- Completion of compliance reporting
- Continuation of required biodiversity monitoring
- Further monitoring of vegetation condition
- Repair and reactivation of 24 Melaleuca Regeneration area
- Repair and renewal of assets as identified by the asset condition register

Condition of the System Summary

The treatment wetland cells were commissioned as part of the 2006 capital works program and components of the system are now in need of replacement and renewal in order to ensure that the wetland system provides the required polishing function for treated effluent from the Byron Bay STP.

The wetland cell inlets in particular have reached the end of their functional life and are now not providing even distribution of effluent flow across the top of the cells. In a number of locations water depths do not support the establishment of dense healthy aquatic macrophyte vegetation. There is also Acid Sulphate Soils underlying Cell D.

Weed management requirements on the site are significant and require sustained effort to but some areas of improvement are evident particularly Cells D, E and H.

Since the bushfire the operation of the 24ha regeneration area has not been feasible. Much of the infrastructure was completely destroyed.

Condition of Cell H has improved with Salvinia control with more bird activity and Black Necked Storks observed on two occasions.

Migratory bird activity also appears to have improved with Latham’s snipe detected in 2024. Grass Owls were not detected on the site in survey undertaken in 2024.

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Report No. 6.1 Infrastructure Services Utilities Monthly Status Report December 2024 - February 2025

Directorate: Infrastructure Services

Report Author: Cameron Clark, Manager Utilities

File No: I2025/434

Summary:

This report summarises the performance of Utilities delivery during the period December 2024 to February 2025.

Recommendation:

That the Committee note the report.

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Report

DRINKING WATER QUALITY

In February 2025 there were three (3) exceedances related to turbidity.

January 2025 there were zero (0) and in December 2024 there were two (2) exceedances at Mullumbimby WTP related to level sensor technical faults.

NSW Health Water Quality Monitoring

The tables below detail the performance of the water supply network for 2025.

Analysis Type	Guideline Value	Units	Mean	Median	Standard deviation	Min.	Max.	Sample Count	Exception Count	Percentile	Percentile	Guidelines
Total Dissolved ...	10000	mg/L	83.86	85.00	8.39	73.00	97.00	7	0	94.9000	73.6000	100.0 %
Total Hardness ...	200	mg/L	51.69	52.80	1.93	49.00	53.70	7	0	53.6100	49.0300	100.0 %
Calcium	10000	mg/L	19.31	19.80	0.77	18.20	20.10	7	0	20.0700	18.2300	100.0 %
Chloride	250	mg/L	13.71	14.00	1.28	11.00	15.00	7	0	15.0000	11.6000	100.0 %
Sodium	180	mg/L	11.57	11.00	1.68	10.00	14.00	7	0	14.0000	10.0000	100.0 %
pH	6.5 - 8.5		7.67	7.70	0.15	7.40	7.90	7	0	7.8700	7.4600	100.0 %
Nitrate	50	mg/L	1.29	1.00	1.13	0.50	4.00	7	0	3.1000	0.5000	100.0 %
Turbidity	5	NTU	0.48	0.10	0.80	0.05	2.40	7	0	1.8300	0.0650	100.0 %
True Colour	15	Hazen Uni...	0.93	1.00	0.49	0.50	2.00	7	0	1.7000	0.5000	100.0 %
Sulfate	250	mg/L	1.00	1.00	0.00	1.00	1.00	7	0	1.0000	1.0000	100.0 %
Magnesium	10000	mg/L	0.84	0.85	0.02	0.81	0.87	7	0	0.8670	0.8130	100.0 %
Fluoride	1.5	mg/L	0.05	0.05	0.00	0.05	0.05	7	0	0.0500	0.0500	100.0 %
Nitrite	3	mg/L	0.05	0.05	0.00	0.05	0.05	7	0	0.0500	0.0500	100.0 %
Aluminium	0.2	mg/L	0.01	0.01	0.00	0.01	0.02	7	0	0.0170	0.0050	100.0 %
Zinc	3	mg/L	0.01	0.01	0.00	0.01	0.02	7	0	0.0170	0.0050	100.0 %
Boron	4	mg/L	0.01	0.01	0.00	0.01	0.01	7	0	0.0127	0.0098	100.0 %
Iodine	0.5	mg/L	0.01	0.01	0.00	0.01	0.01	7	0	0.0100	0.0100	100.0 %
Copper	2	mg/L	0.00	0.00	0.00	0.00	0.01	7	0	0.0060	0.0020	100.0 %
Iron	0.3	mg/L	0.01	0.01	0.00	0.01	0.01	7	0	0.0050	0.0050	100.0 %
Selenium	0.01	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0035	0.0035	100.0 %
Barium	2	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0034	0.0024	100.0 %
Lead	0.01	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0007	0.0001	100.0 %
Arsenic	0.01	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0005	0.0005	100.0 %
Chromium	0.05	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0005	0.0005	100.0 %
Mercury	0.001	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0004	0.0004	100.0 %
PFBS	9999	µg/L	0.00	0.00	0.00	0.00	0.00	1	0	0.0003	0.0003	100.0 %
Nickel	0.02	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0002	0.0002	100.0 %
Manganese	0.5	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0002	0.0002	100.0 %
Molybdenum	0.05	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0001	0.0001	100.0 %
Silver	0.1	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0001	0.0001	100.0 %
Antimony	0.0030000...	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0001	0.0001	100.0 %
Cadmium	0.002	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0001	0.0001	100.0 %
PFHxS	9999	µg/L	0.00	0.00	0.00	0.00	0.00	1	0	0.0001	0.0001	100.0 %
PFOA	0.5600000...	µg/L	0.00	0.00	0.00	0.00	0.00	1	0	0.0001	0.0001	100.0 %
PFOS	9999	µg/L	0.00	0.00	0.00	0.00	0.00	1	0	0.0001	0.0001	100.0 %
Sum of PFOS an...	0.0700000...	µg/L	0.00	0.00	0.00	0.00	0.00	1	0	0.0001	0.0001	100.0 %
Uranium	0.02	mg/L	0.00	0.00	0.00	0.00	0.00	7	0	0.0001	0.0001	100.0 %
⊟ **Microbiology**												
Temperature	30	C	21.94	21.25	3.72	15.40	30.90	104	1	27.4700	16.5150	99.0 %
pH	6.5 - 8.5		7.76	7.80	0.10	7.50	8.00	104	0	7.9000	7.6000	100.0 %
Total Chlorine	5	mg/L	1.12	1.16	0.27	0.13	1.57	99	0	1.4210	0.7150	100.0 %
Free Chlorine	0.2 - 5	mg/L	1.05	1.06	0.20	0.40	1.90	103	0	1.3190	0.7310	100.0 %
E. coli	0	mpn/100 ...	0.50	0.50	0.00	0.50	0.50	103	0	0.5000	0.5000	100.0 %
Turbidity	5	NTU	0.20	0.18	0.12	0.11	1.17	84	0	0.3240	0.1200	100.0 %

Incident Reports and Public Health Reportable Events

There were zero (0) Public Health reportable events and NSW Health Sampling non-compliances in February, January 2025.

EPA Reportable Events

There were zero (0) EPA reportable incident during February, January 2025 and December 2024.

ASSET MAINTENANCE MANAGEMENT

Continuous Improvement Actions

Recent Improvements:

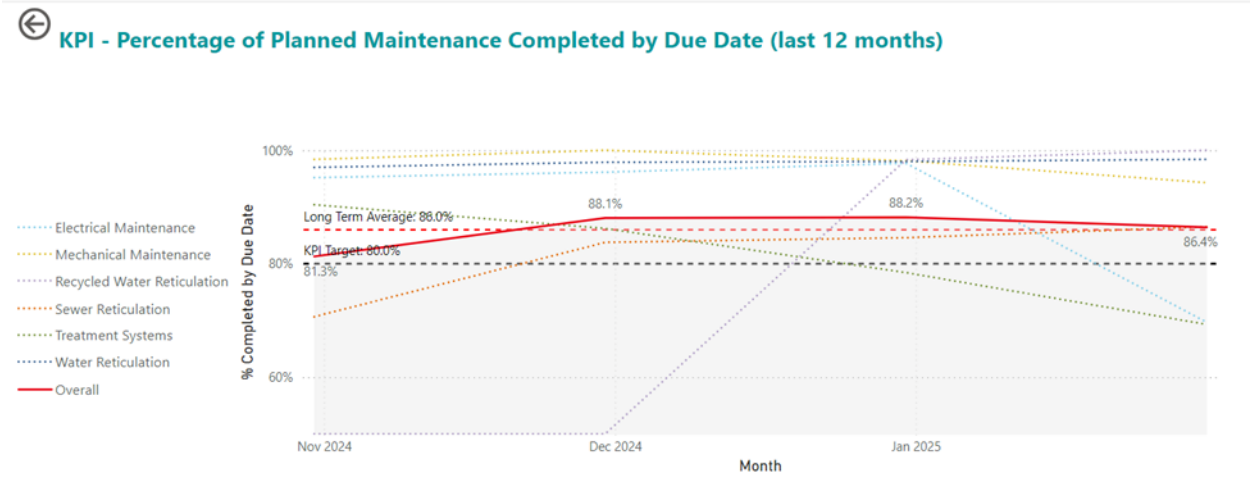
1. Property water meters have already been brought into the system and reactive maintenance tasks are routinely logged against these. The geographical location of the meters could not be discerned as part of the GIS upload and therefore meters are currently, in general, located in the centre of each lot. We are currently undergoing a process of relocating each meter to the correct location in line with information held in the Water Billing system. Currently:

   a. Mullumbimby, Bangalow, and Brunswick Heads are complete and service lines have been generated.

   b. Suffolk Park is at approximately 35% completion and will be included in the system in the coming weeks.

2. Following recent update to the Assetic platform, changes have been made to the Planned Maintenance programming and the Asset catalogue to create separate Work Groups for operational teams. Previously all teams were within one Water and Sewer Work Group, which cluttered workspaces and required complex filtering to avoid seeing all work for all teams. Moving forward, all PM tasks will be generated within their appropriate Work Groups. Team leaders and supervising staff who create work orders for reactive work have been notified of this change.

3. Because of the live nature of current reporting integrations between Assetic and Power BI, there is not currently a way to look back on the state of the system as it was in any given month in the past. The IT Team have created a series of history tables that will be appended at the end of every month, essentially creating easily reportable snapshots of the Assetic system to track KPIs, as seen below



Next Steps:

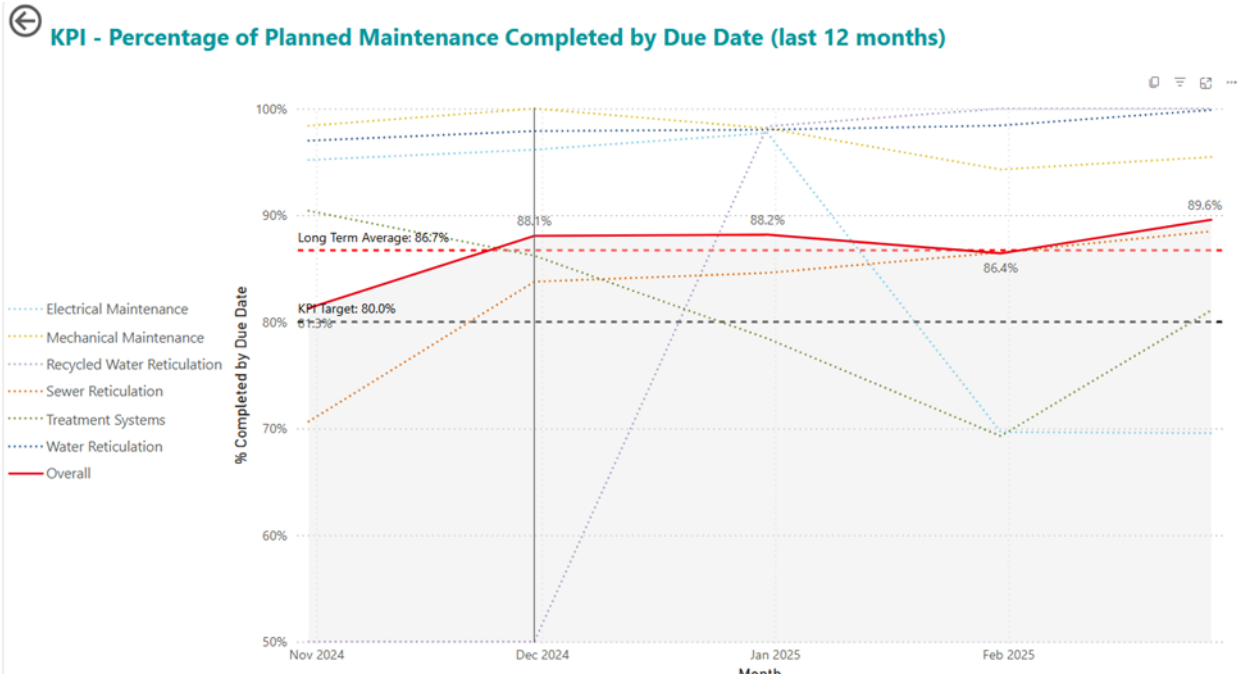
1. Weekly meetings with team leaders were suspended over the Christmas/New Year break and have resumed to drive further improvements to the Assetic System.

2. With the ongoing effort to digitise and properly catalogue plans and important asset-related documents, the team will soon be uploading more of these documents to Assetic to be easily accessible to field staff when needed.

ASSET MAINTENANCE STATUS

Planned Maintenance – Progress against Program

Overall, Utilities planned maintenance in February is 89.6% tasks completed by due date against a target of 80%. The current long-term average of tasks completed by due date is 86.7%.



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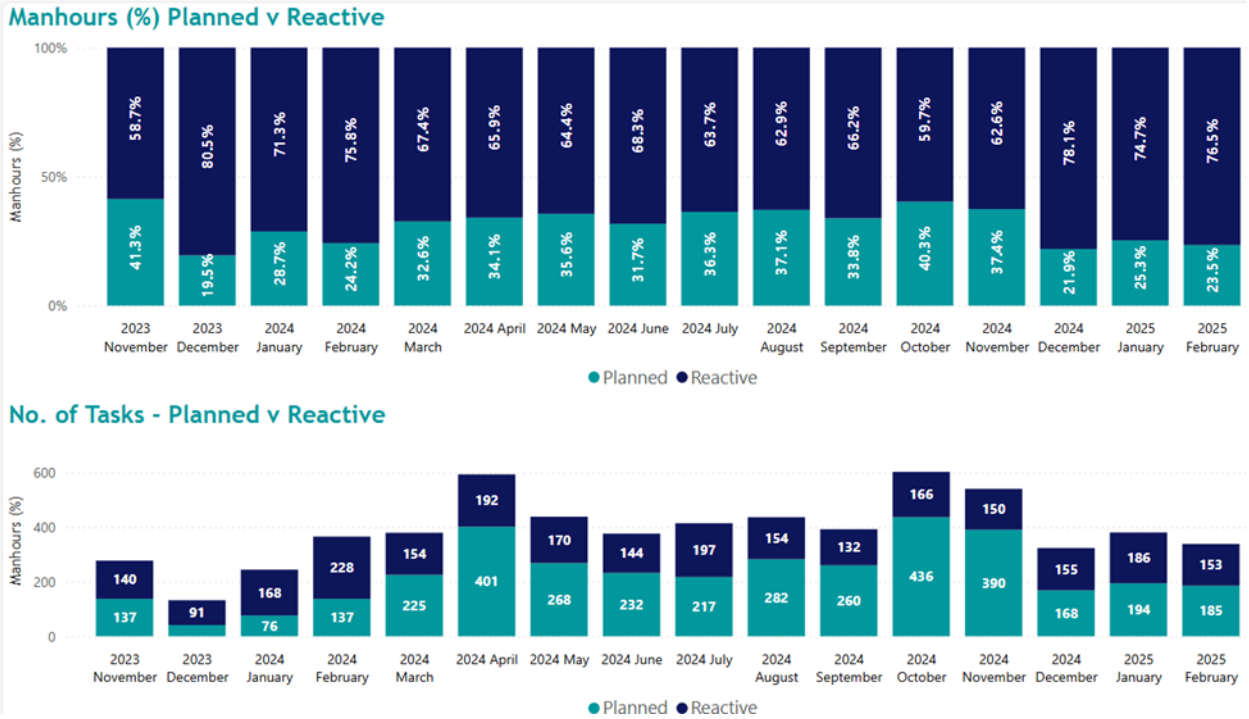
Planned versus Reactive Maintenance

The figure below shows the comparative maintenance hours for each team between planned and reactive maintenance. Reactive maintenance has taken 67.0% of all hours spent working on assets for the last 12 months.



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CAPITAL WORKS

SPS Renewals for Byron, Mullum, Ocean Shores & Bangalow

SPS	% COMPLETE	PUMPS DELIVERED	SWITCH-BOARD DELIVERED	COMPLETED SCOPE SUMMARY
SPS 1002	100	N/A	Delivered	Casted new switchboard pad and installed new 3x 63mm electrical conduits and new 32mm mains onto pumps. Switchboard installed. Made good old switchboard plinth and penetrations into well and valve chamber. Restoration completed.
SPS 1005	100	N/A	Delivered	Removed existing broken sealed surface and re-asphalt access road
SPS 1007	100	N/A	Delivered	MH and bypass connection installed. NPE by pass pumps demob. Epoxy works completed and SPS back in operation. Add spindle (SS316) on inlet valve. Replaced risers in PE 125 and replaced lifting chains in SS. Installed new switchboard on new concrete pad

				(1960x1600x200) with new odour filter and old concrete plinth removed. 3x63mm conduit 16mm electric main installed. Penos with 2 parts mega poxy (5-10mm) concluded. Replaced odour filter to ground mount McBerns filter. Water service to be relocated. Fixed padlock cover on lid. Restoration completed.
SPS 2002	100	N/A	Delivered	Completed replacement of risers PE125 through to the valve chamber, no need for valves. New PE pipe connected directly into valves to save space. New Spindle on SS316 was installed. Restoration completed.
SPS 2004	100	N/A	Delivered	Replace existing DN150 gate valve in the 2002 rising main on outside of well
SPS 2010	100	N/A	Delivered	Replaced risers PE180, DN150 outlet gate valves, check valves, Gibault and flanged spigot. Installed new Switchboard pad (1600x1600x200). 3 x 63mm electrical conduits installed to green boy approx. 120m away. Water Service relocated. Excavation under high water table needed dewatering system. Restoration completed.
SPS 3004	100	N/A	Delivered	Bypass completed, Epoxy Coating and crack injections completed, Standpipe and ductile iron manifold updated to HDPE.
SPS 3010	100	N/A	Delivered	Replaced risers PE125 from elbow on wet well to valve pit, DN150 outlet gate valves, check valves. Relocated water service. Restoration completed.
SPS 3017	100	N/A	Delivered	Replaced inlet gate valve and refurbish inlet pipe penetration
SPS 3021	100	N/A	Delivered	Construction completed. Replaced DN125 risers, DN100 outlet gate valves, check valves, DN150 inlet gate valve, replace guide rails and brackets, relocated water service, removed vent pole and replaced with McBerns odour filter, removed switchboard plinth and replace switchboard. Restoration completed.
SPS 4007	N/A	N/A	Delivered	Removed from scope
SPS 5003	N/A	N/A	Delivered	Removed from scope
SPS 5014	100	N/A	Delivered	New switchboard plinth cast done, already installed new 3x63mm conduits to pump well, removing existing conduits and grout. No need to remove part of the fence. New electrical mains from green boy to board completed, new switchboard and commission with electricians had issues but a work around was completed. Running on new switchboard. Restoration completed.
SPS 5017	100	N/A	Delivered	Completed the replacement of the DN125 risers, DN100 outlet gate valves, check valves and dismantling joints, DN150 inlet gate valve and spindle as well as handrail around new switchboard platform. Old platform was removed, switchboard replaced as well as new electrical mains. Water service relocated. Restoration completed.

SPS 5020	100	N/A	Delivered	Completed the install of the 2 x new DN125 PE riser pipes through to the valve chamber, new gate valves and check valves, Gibault and flanged spigots. New gate valve DN150 on incoming gravity sewer. New slab for switchboard (3120x1000x200) was casted. Applied bitumen coat on spigot. Removed the Ladder. Restoration completed.
SPS 5022	100	N/A	Delivered	Installed new switchboard, conduits, electric main and new concrete platform. Removed existing switchboard and concrete plinths and installed new switchboard on new platforms. Pipework is also completed as well as stairs. Relocated water service. Installed new Covers, grill and frames sealed for odour control. Handrails were installed and existing plinth was modified to suit new ground mount odour filter. Restoration completed.

Gravity Sewer Mains Remediation

Based on previous condition assessments of the gravity sewer main network, Willow and Sparrow identified mains that required remediation works to prolong their use and/or to fix acute defects. The remediation scope included the installation of patch liners, excavation and repair, and CCTV survey. This package of works was awarded to Subsurface Pipe Solutions to a value of $132,950 plus GST. Work has commenced and is currently running on schedule. There has been some variation in scope due to previously unknown site and asset conditions which has resulted in lowering the overall budget whilst maintaining the desired outcomes. This project is nearing completion.

Gravity Sewer Condition Assessments

The condition assessment of gravity sewer mains and maintenance holes was awarded to Willow and Sparrow (maintenance holes) and Subsurface Mapping Solutions (mains). The Maintenance hole condition assessments are underway. The CCTV mains contract was awarded to Subsurface Mapping Solutions and work is scheduled to be completed by June 30. The sewer catchments that fall within this scope are across Bangalow, Suffolk Park, and Ocean Shores. The indicative budgetary limit of ~$320,000 will cover the costs for both CCTV assessments and MH visual assessments. Condition assessment reports for mains and maintenance holes will be completed once all data has been gathered.

Water Main Replacements – Supply and Installation: Fletcher St, Carlyle St and Bangalow Rd Byron Bay; and Azalea St Mullumbimby

Site 01 Carlyle Street – Byron Bay

- Construction is completed – Planit and CivilCS are to review and finalise WAE and ITPS;

Site 02 Azalea Street – Mullumbimby

- Construction is completed – Planit and CivilCS are to review and finalise WAE and ITPS;
- CivilCS to complete final remediation works.

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Site 03 Fletcher Street– Byron Bay

- Construction is completed – Planit and CivilCS are to review and finalise WAE and ITPS;
- CivilCS to complete final remediation works.

Site 04 Bangalow Road – Byron Bay

- Construction is completed – Planit and CivilCS are to review and finalise WAE and ITPS;
- CivilCS to complete final remediation works.

Paterson St Reservoir Replacement

Work accomplished in the period:

- Michael Salu (SSE) has finalized the structural engineering concept designs (exclusive of stairs).
- Planit has now issued their Concept Design Plans for Council review.
- A meeting with the telcos occurred mid-December. Agreement was made to progress the Concept Design to Detailed Design. Council need to review the concept plans and a new fee proposal is required to be submitted by Planit.

Telcos – Paterson: NO CHANGE FROM MAY 2023

- A meeting was held with BMM Group (who act on behalf of all major Telcos)
- BSC and BMM have agreed on a concept design for the antenna locations and Telco access to the antennas – being from a Telco gantry off the side of the reservoir, NOT via the BSC stairs and roof.
- Planit to provide survey and concept design to BMM to allow them to proceed with planning approvals and draft design of the access and antenna connections.
- Concept structural plans have now been issued to the telecos for comment.

Mullumbimby Emergency Trunk Water Main Construction

Work accomplished in the period:

- The project has now commenced construction.
- UGL Regional Linx held a meeting as they required additional information to provide approval. Plans were updated accordingly with the water main being 4.1m deep to accord with their standard requirements.

Ewingsdale Road Water Main

Work accomplished in the period:

- Planit has now completed the detailed design of this water main, inclusive of the structural engineering design of the water main brackets.
- ENV Solutions has now completed their ASSMP Report.
- Plans were reissued to show survey marks.
- Design now under staff review.

Main Arm Road Concept Water Main

Work accomplished in the period:

- Project postponed to FYE2027 due to budget resource constraints.