1. WORKS REPORT

Author	Director Infrastructure and Engineering Services
Responsible Officer	Director Infrastructure and Engineering Services
Link to Strategic Plans	CSP – 4.3.4 Ensure Council's property assets are monitored and well managed

Executive Summary

This report provides information regarding works undertaken for the given period in regard to both operational and capital works.

Report

The Works Report **(*Attachment No. 1)*** for the period 1 November 2023 to 30 November 2023 is presented to Council for information.

Financial Implications

Council has provision for these services in its Operational Budget.

Legal and Regulatory Compliance

Local Government Act 1993
Roads Act 1993

Risk Management Issues

Nil

Internal/External Consultation

Nil

Attachments

1. Works Report

RECOMMENDATION

That the information be noted.

2. NARROMINE LEVEE FEASIBILITY STUDY PROGRESS REPORT

Author	Director Infrastructure and Engineering Services
Responsible Officer	Director Infrastructure and Engineering Services
Link to Strategic Plans	CSP – 2.1.3 Resolve issues surrounding the flood levee and impacts on residential development

Executive Summary

This report provides a short summary of the recent progress of the Narromine Levee Feasibility Study.

Report

In 2022 Council received funding from the Department of Planning and Environment (DPE) to undertake a feasibility study on the Narromine Levee. Stantec were engaged in early 2023 to undertake the works.

There are five phases of the feasibility study:

A. Community and stakeholder consultation, levee alignment and physical studies
B. Review of previous flood studies
C. Geotechnical investigations
D. Concept design
E. Environmental assessment
F. Detailed design

Phases A, B and C were submitted to Council in November 2023. They included a detailed flood review identifying impacts of the current situation in a 1% AEP flood event (equivalent to a 1 in 100-year event) and also the impacts on the township with a levee. The flooding impacts of a 1% AEP are shown in the following map.

2. NARROMINE LEVEE FEASIBILITY STUDY PROGRESS REPORT (Cont'd)

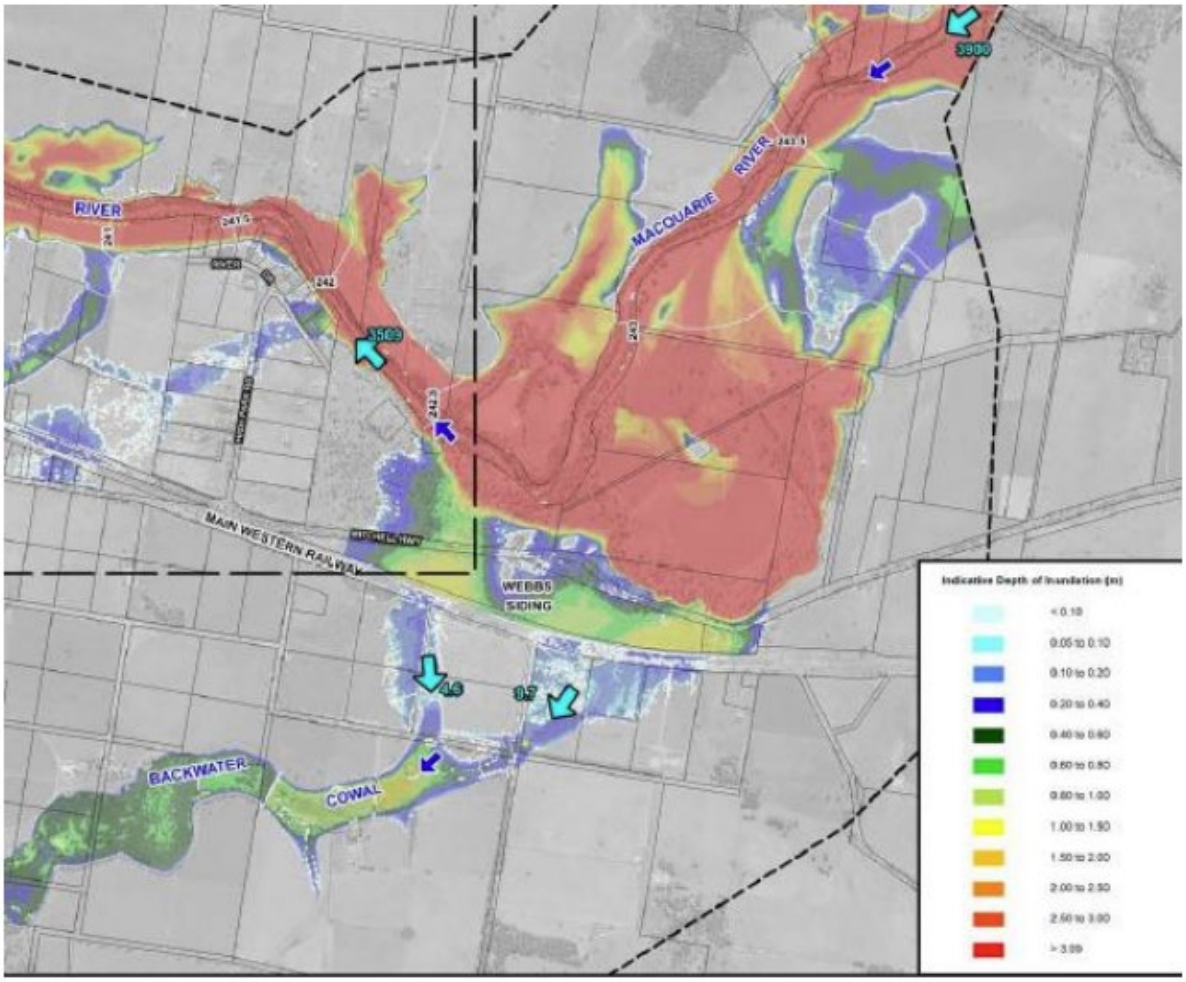

Figure 1 Present Day 1% AEP Flood Depth - source: Narromine Town Floodplain Risk Management Study and Plan Update (Lyall & Associates, 2021)

The consultants are currently finalising the concept design which will be provided to Council in early February 2024. This will include high-level costings of the construction of the proposed levee and the final alignment.

Substantial community engagement has occurred both within this current project and in previous Levee study projects and Council is committed to listening to the community and capturing local knowledge. Further stakeholder engagement sessions will be held in February 2024 specifically for residents whose property will be directly impacted by the creation of a levee. A Floodplain Management Committee meeting will be held in late January to further discuss the project's findings and progress.

A workshop between Council staff, Councillors and Stantec will occur in mid-2024 to review the feasibility study and determine the next steps.

2. NARROMINE LEVEE FEASIBILITY STUDY PROGRESS REPORT (Cont'd)

Financial Implications

The current feasibility study is funded by a DPE grant.

Legal and Regulatory Compliance

Nil

Risk Management Issues

Nil

Internal/External Consultation

Nil

Attachments

Nil

RECOMMENDATION

That the information be noted.

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3. NARROMINE WATER SUPPLY FUNDING

Author	Director Infrastructure and Engineering Services
Responsible Officer	Director Infrastructure and Engineering Services
Link to Strategic Plans	CSP – 3.3.2 Ensure development needs align to utilities infrastructure

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Executive Summary

This report provides information and recommendations to Council regarding the upgrade of the Narromine Water Supply System.

Background

Narromine Shire Council is the responsible water utility for the supply of potable water within the township of Narromine. In 2018 the Department of Planning and Environment (DPE) undertook risk assessments on all water utilities across NSW. Narromine scored in the highest risk category for Water Supply and Water Quality. As a result, DPE have committed to providing funding to Council through the "Safe and Secure" water funding program.

3. NARROMINE WATER SUPPLY FUNDING (Cont'd)

To assist in determining the town's future water requirements a consultant was engaged to undertake a thirty-year strategic plan, referred to as an Integrated Water Cycle Management Plan (IWCM). Through this planning process the projected growth and network expansion were reviewed as was the ongoing sustainability of Council's existing bores.

A second consultant was engaged to complete detailed investigations into the two major risks: water quality and water security. A workshop will be held on December 12 where Councillors, Council staff, consultants and DPE staff attended to discuss the recommended options.

Findings – Water Security
To improve Narromine's water security the recommended option has three key components:

1. Continue to operate and maintain the existing bores
2. Obtain high security river water licence
3. Utilise the original water treatment plant (WTP) location on Macquarie River and the existing pump well structure to install new river pumps
4. Install a new pipeline from the original WTP site to the current WTP site on the McGrane Way.

The above combination will provide significantly more water security by supplying either river or bore (or both) to the WTP.

Findings – Water Quality
To ensure both river and bore water can be treated to Australian Drinking Water Guidelines the following treatment process is recommended:

1. Purchase the existing WTP from the current owner/operator
2. Purchase additional treatment modules (including sedimentation, ozone and membranes) from the current supplier to increase the capacity of the WTP to approximately 7.5 ML (currently 3 ML).
3. Relocate the aeration tank, chlorination system and high lift pumps, currently on McGrane Way at the Wetlands entrance, to the current WTP site.

In addition to above Council would also seek to install a large shed and amenities area at the WTP site to provide storage of water and sewer equipment and repair tools and a designated lunchroom/depot for the water team.

Financial Implications

The consultants undertaking the Options Analysis have provided a high-level cost estimate. The cost to upgrade the existing river offtake structure, install river pumps and install a pipeline from the river to the current WTP site is $7.5 million. The cost to purchase, install and commission a new WTP at the current site is $30 million.

Given these cost estimates are high-level, a contingency of 25% is appropriate. This brings the cost of the works to an estimated $47 million.

Safe and Secure will provide funding for 75% of the project, resulting in a contribution of $35 million, however, Council is required to fund the remaining $12 million. Council's water fund is not currently in a position to finance this expense.

3. NARROMINE WATER SUPPLY FUNDING (Cont'd)

Grant Funding Opportunity

In November the Australian Government announced a funding opportunity for local water utilities named the "National Water Grid Fund". This funding opportunity requested *Expressions of Interest* (EOI) for water projects of high importance be submitted by early December; shortlisted projects will be given the opportunity to submit a formal proposal in January 2024. Successful applications will receive funding of up to 25% of the project cost.

Council submitted an EOI application in early December for the National Water Grid Fund for $50 million. Council's intention is to combine the two grants (Safe and Secure and National Water Grid Fund) to receive grant funding totalling 100% of project cost.

If successful design work followed by construction could occur with limited Council funding required.

Legal and Regulatory Compliance

Water Management Act 2000
Water Act 191

Risk Management Issues

As Narromine continues to grow the existing bores and WTP cannot meet the water supply demand. The above projects will decrease the frequency of imposed water restrictions and enable the town to continue to grow and thrive.

Internal/External Consultation

Nil

Attachments

- IWCM Issues Paper and Options Reports ***(Attachment No. 2)***.

RECOMMENDATION

It is recommended that if Council is invited to submit a detailed proposal for the National Water Grid Fund that a submission is placed requesting a 25% contribution of $50 million to address the water security and quality risks within Narromine.

Melanie Slimming
Director Infrastructure and Engineering Services

Works Report

November has seen the progression and completion of many projects across the shire and the team continues to be busy in the lead up to Christmas. An overview of the major works to occur within November is included below.

Water and Sewer

The water and sewer team continue to operate the three water treatment plants, ensuring water quality meets the Australian Drinking Water Guidelines and NSW Health legislation. Water testing occurs daily across the Shire, including on weekends. Frequent testing enables Council to be confident in water quality supplied to our residents.

The water team responded to three major water main breaks in Narromine, and one in Trangie. As the weather warms up water usage increases putting additional strain on the buried infrastructure, water main bursts will be something the team continues to monitor throughout the summer months.

The Southern Zone water booster pump station, located at Duffy Street, is now fully operational. This booster pump station will have a massively positive impact on residents on the southern end of town, ensuring that pressures remain consistent even during high water demand periods.

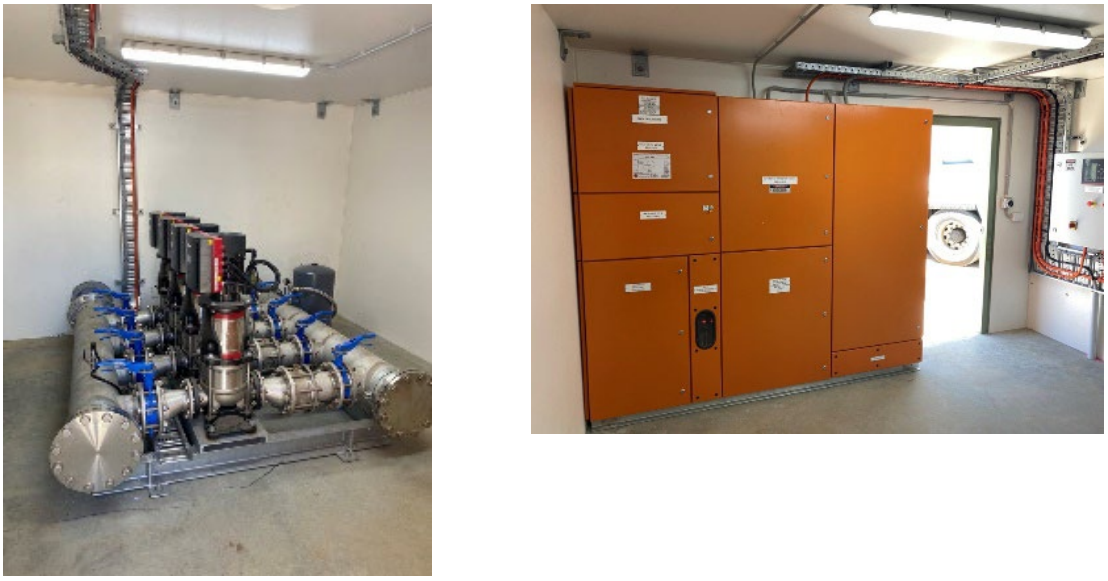

Figure 1: The new booster pump station on Duffy Street, Left: pump skid, right: electrical switchboard

The Water and Sewer team are working through two options reports for the ongoing water security and water quality for Narromine. Further information on the outcomes of the reports is contained in a separate report. This work is part of Council's long-term water and sewer strategy and is key to ensuring a sustainable water supply for Narromine into the future.

Figure 2: The new booster pump station on Duffy Street, Left: pump station building, right: pump station generator

During November the Water and Sewer team attended sewage effluent testing training with the Department of Planning and Environment (DPE). DPE are the regulators of Water Utilities and provide training for operators, managers, engineers and other staff working in the water industry. DPE training is crucial for ensuring staff and management are aware of the current standards and processes to ensure Council is providing the best service to the community.

Council's potable water is sourced from a number of bores located across the Shire. Bores require ongoing maintenance to ensure ongoing operation. Recently Trangie Bores 1 and 2 were cleaned and inspected, resulting in a significantly improved performance, before and after condition is shown in the photos below. The red build up visible in the before photo is iron-bacteria, this is inevitable in bores however if not cleaned regularly will completely block the bore inlet and reduce extraction rates. Each council bore is inspected and cleaned every five years.

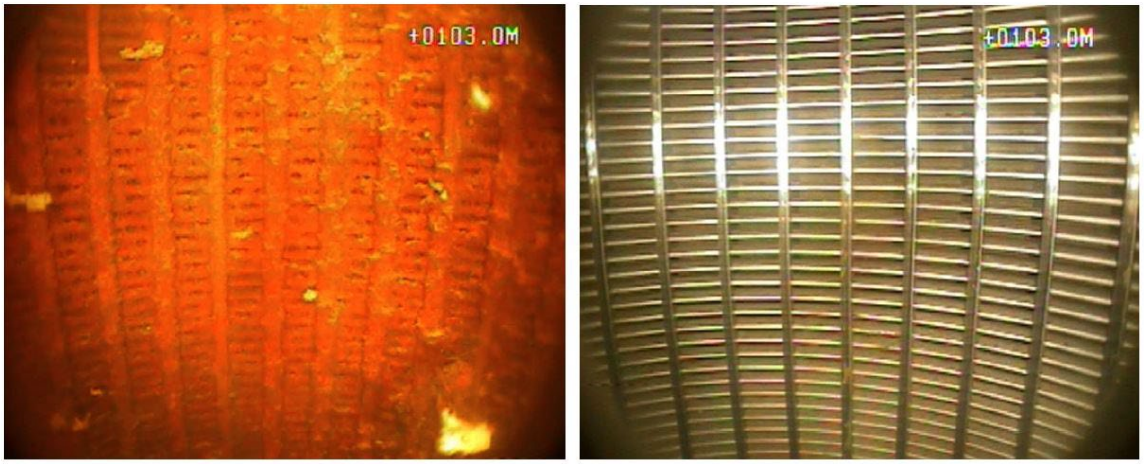

Figure 3: Bore 1, left: before cleaning, Right: after cleaning

Council recently purchased a vacuum truck. The truck can dig trenches via a process called "hydro-excavation" a non-invasive excavation technique. This machine has been thoroughly praised by the team who are able to install water connections more quickly. The team have utilised the new equipment in Tomingley where new connections and water mains have been installed to the entire town. The new water main installation is nearly complete.

Figure 4: Staff using the new excavation trailer at Tomingley

The water team was successful in winning the Water Industry Operator Association's inaugural award for the "Team of the Year". This award was given to the team as a result of their hard work and innovative ideas for the installation and completion of the Tomingley Water Treatment plant, which was finished earlier in the year. The team is to be commended on their great achievements, both winning the award and the ongoing excellent performance of the Tomingley Water Treatment Plant.

Figure 5: Narromine's Water Team receives the WIOA Team of the Year award in Canberra

Wetlands Project

The wetlands project continues to expand the Council's stormwater holding capacity, improving the town's stormwater management. The new sign has been installed and looks wonderful.

Figure 6: Narromine Wetlands sign is now installed at the corner of McGrane Way and Nellie Vale Road

Quotes have been requested for two additional lunch shelters which will be installed once the remaining earthworks are completed. To date 48 solar lights have been installed, with the remaining 26 to be installed at the completion of the bulk earthworks.

To help assist with the maintenance of the area Council approached the Dubbo Correctional Services who will provide maintenance for one day per week starting in early 2024. This is a great initiative from Council and opportunities for further collaboration may be investigated in later 2024.

Figure 7: Aerial view of the Narromine Wetlands Project

Facilities and Major Projects

Both Narromine and Trangie Pools continue to operate with assistance from Council's Facilities team. The pools are looking fantastic and are getting plenty of use by customers.

Council received a grant to upgrade public amenities and are replacing the toilets at Dundas Park. A toilet block has been ordered and will arrive in February for installation. Council was successful in receiving a Bus Stop upgrade grant, which will result in the improvement and upgrade of several bus-stops within Narromine.

The Narromine Tennis building will be completed by mid-December and opened in early 2024. This facility will provide an excellent base for all tennis users.

The Trangie sporting precinct building and facilities are now complete, with the car park scheduled for completion in early 2024.

Figure 8: The Trangie Sporting Precinct is complete

The Narromine Aerodrome has been very busy during November and December with over 200 people onsite daily for the world gliding championships. Despite some poor weather the competitors were able to have plenty of gliding time. The 26 flag poles were filled with flags from the countries competing and really frames the entrance to the aerodrome. Additionally, the facilities team have worked on Building #3 at the aerodrome to secure the roof and prevent it from becoming dislodged. The team have also installed temporary fencing around the building to ensure no public access.

Figure 9: The Aerodrome entrance is looking fantastic, with 26 Flags Setup

Engineering Services

The Engineering Services Team continues to create designs and review plant and fleet information. Currently the design team is working with a consultant to licence Council's Quarries.

RFS have recently created an online portal to enable local businesses and Councils to list plant and equipment in the event of an emergency. Council have been working with RFS to become setup on the portal. In future emergencies RFS will utilise the portal to quickly review what plant is available, and if plant is used, the portal also enables a fast way for Council to invoice RFS for fast payment.

Figure 10: Crushed material management at a Council Quarry

Council is working on finalising the Roads Strategy which is currently in draft form. Council staff are currently collating field Traffic Count information, and this will feed into the final strategy. A presentation on the final strategy will be presented to Council in 2024.

Parks and Gardens

The Parks and Gardens team were busy getting into the Christmas Spirit, putting up Christmas trees in Tomingley, Trangie and Narromine at the end of November.

Figure 11: The Narromine Christmas tree was setup in late November

Parks and Gardens (Cont'd)

The team continues to manage trees by clearing laneways in Trangie and lifting tree canopies in the main street to maintain shade cover but reduce encroachment risks.

The team are also focused on presentation of Cale Oval for the World Gliding Championships Opening Night in early December.

In addition to the Gliding Championships opening Cale Oval will be well utilised during December with the Venetian Carnival and NSW Youth Cricket Championships also occurring. The Oval is in great condition and is a wonderful show piece for the town.

Spraying continued in November with a focus on Tiger Pear weed, the following areas were sprayed:

- Spray Tiger Pear - Farrendale Road
- Spray / Mow / Slash - Narromine Pound
- Spray Tiger Pear - Farrendale Road
- Spray Tiger Pear - Warren Road
- Spray Tiger Pear - Burroway Road
- Spray Tiger Pear - Mungeribar Lane
- Spray Tiger Pear - Boggie Plains Road
- Spray Tiger Pear - Barlings Road
- Spray Tiger Pear - Haywoods Road
- Spray Silverleaf Nightshade - Burroway Road

Roads

Council is currently working on a number of roads projects. The western half of Gainsborough Road continues to be upgraded. The road has been designed to accommodate heavy vehicles and has been built up significantly to reduce flooding and wash-out issues that have caused significant damage in previous rain events. Material laying and compaction for the western portion will be completed by early January and Council staff will then complete the approaches onto Gainsborough from the McGrane Way. It is expected that sealing of the approaches and road will occur in March. Further works on the eastern end of Gainsborough are planned for later in 2024.

The team continues to work on Bogan Cathundril road with some wet weather delays occurring. The road is being built up with material being sourced from two of Council's quarries. The work is scheduled to be completed by mid-January. Further re-sheeting maintenance has also occurred on Swifts Lane and Montgomery's Road.

Roads (Cont'd)

Figure 12: Carting material to a job site

Council is currently utilising a Heavy Patching Grant and completing patching on Tomingley Road. The team plan to complete patching on Tantitha Road, Wambianna Road and Warren Road prior to Christmas.

Council has received a number of complaints around the condition of Tullamore Road, specifically a 6km section that is very narrow with the edges failing. The upgrade of this road is scheduled for early 2024. This portion of the road will be widened and resealed to improve road condition and address safety concerns.

Figure 13: Council's roads team utilising the excavator.

Trangie Truck Wash

The Trangie Truck Wash continues to progress well. The road base material is installed, with a top layer to be laid in early December. Electrical works, including the AVDATA system that will be used for managing payments, is installed and the pump and pipework have been delivered to site. The concrete wash-down area will be poured in early December.

The remaining works include sealing the road, installation of the water infrastructure and construction of a concrete receiving structure. It is anticipated that the truck wash will be open to the public in March 2024.

Figure 14: Aerial view of Trangie Truck Wash

Back to Report

NSW GOVERNMENT Public Works Advisory

Narromine Shire Council

Integrated Water Cycle Management Strategy

Issues Paper

Report Number: ISR22031

May 2022

Prepared for:

Narromine SHIRE COUNCIL

Report Number: ISR22031

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Cover page: Trangie Grain Silos, Aussie Towns, https://www.aussietowns.com.au/town/trangie-nsw

Executive Summary

Narromine Shire is a Local Government Area located in central NSW. The majority of the population resides within the Narromine township, with a small percentage of the population residing in villages of Trangie and Tomingley.

Narromine Shire Council commissioned the preparation of an IWCM Strategy to comply with the NSW Government's Best-Practice Management of Water Supply and Sewerage Framework. This report provides a summary of the issues and all the outcomes from items 2 to 7 of DPE Water's IWCM checklist.

Water supply and sewerage schemes

Narromine and Trangie have their own potable water supply schemes (WSSs). The Tomingley village has recently been supplied with potable water from the commissioning of the new Tomingley Water Treatment Plant in 2022; previously being supplied with non-potable water. Narromine is also supplied with raw untreated surface water for irrigation of public open spaces within the township.

Sewerage schemes

Narromine and Trangie both have their own conventional gravity sewerage system. Sewage from Narromine is treated in an oxidation pond plant, and sewage from Trangie is treated in an intermittent extended aeration plant (Pasveer Channel).

Growth

Council anticipates growth to occur largely within Narromine, little growth in Trangie, and no growth in Tomingley. The projected number of occupied dwellings and population serviced by each water supply and sewerage scheme based on the nominated growth rates are given in Table S-1 and Table S-2 respectively.

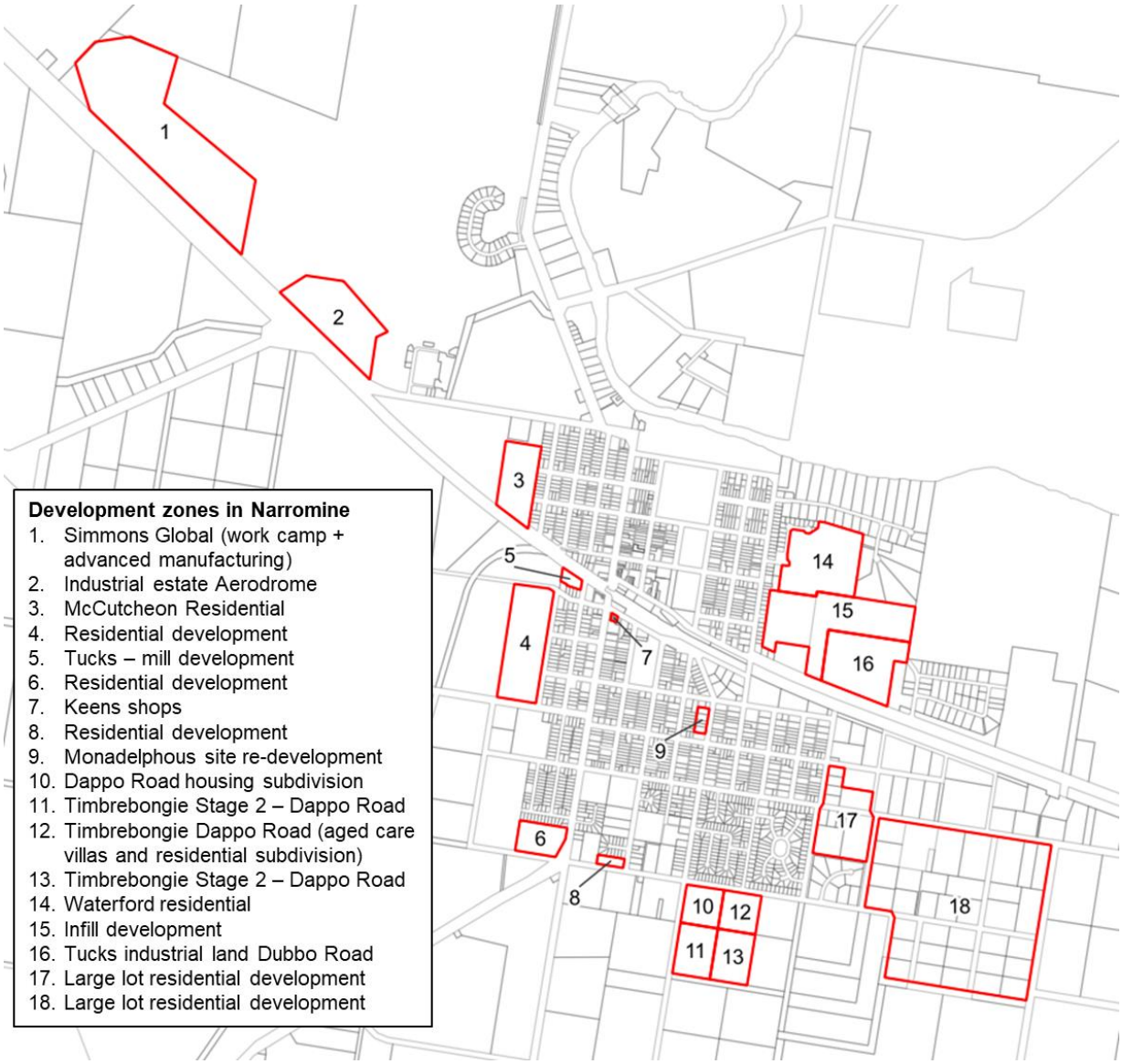
Table S-1: Projected dwellings and population – water serviced areas

	2022	2027	2032	2037	2042	2047	2052
Projected occupied dwellings							
Narromine	1,339	1,451	1,541	1,562	1,566	1,566	1,566
Trangie	358	364	374	382	382	382	382
Projected water supply serviced population							
Narromine	3,214	3,482	3,698	3,749	3,757	3,757	3,757
Trangie	788	801	823	841	841	841	841

Table S-2: Projected dwellings and population – sewerage serviced areas

	2022	2027	2032	2037	2042	2047	2052
Projected occupied dwellings							
Narromine	1,271	1,417	1,521	1,625	1,648	1,648	1,648
Trangie	323	329	339	347	347	347	347
Projected sewer serviced population							
Narromine	3,051	3,401	3,651	3,901	3,956	3,956	3,956
Trangie	710	723	745	762	762	762	762

Council provided development areas within Narromine which is shown Figure S-1 below.



FigureS-1: Development areas in Narromine township

Water demand analysis and assessment

A water demand analysis is undertaken to calculate the unit demands, estimate the water losses and forecast the following demands:

- Average (rainfall) year demands – for revenue planning
- Unrestricted (dry) annual demands – to assess drought security
- Peak day demands – to assess system reliability

The estimated residential unit demands are given in Table S-3.

Table S-3: Residential unit demand per active residential assessment

Water supply scheme	Average year demand (kL/year)	Dry year demand (kL/year)	Average day demand (L/day)	Peak day demand (L/day)	Climate independent (internal) demand (L/assessment/ day)	Baseline internal demand per person (L/person/ day)
Narromine Potable WSS	407	498	1,114	3,049	635	264
Trangie WSS	422	588	1,156	4,028	234	106
Tomingley WSS	153	185	418	1,113	N/A*	N/A*

*Internal usage not estimated as water was non-potable. Internal plumbing likely not connected to the reticulation. Instead, rainwater tanks or private bores may be used for internal usage.

The 30-year water demand projections for the nominated growth rate are provided in Table S-4.

Table S-4: Summary of water demand projections for Narromine Potable and Trangie WSS

Demands	2022	2027	2032	2037	2042	2047	2052
Narromine Potable WSS							
Average year demand (ML/year)	662	726	770	814	825	825	825
Unrestricted future year extraction (ML/year)	1,014	1,119	1,191	1,263	1,280	1,280	1,280
Peak day production (ML/day)	6.1	6.6	7.0	7.4	7.5	7.5	7.5
Trangie WSS							
Average year demand (ML/year)	214	216	220	224	224	224	224
Unrestricted future year extraction (ML/year)	352	354	360	364	364	364	364
Peak day production (ML/day)	2.4	2.4	2.5	2.5	2.5	2.5	2.5

There is no growth expected to occur within the Tomingley village. Therefore, demand forecast is not required.

Sewer load analysis and projection

A sewer load analysis is undertaken to assess the unit loadings and the average dry weather flow for the sewerage schemes. The results of the sewer load analysis are summarised in Table S-5.

Table S-5: Nominated 2021 ADWF and estimated unit hydraulic loading

Sewerage scheme	Residential EP	Non-residential EP	Total EP	Nominated ADWF (kL/day)	Assessed unit loading (L/EP/day)
Narromine	3,051	936	**3,987**	670	164
Trangie	710	373	**1,082**	190	176

The 30-year sewer load forecast for each sewerage scheme is provided in Table S-6.

Table S-6: Projected EP and ADWF for Narromine and Trangie sewerage schemes

Sewerage scheme	Loading	2022	2027	2032	2037	2042	2047	2052
Narromine	EP	4,054	4,429	4,690	4,947	5,010	5,010	5,010
	ADWF (kL/day)	681	744	788	831	842	842	842
Trangie	EP	1,087	1,096	1,118	1,135	1,135	1,135	1,135
	ADWF (kL/day)	191	192	196	199	199	199	199

Issues

The issues identified with the water supply and sewerage services are presented in the following tables below.

Table S-7: General IWCM issues

Issue type	Target for compliance	Issue
Best practice management	Best practice pricing – tariff structure	Council advised that the access charge for bulk users should be increased.
	Best practice pricing – inclining block tariff	Council does not have step increases in water usage charge.
Levels of service	LOS targets	Council needs to nominate performance indicators and targets for water supply and sewerage services.

Table S-8: Water supply IWCM issues

Issue type	Target for compliance	Issue
General		
Reliability of supply infrastructure	Capacity / entitlement	Climate change data for the region predicts above 35ºC days will increase by 10-20 days in the near future (2020-2039) and 30-40 days in the far future (2060-2079). This will put additional stress on the water supply system and its ability to meet the target level of service for system reliability during prolonged dry periods.
Narromine Potable WSS		
Reliability of supply infrastructure	Water losses	The infrastructure leakage index (ILI) for the Narromine Potable WSS is 6.7, indicating a high water loss. The water loss is around 264 L/assessment/day, which is approximately three times the state median.
Water quality	Water quality risk assessment	Based on PWA's water quality risk assessment tool, the inherent risk of the Narromine source water catchment is 'Very High, indicating a very high risk to chlorine-sensitive and chlorine-resistant pathogens. This is due to disused uncapped bores close to all of the town water supply bores, along with a large number of failed stock and domestic bores.

Issue type	Target for compliance	Issue
		The residual risk of chlorine-resistant pathogens in the Narromine Potable WSS is very high due to no treatment barriers that control these pathogens in Narromine.
Trangie WSS		
Regulatory	Exceedance of Water Access Licence entitlement	The unrestricted future extraction for the Trangie WSS is expected to already exceeded the WAL entitlement for Trangie (350 ML/year).
Reliability of supply infrastructure	Water losses	The infrastructure leakage index (ILI) for the Trangie WSS is 12.6, indicating a very high water loss. The water loss is around 455 L/assessment/day, which is about five times the state median.
Tomingley WSS		
No IWCM issues identified in the Tomingley WSS		

Table S-9: Sewerage system IWCM issues

Issue type	Target for compliance	Issue
General		
Regulatory	On-site sewage management system (OSSMS) policy	Council does not currently have an OSSMS policy.
Narromine SS		
Regulatory	Log reduction value (LRV) assessment based on Narromine STP treatment processes	Based on PWA's preliminary LRV assessment for the Narromine effluent reuse scheme, the current treatment and non-treatment barriers at the Narromine STP do not achieve the target LRV for the removal of protozoa, viruses and bacteria for the irrigation of agricultural non-food crops.
Reliability of infrastructure	STP performance – raw sewage not screened	Council has identified that raw sewage is not screened, and it is unknown what build-up of solids (screenings) and grit has occurred over time.
	STP performance – possible leakage from effluent pond in Narromine STP	Based on PWA's water balance model of Narromine STP for conducting an overflow assessment from the effluent pond, the model calculated effluent pond overflows in every year. Council indicated that the STP ponds have never overflowed, along with no effluent reuse at Narromine since 2015-16. From these considerations, it may potentially be possible that the effluent stored in the ponds are leaking through the clay liner base and into the ground.
	SPS performance – pump run time	Narromine SPS 1 and 2 are estimated to have exceeded three hours of pump run time daily.

Issue type	Target for compliance	Issue
	SPS performance – PWWF	Narromine SPS 1 (pump rate 46.0 L/s) – the PWWF from all upstream catchments is estimated to be 117.0 L/s. Narromine SPS 2 (pump rate 14.2 L/s) – the PWWF from the Narromine SPS 2 catchment is estimated to be 39.0 L/s. The pumps at Narromine SPS 1 and 2 are estimated to have exceeded their pump duties during PWWF.
	SPS performance – septicity analysis	The estimated detention time in the rising mains for Narromine SPS 4, 5, 8 and 9 are currently over eight hours, indicating a high risk of odour and septicity. The estimated detention time in the rising mains for Narromine SPS 1 and 6 are currently over four hours, indicating a medium risk of odour and septicity.
Capacity	Projected load against STP capacity	Due to growth in the Narromine SS, the assessed capacity of the maturation pond in the Narromine STP will be lower than the 30-year projected loading.
Trangie SS		
Performance / Regulatory	Effluent management – discharge to the environment	Effluent overflows from the maturation pond in the Trangie STP flows along a 2 km effluent discharge channel and terminates at the Trangie Agricultural Research Station. Council indicated that this could have potential WHS and environmental risks as the overflows are uncontrolled and discharged through an area where access by livestock and potentially human contact is possible.
Reliability of infrastructure	SPS performance – PWWF	Trangie SPS 2 (pump rate 7.55 L/s) – the PWWF from the Trangie SPS 2 catchment is estimated to be 6.2 L/s. However, with the pump flow rate from the Trangie SPS 3 going into the Trangie SPS 2 catchment, this will be 9.1 L/s. Trangie SPS 3 (pump rate 2.85 L/s) – the PWWF from the Trangie SPS 3 catchment is estimated to be 4.5 L/s. The pumps at Trangie SPS 2 and 3 are estimated to have exceeded their pump duties during PWWF.
	SPS performance – septicity analysis	The estimated detention time in the rising mains for Trangie SPS 1 and 3 are currently over four hours, indicating a medium risk of odour and septicity.

Issue type	Target for compliance	Issue
On-site sewage management systems		
Performance / Regulatory	Effluent management	The soil profile in Tomingley is poorly drained due to the presence of clay soils. This combined with most lots within the Tomingley village averaging 1,020 m2 means that there is a potential public health risk due to insufficient area for effluent disposal. There are two properties that are within 100 m from the Gundong Creek. If these OSSMS were to fail, effluent disposed from the absorption trenches would flow to the Gundong Creek, creating a potential contamination risk of surface water.

Contents

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1. The IWCM strategy

1.1 Purpose

The Integrated Water Cycle Management (IWCM) Strategy is a local water utility's (LWU's) 30-year strategy for the provision of appropriate, affordable, cost-effective and sustainable urban water services that meet community needs and protect public health and the environment. The IWCM Strategy

- Identifies the water supply and sewerage needs of a LWU
- 'Appropriately sizes' any infrastructure projects and determines their priority, and considering of whole-of-life costs
- Identifies the lowest level of sustainable Typical Residential Bill (TRB) to meet the levels of service, while maintaining cost recovery
- Includes a 30-year Total Asset Management Plan and Financial Plan.

1.2 Process

The process of preparing an IWCM Strategy follows the 2019 Department of Planning and Environment (DPE) Water's IWCM Strategy Check List and broadly includes the following:

- Preparation of an IWCM Issues Paper
- Evaluation of feasible options
- Creation of IWCM Scenarios
- Developing the IWCM Strategy
- Preparation of a Total Asset Management Plan and Financial Plan
- Public exhibition
- Concurrence by DPE and adoption by Council

1.3 IWCM Issues Paper

The IWCM Issues Paper presents the analysis that have been undertaken and summarises the IWCM issues that have been identified through the analysis. The following are inputs to the IWCM Issues Paper:

- Service Objectives and Targets
- Growth strategy
- Existing systems
- Water demand analysis
- Sewer loading analysis
- Existing system performance assessment
- Assessment of unserviced areas.

This report presents the outcomes of the analysis.

2. Study area context

Narromine Shire is a local government area (LGA) located in central NSW approximately 330 km north-west of Sydney and about 40 km west of Dubbo. The LGA area is approximately 5,260 km^2 and accommodates a resident population close to 6,520 as of 2019/20. Narromine Shire Council (NSC) supplies water and sewerage services to towns in Narromine LGA.

The major urban centre in the Narromine Shire is the Narromine township, along with two other towns Trangie and Tomingley.

A map of the Narromine Shire LGA from Google Maps is shown in Figure 2-1.

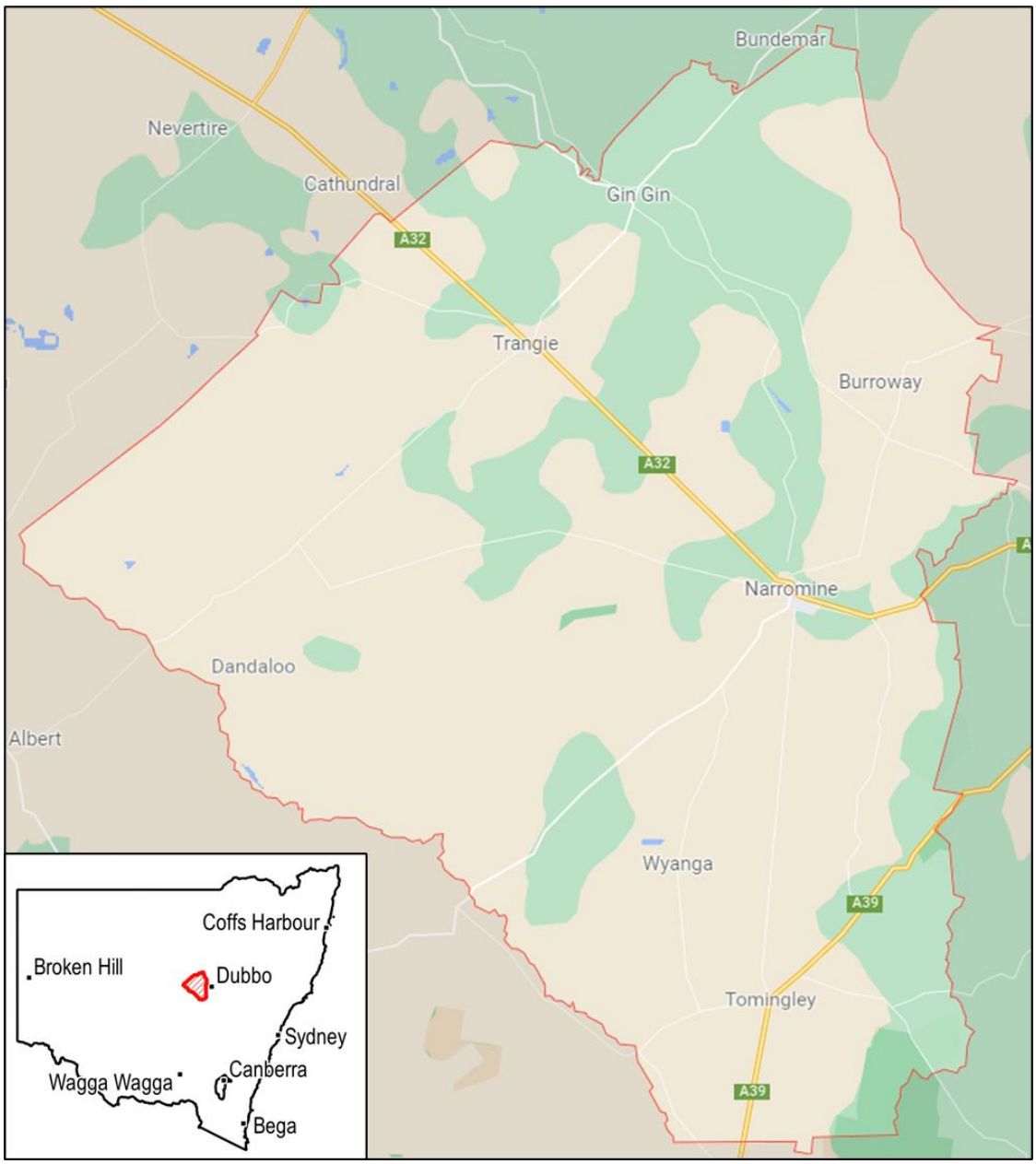

Figure 2-1: Narromine Shire Local Government Area (Google Maps)

2.1 Serviced communities

Water supply

There are four water supply schemes that Council operates in the Narromine Shire LGA:

1. Narromine Potable Water Supply Scheme (WSS)
2. Narromine Raw WSS
3. Trangie WSS
4. Tomingley WSS

It is noted that the Tomingley WSS was a non-potable WSS until the commissioning of the Tomingley drinking water treatment plant in April 2022, where the Tomingley WSS is undergoing major upgrades to make it a drinking water supply.

Sewerage

There are two sewerage schemes that Council operates in the Narromine Shire LGA:

1. Narromine Sewerage Scheme
2. Trangie Sewerage Scheme

2.2 Unserviced communities

Tomingley is the only town that is currently unserviced for sewerage.

3. Regulatory Compliance

The delivery of urban water services including water supply, sewerage and stormwater services is subject to a number of legislative and regulatory requirements, guidelines, contractual obligations for delivery of services and other external and internal factors, collectively referred to as the operating environment. An IWCM issue will arise if there is a failure to meet the legal obligations or agreed levels of service in water supply and sewerage servicing including the following:

- Legislative and regulatory requirements (health requirements, WHS, EPA Licence)
- Levels of service targets (as agreed with customers)
- Contractual and agreed arrangements (e.g. Memorandum of Understanding (MoU))
- Best Practice Management criteria

Table 3-1 provides the details of the status of compliance with the legislative and regulatory requirements by the Council.

Table 3-1: Legislative requirements

Key legislative framework and their main purposes	Narromine Shire Council's current performance
Local Government Act (1993)	
This Act aims to provide the legal framework for an effective, efficient, environmentally responsible, and open system of Local Government including the provision, management and operation of water supply and sewerage works and facilities. It covers:	Council operates three water supply schemes and two sewerage schemes under the authority of the Local Government Act 1993.
Section 60 (S60) – Ministerial approval required for certain council works A council must not, except in accordance with the approval of the Minister for Primary Industries, do any of the following: b) as to water treatment works – construct or extend any such works, c) as to sewage – provide for sewage from its area to be discharged, treated or supplied to any person	There is Section 60 approval for the Narromine Temporary WTP and the Tomingley WTP. Narromine and Trangie STPs were both constructed prior to 1993, hence a Section 60 approval is not required.
Section 61 – Ministerial directions concerning certain works The Minister for Primary Industries or a person authorised by the Minister may direct a council to take such measures as are specified in the direction to ensure the proper safety, maintenance and working of any of the following works: b) water treatment works, c) sewage treatment works.	Council has received Section 61 inspections for: Narromine WTP – see Section 8.2.5. Tomingley WTP – see Section 11.2.5. Trangie STP – see Section 13.3.2. Council advised that there are no Section 61 inspections for the Narromine STP.
Section 64 – Construction of works for developers As a precondition to granting a certificate of compliance for development, a water supply authority may, by notice in writing served on the applicant, require the applicant to do either or both of the following: a) to pay a specified amount to the water supply authority by way of contribution towards the cost of such water management works as are specified in the notice, being existing works or projected works, or both,	Council has a 2020 Development Servicing Plan (DSP).

Key legislative framework and their main purposes	Narromine Shire Council's current performance
b) to construct water management works to serve the development.	
Section 68 – What activities require the approval of the council? A person may carry out *operation of a system of sewage management* (meaning to hold or process, or re-use or discharge, sewage or by-products of sewage) only with the prior approval of the council. Council can manage the approval process under their liquid trade waste policy.	Council has a Liquid Trade Waste Policy adopted in April 2016 – see Section 5.2.6.
Section 382 – Insurance against liability A Council must make arrangements for its adequate insurance against public liability and professional liability.	Council has insurance against public liability, professional indemnity, property protection, motor vehicle insurance and workers compensation under Section 382 of the Act.
Environmental Planning and Assessment Act (1979) (including the EPA Regulation 2000)	
This Act aims to encourage proper management of resources, the orderly use of land, the provision of services, and the protection of the environment. It covers: ▪ Local Environmental Plans (LEP) ▪ Environmental Impact Statement (EIS) ▪ Reviews of Environmental Factors (REF)	Council advised these legislative and regulatory requirements are generally met by Council.
Public Health Act (2010)	
This Act aims to promote, protect and improve public health; by providing safe drinking water to the community. Section 25 – a supplier of drinking water must have a quality assurance program in place and must comply with its requirements. A Drinking Water Management System (DWMS) satisfies this requirement. The requirements of the DWMS are as follows: ▪ Produce an annual report to be made available to consumers, regulatory authorities and stakeholders ▪ The DWMS will be internally reviewed. The review will assess Council's performance in relation to: ▪ CCPs and their exceedances ▪ Improvement Plan ▪ Record keeping ▪ NSW Health Database performance	Council has a 2018 DWMS, and has supplied DWMS annual reports from 2015 to 2020.
Water Management Act (2000) and Water Act (1912)	
This Act promotes the sharing of responsibility for the sustainable and efficient use of water between the NSW Government and water users and provides a legal basis to manage NSW water planning, allocation of water resources and water access entitlements.	Council owns a number of water access licences (WALs). See Sections: 8.1.3 for Narromine Potable WSS 10.1.3 for Trangie WSS 11.1.3 for Tomingley Non-Potable WSS

Key legislative framework and their main purposes	Narromine Shire Council's current performance
Protection of the Environment Operations Act (1997)	
Section 43 – Environment protection licences Environment protection licences (EPLs) may be issued to authorise the carrying out of scheduled activities at any premises, as required under section 48. This clause applies to sewage treatment, meaning the operation of sewage treatment systems that involve the discharge or likely discharge of wastes or by-products to land or waters.	Council holds an EPL for the Narromine STP – see Section 12.5.2 Trangie STP does not have an EPL as they do not discharge wastes to land or water and are therefore not a scheduled activity under Section 48.
Work Health and Safety Act 2011 and WHS Regulation 2017	
To provide for a balanced and nationally consistent framework to secure the health and safety of workers and workplaces. Under the Act, for Workplace Management, Council has a duty to: ▪ Identify hazards ▪ Manage risks to health and safety ▪ Implement, maintain and review risk control measures.	Council has a Work Health and Safety Policy adopted in February 2018. The policy states that the Policy will be reviewed every four years of its adopted or latest amendment.
Fluoridation of Public Water Supplies Act (1957)	
This Act covers the addition of fluoride to public water supply under the NSW Fluoridation Code of Practice.	The Narromine Potable and Trangie water supply schemes are not fluoridated
Dam Safety Act 2015	
Under this Act, the owner of any dam listed as a prescribed dam must meet the requirements of the NSW Dams Safety Committee (DSC). The DSC assigns dams a consequence category relative to their dam failure consequence, and this determines the level of reporting and type of actions required by the dam owner as part of their Safety Management System (SMS).	Not applicable as Council does not own any prescribed dams
Commonwealth Water Act 2007 and Water Regulations 2008	
Part 7 of the Act – Water information The Bureau of Meteorology is required to collect, hold, manage, interpret and disseminate Australia's water information. Section 126 of the Act places an obligation on persons specified in the Regulations to give certain water information to the Bureau. Part 7 of the Regulations defines who must give specified water information to the Bureau, and the time and format in which it must be given. The Regulations individually name over 200 organisations which are required to give the Bureau specified water information that is in their possession, custody or control.	Narromine Shire Council is not listed as a "persons" who must give information to the Bureau under the regulations.

4. Asset performance and issues

4.1 Asset condition assessment

To be completed – Council to provide draft condition assessment report from APV (to be made available in May 2022)

4.2 Asset management and performance indicators

The asset performance indicators with the Code of Accounting Practice and Financial Reporting benchmark for the water supply and sewerage assets are presented in Table 4-1 and Table 4-2 respectively. These values are obtained from Special Schedule 7 of Council's 2015/16 to 2019/20 Financial Statements.

Table 4-1: Council's water supply asset performance indicators

Indicator	2015/16	2016/17	2017/18	2018/19	2019/20	Bench-mark
Infrastructure renewals ratio = Asset renewals / Depreciation, amortisation and impairment	1706%	448%	215%	352%	165%	**>100%**
Infrastructure backlog ratio = Estimated cost to bring assets to a satisfactory standard / Net carrying amount of infrastructure assets	57.32%	41.89%	48.13%	3.32%	1.81%	**<2%**
Asset maintenance ratio = Actual asset maintenance / Required asset maintenance	87%	82%	98%	98%	98%	**>100%**
Cost to bring assets to agreed service level = Estimated cost to bring assets to an agreed service level set by Council / Gross replacement cost	Not reported	26.51%	26.00%	2.00%	1.00%	**None**

For the water supply performance indicators:

- Since 2017/18, the reported infrastructure renewals ratio has been within the benchmark (more than 100%). This indicates that renewals have been keeping in pace with depreciation.
- The infrastructure backlog ratio has been within benchmark (less than 2%) for four consecutive financial years prior to 2019/20.
- The asset maintenance ratio has been below the benchmark (less than 100%) in the last five financial years. This means that in most years, required maintenance is not being undertaken.

Table 4-2: Council's sewerage asset performance indicators

Indicator	2015/16	2016/17	2017/18	2018/19	2019/20	Bench-mark
Infrastructure renewals ratio = Asset renewals / Depreciation, amortisation and impairment	155%	45%	4%	84%	32%	**>100%**
Infrastructure backlog ratio = Estimated cost to bring assets to a satisfactory standard / Net carrying amount of infrastructure assets	58.24%	4.78%	5.87%	1.45%	1.52%	**<2%**
Asset maintenance ratio = Actual asset maintenance / Required asset maintenance	84%	53%	97%	106%	106%	**>100%**
Cost to bring assets to agreed service level = Estimated cost to bring assets to an agreed service level set by Council / Gross replacement cost	Not reported	5.30%	4.00%	0.96%	1.00%	**None**

For the sewerage performance indicators:

- The reported infrastructure renewals ratio has been below the benchmark (less than 100%) in the last four financial years. This indicates that renewals have not been keeping pace with depreciation.
- The infrastructure backlog ratio has been within benchmark (less than 2%) for three consecutive financial years prior to 2018/19.
- The asset maintenance ratio has been within the benchmark (greater than 100%) in the last two financial years.

5. Financial performance and issues

5.1 Water supply services

5.1.1 Financial performance indicators

Some key indicators of the water fund's financial performance are presented in Table 5-1. The 2017/18 data was obtained from the Special Schedule 3 of the Annual Financial Statements. From 2018/19 onwards the information was obtained from Council's Financial Data Returns.

Table 5-1: Financial performance - Water supply

Financial performance	2017/18	2018/19	2019/20	2020/21
Total OMA* / Rates & Charges	63%	78%	Not reported	Not provided
Economic rate of return (ERR)	0.75%	Not reported	Not reported	Not provided
Revenue split (residential : non-residential)***	Res: 81% Non-Res: 19%	Res: 78% Non-Res: 22%	Res: 78% Non-Res: 22%	Res: 79% Non-Res: 21%
Residential revenue split (usage charge : access charges)***	Usage: 68% Access: 32%	Usage: 64% Access: 36%	Usage: 65% Access: 35%	Usage: 65% Access: 35%
Management cost % of OMA	44%	64%	Not reported	Not provided
Revenue from developer charges ($'000)**	0	0	0	Not provided
Accumulated surplus ($'000)	11,422	11,457	12,424	Not provided

* Operating Cost (OMA) = Management Expenses + Operational and Maintenance Expenses

** Development costs have been carried out by Council over the past 5 years, Council has adopted the option to not levy fees

*** Updated figures provided by Council

Note: PWA has received financial statements and/or financial data returns from 2017/18 to 2019/20. Council has notified that the provided information from the financial statements from 2017/18 to 2019/20 was not accurate. Council is currently experiencing difficulties obtaining financial data to provide PWA updated/corrected financial data returns.

The following were observed from the water supply financial data:

- Based on PWA's experience, the total OMA cost should not be more than 60 to 70% of the income from rates and charges (or lower) to allow the LWU to set aside funds for renewals. Council has not achieved this in 2017/18, the following 2018/19 financial year Council achieved 64%.
- The ERR has not been reported in Council's financial data returns in the last two financial years, despite being reported in the LWU performance monitoring data.
- Revenue split has averaged 79% residential and 21% non-residential from the last four financial years, which has closely reflected the historical customer usage split between residential and non-residential.
- DPIE Water's LWU Circular 11 states that medium utilities (less than 4,000 connected properties) like Narromine, need to raise at least 50% of residential revenue from water usage charges. Council has consistently maintained this for the past three financial years. Council advised that the usage charges have increased over the last three to four years, indicating a commitment from Council in terms of cost recovery.

- Revenue from developer charges has been reported as $0 in the last three financial years. Council has notified that over the last five financial years, all developments have been carried out by Council, and Council has adopted the option to not levy fees. Although Council has adopted a DSP which will be applied to forthcoming developments but only in Narromine.
- There is surplus maintained for water supply according to Council's financial data returns.

5.1.2 Comparison with similar sized LWUs

A comparison of NSC LWU performance with similar sized LWUs as reported in DoI Water's "LWU performance monitoring data and reports 2019/20" [1] is listed in Table 5-2 for water supply. This is the latest available data.

Table 5-2: 2019/20 LWU performance against DPIE Water Supply benchmarking indicators compared to median for similar sized LWUs

Indicator	LWU Performance	Median for LWU with less than 4,000 properties
Residential fixed charge	$236.00	$391.20
Step 1 Residential usage charge	$1.50 per kL	$1.70 per kL
Step 2 Residential usage charge*	N/A	$2.80 per kL
OMA Cost (OMA)	$1.28 per kL	$1.47 per kL
Typical Developer Charge	$5,308 per ET	$4,380 per ET
Typical Residential Bill (TRB)	$694.27	$785.22
Return on Assets	-0.85%	-0.01%
Economic Rate of Return (ERR)	-1.45%	0.125%
Residential Revenue from Usage Charges	67% of residential bills	55.5% of residential bills

*LWU website did not report Step 2 Residential usage charges for 2019/20

Council has lower residential water usage fees and charges and TRB compared to LWUs of similar size.

5.1.3 Performance monitoring data

DPIE Water's website provides "LWU performance monitoring data and reports 2019/20" for the last seven years. The key financial performance indicators for Council's water services are presented in Figure 5-1.

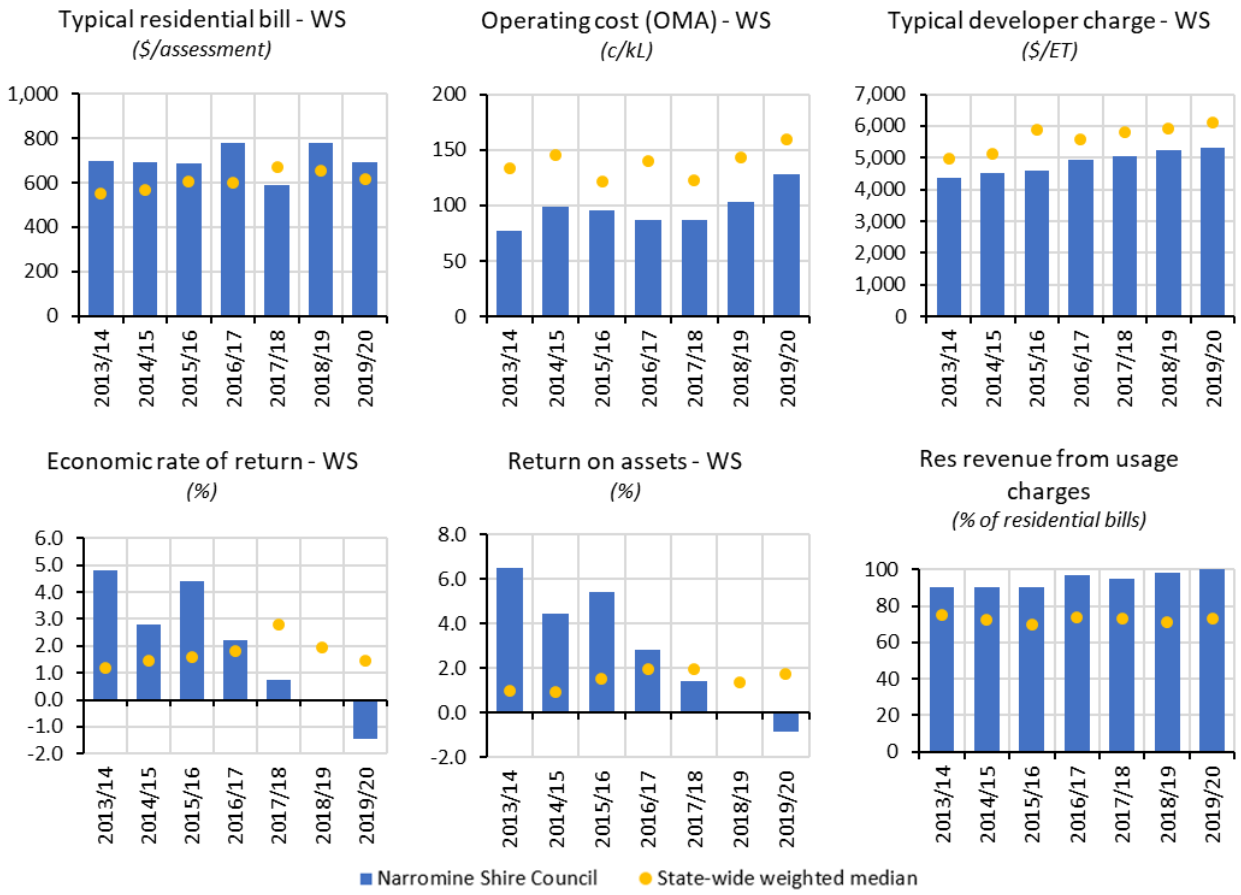

Figure 5-1: Historical water supply performance indicators for NSC

The following observations were observed from the monitoring report for the water service indicator:

- Typical residential bills remained relatively steady, with a sudden decrease in 2017/18. It has remained above the state-wide weighted median. Council advised that the sudden decrease in 2017/18 was predominately due to water restrictions.
- The operating costs have generally been trending upwards, however still below the state-wide weighted median.
- Typical developer charges were steadily increasing for the past 7 years, however still below the state-wide weighted median. Council advised that they have a developer servicing plan, however it is not levied and they can, by resolution, consider to waive developer charges.
- Both the economic rate of return and the return on assets have generally been trending downwards, while the state-wide weighted median for both indicators has been trending upwards. Note that there was no reported value for both indicators on 2018/19.
- The residential revenue collected from usage charges has been trending upwards from 90% to 100%.

5.1.4 Council's tariff structure

The water supply fees and charges are shown in Table 5-3 for the NSC water supply schemes. The data was obtained from Council's 2021/22 Fees and charges. [2]

Table 5-3: Fees and charges for water supply 2021/22

Fee component	Unit	Narromine, Trangie and Rural	Tomingley (Treated non-potable)
Water access charge			
20 mm	$/year	255	250
25 mm	$/year	395	386
32 mm	$/year	645	630
40 mm	$/year	1,005	980
50 mm	$/year	1,555	1,520
100 mm	$/year	6,245	6,095
Access charge for bulk users*	$/year	50% of access charge	50% of access charge
Water consumption charges (usage)			
Residential	$/kL	1.85	1.62
Non-residential	$/kL	1.91	1.80^
Bulk water supply	$/ML	477.00	477.00

* Community groups/Organisations only – approved on a case-by-case basis. Council advised that there are currently two users, with only one active user (Race Club)

^ Provided by Council over the phone

Council advised that the access charge for bulk users should be increased. Issue

5.1.5 Assessment of best practice pricing

Council's water supply pricing is compared to the Water Supply, Sewerage and Trade Waste Pricing Guidelines [3]. The best practice pricing criteria for water supply is summarised in Table 5-4.

Table 5-4: Best practice pricing - Water supply

	Best Practise Criteria	Comment
1	Res and Non-res: Two-part tariff (usage charge and access charge)	Council adopts a two-part tariff with access charges and usage charge
2	At least three billing cycles per year. To see seasonal changes in usage.	NSC has four billing periods per year according to the Council website
3B	For <4,000 connected residential properties in LGA, revenue from residential usage charge should be at least 50% of total residential revenue	Council's residential usage charge is 67% of total residential revenue in the 2019/20 financial year
4	Water Access Charge (both res and non-res) should be proportional to the square of the diameter of the meter size	Water access charge is approximately equal to the square of the diameter of the meter size
5	Council implements developer service charges (DSCs)	Council implements developer service charges
6	Recommended - inclining block tariff (step increase in usage charge). Recommended second step usage charge should be at least 1.5x first step charge for strong price signal	Council does not have step increases in usage charge. Potential issue

5.2 Sewerage services

5.2.1 Financial performance indicators

Some key indicators of the sewerage fund's financial performance are presented in Table 5-5. The 2017/18 data was obtained from the Special Schedule 3 of the Annual Financial Statements. From 2018/19 onwards the information was obtained from Council's financial data returns.

Table 5-5: Financial performance - Sewerage

Financial performance	2017/18	2018/19	2019/20
Total OMA / Rates & Charges	51%	56%	Not reported
Economic rate of return (ERR)	1.47%	Not reported	Not reported
Revenue split (residential : non-residential)	Res: 72% Non-Res: 28%	Res: 76% Non-Res: 24%	Res: 78% Non-Res: 22%
Management cost % of OMA	74%	69%	Not reported
Revenue from developer charges ('000)**	0	0	0
Accumulated surplus ('000)	9,813	10,445	10,944

*Operating Cost (OMA) = Management Expenses + Operational and Maintenance Expenses

**Development costs have been carried out by Council over the past 5 years, Council has adopted the option to not levy fees

Note: See note from Section 5.1.1

The following were observed from the sewerage financial data:

- Based on PWA's experience, the total OMA cost should be not more than 60 to 70% of the income from rates and charges (or lower) to allow the LWU to set aside funds for renewals. Council is achieving this for their sewerage fund.
- The ERR has not been reported in Council's financial data returns in the last two financial years, despite being reported in the LWU performance monitoring data.
- Revenue from developer charges has been reported as $0 in the last three financial years. Similar to the water supply financial performance, Council has notified that over the last five financial years all developments have been carried out by Council, and Council has adopted the option to not levy fees.
- There is surplus maintained for sewerage according to Council's financial data returns

5.2.2 Comparison with similar sized LWUs

A comparison of NSC LWU performance with similar sized LWUs as reported in DoI Water's "LWU performance monitoring data and reports 2019/20" [1] is listed in Table 5-6 for sewerage. This is the latest available data.

Table 5-6: LWU performance against DPIE Water Sewerage benchmarking indicators compared to median for similar sized LWUs

Indicator	LWU Performance	Median for LWU with less than 4,000 properties
Typical Residential Bill (TRB)	$631	$631
OMA Cost (OMA)	$2.67 per kL	$2.53 per kL
Typical Developer Charge	$4,095 per ET	$4,095 per ET
Economic Rate of Return (ERR)	1.01%	0.32%

Indicator	LWU Performance	Median for LWU with less than 4,000 properties
Return on Assets	2.68%	0.56%

Council's residential sewerage fees and charges, and resulting TRB, is the medium of the LWUs of similar size.

5.2.3 Performance monitoring data

DPIE Water's website provides "LWU performance monitoring data and reports 2019/20" for the last seven years. The key financial performance indicators for Council's sewerage services are presented in Figure 5-2.

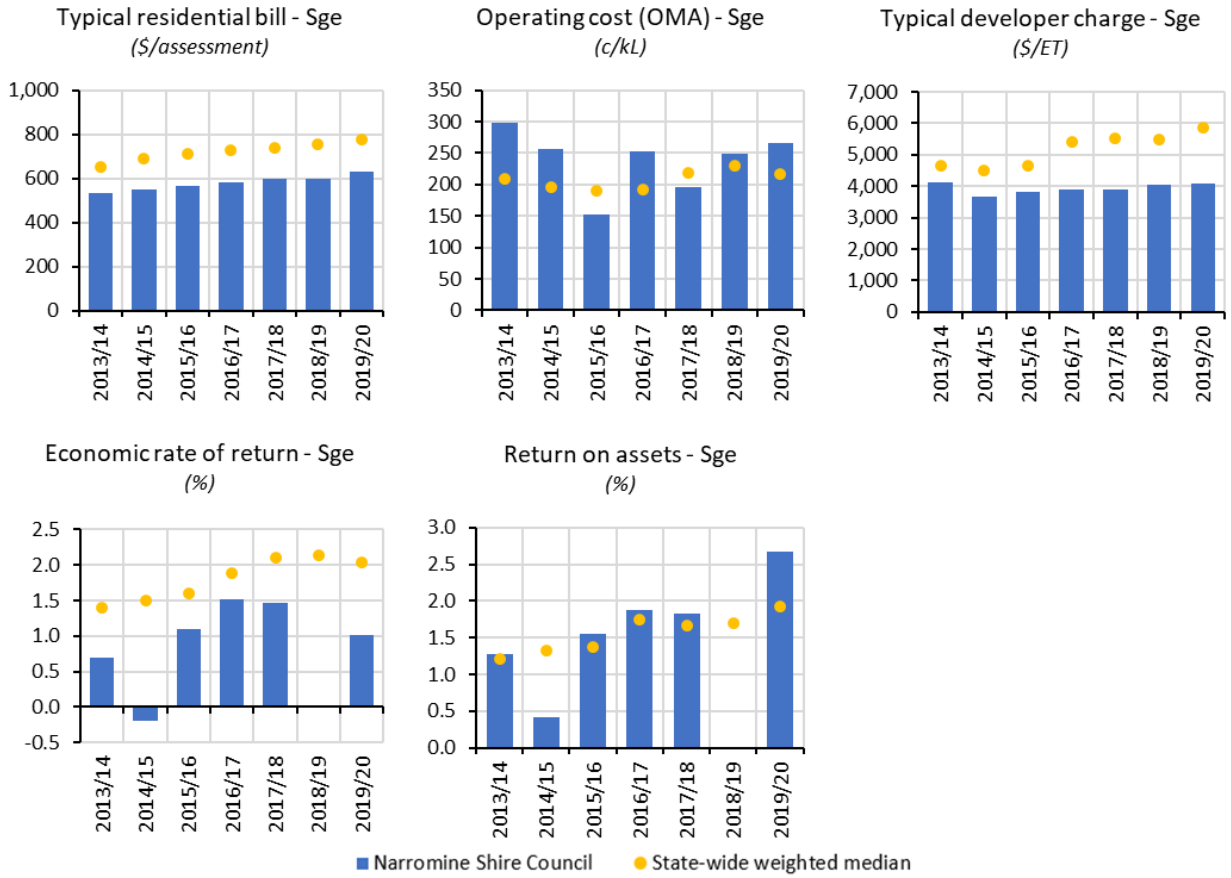

Figure 5-2: Historical sewerage services financial performance indicators for NSC

The following observations were observed from the monitoring report for the sewerage service indicators:

- Typical residential bill for sewerage have been relatively steady with small increases year-on-year, however still below the state-wide weighted median.
- Operating costs have fluctuated around the state-wide weighted median, with no general trend in either direction.
- Typical developer charges during 2014/15 sharply fell from 2013/14, since then the typical developer charges have been steadily increasing back to 2013/14 level. The typical developer charges has been below the state-wide weighted median.

- The economic rate of return was mostly positive, except for 2014/15, indicating good financial health. It has also generally been trending upwards, however still below the state-wide weighted median. Note that there was no reported value for 2018/19.
- The return on assets has been positive in all financial years, indicating that the sewerage business has been profitable. It appears that the return on assets has been on par with the state-wide weighted median, except for 2019/20. Note that there was no reported value for 2018/19.

5.2.4 Council's tariff structure

The sewerage fees and charges are shown in Table 5-7 for the NSC sewerage schemes. The data was obtained from Council's 2021/22 Fees and charges [2].

Table 5-7: Fees and charges for sewerage 2020/21

Fee component		Unit	Narromine and Trangie
Sewer access charge			
Residential		$/year	664.00
Non-residential	20 mm	$/year	236.26
	25 mm		369.16
	32 mm		604.83
	40 mm		945.05
	50 mm		1,476.64
	100 mm		5,906.56
Sewer usage charges			
Non-residential		$/kL	2.50

5.2.5 Assessment of best practice pricing

Council's service charges are compared to the Water Supply, Sewerage and Trade Waste Pricing Guidelines [3]. The best practice pricing criteria for sewerage services is summarised in Table 5-8.

Table 5-8: Best practice pricing - Sewerage

	Best Practise Criteria	Comment
1	Residential: uniform annual sewerage bill (only annual access charge)	Council has uniform access charge for residential sewerage service
2	Non res: two-part tariff (usage charge and access charge)	Council applies access charge and usage charge for non-residential users
3	Sewer Discharge Factor used to calculate non-residential sewerage bill (both access charge and usage charge)	Sewer discharge factors are used by Council to calculate non-residential sewerage bill.
4	Sewerage Access Charge (non-res) should be proportional to the square of the diameter of the meter size	Non-residential sewerage access charge is proportional to the square of the diameter of the meter size.

5.2.6 Liquid trade waste policy

Council's current liquid trade waste policy was adopted in July 2018 in accordance with the NSW Framework for Regulation of Sewerage and Trade Waste (Section 3.1 on page 20).

NSC engaged with external consultants to conduct inspections of potential liquid trade waste dischargers in June 2017, 102 businesses in Narromine and 23 in Trangie were assessed [4]. During the investigation, the owner/ manager of the relevant businesses was informed of the Council's liquid trade waste policy and where relevant a classification was given.

The results of the inspection and categorisation for dischargers are given in Table 5-9.

Table 5-9: Number of dischargers by classification

Discharge classification type	Narromine	Trangie
Classification A – exempt dischargers are low risk with low volume and are not required to apply for approval	7	2
Classification A – low risk with low volume (<5 kL/day or 1,000 kL/year, and <16 kL for retail food preparation)	33	12
Classification B – medium risk with volume (greater than 5 kL/day or 1,000 kL/year, and >16 kL for retail food preparation)	9	2
Classification C – high risk dischargers, if an activity is not listed in the other classifications it is considered to be of this classification	0	0
Classification S – dischargers include pan contents, septic tank pump-outs and chemical toilet waste	2	2
Not discharging LTW	51	5

6. Levels of Service (LOS)

6.1 Water supply and sewerage service objectives and targets

Council has some LOS targets available in the *Narromine Shire Council Strategic Business Plan: Water Supply and Sewerage Businesses (2013)* which was prepared by CPE Associates.

A typical list of objectives and targets relevant to water supply, sewerage management and general services has been provided from Table 6-1 to Table 6-3. Each objective has one or more Service Standard (or Design Basis) drawn from legislation, best practice guidelines, and industry practice. Where relevant, PWA have provided example indicators and targets which could be used to monitor performance, given in red.

It is recommended Council review LOS performance indicators and targets for the water supply and sewerage services. Council should have a way to monitor performance against all LOS performance indicators, to see if they are meeting their targets. Issue

It should be noted that the objectives and targets would have a direct and significant influence on the future direction and management of the sewerage services, hence allowing the identification of issues. Further it is noted that meeting agreed objectives and targets incurs cost, which needs to be recovered through typical residential bills and developer charges, and hence needs to be considered in the context of the community's preferences and ability to pay (i.e. affordability). Thus, it is expected that Council would use the draft typical list as the starting point in its consultation with the PRG/Community and establish through the consultation process an agreed set of objectives and the associated Key Performance Indicators (KPIs) and targets.

Table 6-1: Narromine Shire Council's water supply service objectives and targets

Objective	Service Standard (Design Basis)	Performance Indicator	Target (where Council does not currently have a target, an example is given in red text)	Performance
Water supply security				
Adequate potable water for current and future generations with reasonable level of restrictions	5/10/10 rule based on 99th percentile unrestricted future demand based on DPIE Water's draft guidelines "Assuring future urban water security, Assessment and Adaption guidelines for NSW local water utilities"	▪ Average duration of drought-related restrictions	e.g. restrictions no more than 5% of time	For Narromine, potable water restrictions have been in place from January 2018 to February 2021. For Trangie, water restrictions have been in place from December 2017 to February 2021.
		▪ Frequency (average number) of drought-related Level 3 restrictions	Less than one event per 10 years	For Narromine Potable WSS, there were Level 3 and above restrictions from January 2019 to March 2020. For Trangie WSS, there were Level 2 restrictions from October 2019 to October 2020. Less than one event per 10 years
		▪ Supply capacity during normal worst recorded drought demand	90% of normal demand[1]	100% of normal demand supplied[1]
Projected town water supply extraction is within the upper limit of the water extraction licence and meets any licence conditions	Not exceeding the licensed entitlement and any other conditions	Annual volume of water extracted	Narromine Potable WSS: 2,000 ML/year Trangie WSS: 350 ML/year	Maximum extraction year: Narromine Potable WSS: 988 ML/year (2018/19) Trangie WSS: 351 ML/year (2018/19)
Minimise water resource	100% compliance with the Water Sharing Plan (WSP) requirements	Number of breaches with the WSP requirements	e.g. nil breaches	Nil breaches for all schemes

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
dependent environmental and third-party impacts	100% compliance with the work approval conditions	Number of breaches with the work approval conditions	e.g. nil breaches	Nil breaches for all schemes
Drinking water quality				
Protects public health	100% compliance with the Australian Drinking Water Guidelines (ADWG) for health-based parameter	Number of boil water alerts	e.g. nil boil water alerts per year	No boil water alerts issued for Narromine Shire Council
	Compliance with the DWMS	DWMS – annual reviewed and regularly audited	e.g. 100% compliance with annual review and audit	For Narromine, this is assessed in Section 8.2.4 for treated water quality, and in Section 8.3.5 for reticulated water quality. For Trangie, this is assessed in Section 10.2.4 for treated water quality, and in Section 10.3.5 for reticulated water quality.
	100% compliance with critical control points (CCPs)	Number of CCP exceedances	e.g. nil CCP critical limit exceedance per year	Narromine: No CCP exceedances in 2020, see Section 8.2.4. Trangie: No CCP exceedances in 2020, see Section 10.2.4.
Aesthetically fit for purpose	95% compliance with the ADWG for aesthetic parameters	Discoloured water complaints	e.g. zero complaints per year	From Council's historical complaints log: ▪ Narromine: One complaint in 2021, 6 in 2020, 1 in 2019, 3 in 2018, 1 in 2017. ▪ Trangie: Zero complaints
		Complaints of taste (e.g. chlorine, palatability,	e.g. zero complaints per year	From Council's historical complaints log:

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
		hardness, staining of fitting/fixtures)		▪ Narromine: One complaint in 2020 and 1 in 2019. ▪ Trangie: One complaint in 2019.
		Complaints of odour (be specific, e.g. algae, others)	e.g. zero complaints per year	From Council's historical complaints log: ▪ Narromine: One complaint in 2020, 1 in 2018 and 1 in 2017. ▪ Trangie: One complaint in 2016.
Reliability of supply infrastructure				
Limit supply interruptions	Asset condition rating (Council to provide default condition rating)	Number of unplanned service interruptions due to asset failure:		
		▪ Water mains breaks	e.g. 10 mains breaks per 100 km per year	1.29 mains breaks per 100 km per year in 2019/20, 2.62 in 2018/19, 3.96 in 2017/18[2]
		▪ Unplanned interruptions	e.g. 10 unplanned interruptions per 1,000 connections per year	1.26 unplanned interruptions in 2019/20, 1.68 in 2019/18, 1.21 in 2017/18[2]
		▪ Duration of unplanned interruptions	e.g. Average 152 mins per event	46 mins in 2019/20, 60 mins in 2018/19, 60 mins in 2017/18[2]
Maintain continuous service availability	Adequate level of workforce resourcing with appropriate skills	Response time to incidents[1]: ▪ Priority 1: Failure to maintain continuity or quality of supply to a large number of customers or to a	60 minutes (during working hours) 120 minutes (after hours)	60 minutes (during working hours and after hours)

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
		critical use at a critical time		
		▪ Priority 2: Failure to maintain continuity or quality of supply to a small number of customers or to a critical use at a critical time	180 minutes (during working hours) 240 minutes (after hours)	60 minutes (during working hours and after hours)
		▪ Priority 3: Failure to maintain continuity or quality of supply to a single customer	1 working day	1 working day
		▪ Priority 4: A minor problem or complaint that can be dealt with at a mutually convenient time	14 working days	14 working days
Maintain adequate pressure	Treatment and distribution system capacity designed to supply 95th percentile peak day demand.	Number of incidents causing complaints about pressure	e.g. zero complaints per year (could be different target for different supply areas)	From Council's historical complaints log, ▪ Narromine: 5 complaints in 2020, 4 in 2019, 11 in 2018 ▪ Trangie: One complaint in 2021, 1 in 2020 and 2 in 2017.
Provide adequate firefighting capability	System can supply 10 L/s for 4 hours when supplying peak day demands while maintaining positive pressure	Percentage of urban area with fire-fighting facilities and capability appropriate to land zone	100% of urban area served[1]	100% area served[1]

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
		Percentage of systems/facilities capable of meeting fire engine requirements	e.g. 99%	No data. Council is currently addressing this.

1 – From Narromine Shire Council's Strategic Business Plan for Water Supply and Sewerage Businesses Final Report (Nov 2013) prepared by CPE Associates

2 – Reported from NSW Department of Industry – LWU performance monitoring data and reports (online)

Table 6-2: Narromine Shire Council's sewerage service objectives and targets

Objective	Service Standard (Design Basis)	Performance Indicator	Target (where Council does not currently have a target, an example is given in red text)	Performance
Reliability of collection and treatment infrastructure				
Maintain Continuous Service Availability	Asset condition rating (Council to provide default condition rating)	Number of unplanned service interruptions due to asset failure:		
		▪ Backup of sewage into properties	e.g. zero backups per year	No data
		▪ Overflow due to pump failure	Less than two per year[1]	Zero sewer overflows per 100 km per year in the past seven financial years from 2019/20[2]
		▪ Sewer mains blockage/collapse	e.g. Less than 60 breaks per 100 km of sewer per year	3.69 breaks and chokes per 100 km per year in 2019/20, 16.67 in 2018/19 and 18.52 in 2017/18[2]
	Workforce resourcing	Response time to incidents[1]:		
		▪ Priority 1 – Failure to contain sewage within the sewer system or any problem affecting a critical user at a critical time	60 minutes (during working hours) 120 minutes (after hours)	60 minutes (during working hours and after hours)
		▪ Priority 2 – Minor failure to contain sewage within the sewer system or any problem affecting a critical user at a non-critical time	180 minutes (during working hours) 240 minutes (after hours)	60 minutes (during working hours and after hours)
		▪ Priority 3 – Minor failure to contain sewage affecting a single property or as bad odours	Next working day	Next working day

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
Protect the environment and receiving waters				
System Performance	Compliance with the EPL	Non-compliances with EPL	e.g. nil	Narromine STP: 1 non-compliance in 2019, see Section 12.5.2.
	Contains 8 hours of sewage load at average dry weather flow (ADWF) within each SPS	Number of overflows at ADWF	e.g. zero sewer overflows per year	Zero sewer overflows per 100 km per year in the past seven financial years from 2019/20[2]
	Rainfall event with a 20% AEP (1-in-5 year event)	Number of overflows for the selected rainfall event	e.g. zero overflows for a less than 20% AEP rainfall event	No data. Council advised that the flat terrain in Narromine makes assessing the overflows from SPS and manholes difficult.
	Compliance with biosolids guidelines	Non-compliances with biosolids guidelines	Meets statutory requirements[1]	Meets statutory requirements[1]
	Reduce effluent discharge from the STP	% effluent reuse	e.g. 100% reuse	Council has reported nil reuse in the last five years.
	Minimise odours	Number of odour complaints	Less than two complaints per year[1]	From Council's historical complaints log, 1 complaint reported in May 2018, and 1 in Dec 2017, both instances in Narromine.
Sound regulation of sewerage and trade waste	Compliant liquid trade waste (LTW) policy	Extent of implementation	e.g. 100% implementation of policy	Council has an LTW Policy and implements the Policy
	Compliant LTW classification, acceptance and approval processes	Percentage of compliant systems/premises	e.g. 90% of systems/premises compliant with LTW policy	From Section 5.2.6, Narromine: 50% of systems/premises discharging LTW Trangie: 78% of systems/premises discharging LTW

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
	Full cost recovery pricing model or pricing model based on Appendix D of the LTW Guidelines	Pricing model based on Appendix D of the LTW Guidelines	e.g. Full cost recovery from pricing model	According to Council's LTW policy, the LTW services are provided to commercial users with full cost recovery through fees and charges.

1 – From Narromine Shire Council's Strategic Business Plan for Water Supply and Sewerage Businesses Final Report (Nov 2013) prepared by CPE Associates

2 – Reported from NSW Department of Industry – LWU performance monitoring data and reports (online)

Table 6-3: Narromine Shire Council's general service objectives and targets

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
Community wellbeing				
Public open spaces (POS) are maintained green with fit-for-purpose cost-effective water	Greener parks, ovals and open spaces	Percentage of all POS to be maintained green independent of weather patterns	e.g. 100%	No data
Environmental sustainability				
Minimise dependence on grid power	On-site generation of renewable sources of electricity where economical	▪ Number of facilities with on-site renewable energy generation system ▪ % per capita reduction in greenhouse gas emissions since 2015	e.g. 50% e.g. 5%	Council advised they have emergency stand-by power at most of its water sites. No data

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
Financial sustainability				
Revenue meets on-going commitments	Common LGA wide **OR** individual town/system specific sewer service charges	Extent of community acceptance of sewer service charges	e.g. >=80% community acceptance of sewer service charges in annual survey	Council advised there is no annual survey being carried out.
	Full cost recovery	▪ Economic rate of return	e.g. >=0%	Water supply: -1.45% in 2019/20[1] Sewerage: 1.01% in 2019/20[1]
		▪ OMA/rates revenue	e.g. <=80%	Water supply: 78% in 2018/19 Sewerage: 56% in 2018/19
		▪ Return on investment (ROI)	e.g. >=2%	Not reported
		▪ Accounting surplus/deficient	e.g. maintain surplus	Not reported
	Non-residential revenue reflects community benefits	Residential and non-residential revenue split	e.g. Revenue split is reflective of usage to within +/- 2%	Revenue from residential and non-residential customers for water supply appears to not be reported correctly. See Section 5.1.1.
	Supports Council's hardship policy	Level of pensioner rebate per property	e.g. Standard pensioner rebate	From Council's website, pensioners can apply for rebate if eligible
Efficient operation delivering stable price paths	Evidence based robust total asset management plan (TAMP), financial plan (FP) and business continuity plan (e.g. Drought Contingency and Emergency Response Plan – DCERP)	TAMP, FP & DCERP – annually reviewed & regularly audited	e.g. Compliant current TAMP, FP & DCERP	Council advised that the TAMP, FP and DCERP are annually reviewed.

Objective	Service Standard (Design Basis)	Performance Indicator	Target **(where Council does not currently have a target, an example is given in red text)**	Performance
Pricing signal for sewerage services is fair and strong to encourage efficient use of services	Water and sewer tariff is compliant with best-practice guidelines	Percentage compliance with best-practice pricing guidelines	e.g. 100% compliance	Assessed in Section 5.1.5 for water supply and Section 5.2.5 for sewerage services
	All users/customer properties with a sewer connection are charged	Percentage of users/customer properties with a sewer connection charged	e.g. 95%	All users/customers (including unmetered users, such as parks and gardens, standpipe usage) are metered and charged
	Efficient price signals	Percentage of users/customer properties not billed	e.g. 10%	See above
Developer charges that are competitive to attract economic growth	Common LGA wide **OR** individual town/system specific sewer developer charges that is compliant with guideline	▪ Extent of community acceptance ▪ Percentage compliance with developer charges guidelines	e.g. 100% e.g. 100%	No data No data
	Full cost or cross-subsidised as per guideline	▪ Extent of community support of cross subsidy OR full cost	e.g. 100%	No data
Asset management				
Maintain up-to-date asset register	Asset register compliant with Accounting standard[4]	Extent of assets captured in the asset register	e.g. 100%	Council's assets are captured and updated in the asset registers
		Accuracy of assets in the management system and what is in-ground	e.g. 90%	No data Will there be in-ground asset audits?
	Asset management system drives service delivery	Percentage usage in work scheduling	e.g. 100%	Council continues to schedule works based on asset management system. Council to confirm

1 – From Narromine Shire Council's Strategic Business Plan for Water Supply and Sewerage Businesses Final Report (Nov 2013) prepared by CPE Associates

6.2 Customer complaints handling process

Narromine Shire Council employs a multi-tiered Customer Request Management (CRM) system for the handling of customer requests. For service and complaints, this system is provided via *Civica Authority*. During business hours, calls are taken by Customer Service Officers. These calls are logged to a CRM and passed to the Water Sewer Team via an online SMS system. This workflow ensures that calls are responded to within Council's agreed service response times. Calls received after hours are taken by the on-call manager who assesses the call and activates an appropriate response via phone to the on-call operator. The Manager enters a CRM at a later time when able to access the system.

The computer-generated CRM is forwarded via email to the Action Officer (normally the Team Leader), and the Responsible Officer (normally the Utilities Technical Officer). This CRM process is closed with feedback given to the customer if requested following actions/repairs being affected.

The work crews complete a service response form, previously in written form, now via an online app within the Microsoft Teams environment. The use of the CRM system brings an auditable trail for tracking of the response and is stored within the Council Records System. The new Service Response app allows for the export of Excel spreadsheets which enable the gathering of statistical data for Asset Management and Renewal purposes.

Council has advised that the CRM system is integrated with the asset and financial systems (that is, for each asset line item in the asset register, the asset details for the asset line item can be linked with its financial details or valuation).

Incident response times are not recorded after addressing customer complaints, with only the date of the incident filled in the CRM system but no duration is recorded.

7. Population growth and development

7.1 Historical population

The Australian Bureau of Statistics (ABS) calculates an estimated residential population (ERP) each year for each GLA in Australia. It uses census data as the basis (which is based on place of usual residence), then adjusts for many factors such as interstate and overseas migration, births and deaths. The historical ERP for the Narromine Shire LGA is given in Table 7-1.

Table 7-1: Historical estimated residential population for Narromine Shire LGA

	1996	2001	2006	2011	2016	2019
NSC LGA	6,775	7,060	6,691	6,832	6,599	6,517
Average annual growth		0.8%	-1.1%	0.4%	-0.7%	-0.4%

The residential population within the Narromine Shire LGA is generally decreasing in population from 1996 to 2019.

The number of private dwellings, private dwelling population, household size and percentage of dwellings occupied from the 2016 Census General Community Profile data for each Urban Centre and Locality (UCL) is given in Table 7-2.

Table 7-2: Household size and occupancy ratio for Narromine and Trangie

	Dwellings			Persons	Household size	% private dwellings occupied
	Occupied	Unoccupied	Total			
Narromine						
Separate house	1,198	136	1,334	3,005	2.5	90%
Semi-detached row or terrace house townhouse etc	22	0	22	28	1.3	100%
Flat or apartment	69	16	85	78	1.1	81%
Total for standard private dwellings	**1,289**	**152**	**1,441**	**3,111**	**2.4**	**89%**
Trangie						
Separate house	285	32	316	632	2.2	90%
Semi-detached row or terrace house townhouse etc	7	7	14	11	1.6	50%
Flat or apartment	22	4	26	34	1.6	85%
Total for standard private dwellings	**314**	**43**	**356**	**678**	**2.2**	**88%**

For the town of Tomingley, the SA1 area was too large to cover the town's serviced area, therefore the smaller meshblocks (MBs) were used instead. The number of dwellings, population and the household size are shown in Table 7-3.

Table 7-3: Calculated household size for the town of Tomingley

	Dwellings	Persons
Tomingley		
Totals from MB data	30	65
Assumed % dwellings occupied		90%
Calculated household size		2.36

See Appendix A for the statistical area 1 (SA1) and meshblocks (MB) zones used for the analysis. The SA1 and MB boundaries correspond well to the existing service area of each town.

7.2 Visitor contribution

From Council's 2020 Local Strategic Planning Statement, aviation events contribute significantly to the tourism economy attracting national and international visitors to the Narromine Shire. The Narromine Aerodrome attracts six major local, regional, national and international events annually. [5]

7.3 Service area population

The serviced area private dwelling numbers were estimated using Council's customer water billing data. The number of occupied dwellings connected to water or sewerage is approximately equal to the number of "active" residential assessments in the customer water billing data that are within the boundaries of the service area. An "active" residential assessment was one that had an average water usage of at least 60 L/assessment/day. This value was chosen as the percentage of "active" residential assessments closely matched the occupancy ratio in the 2016 Census.

7.3.1 Water supply service area

The historical number of residential assessments in the customer water billing data for each water supply area is given in Table 7-4. Refer to Figure 8-9 for the service area map of Narromine, Figure 10-7 for Trangie, and Figure 11-2 for Tomingley.

The number of residential assessments is approximately equal to the number of connected properties, as each property generally receives one water bill. Hence the assessments will be used for the analysis.

Table 7-4: Historical residential assessments in each water supply scheme

	2017/18	2018/19	2019/20	2020/21
Narromine WSS				
Active	1,371	1,342	1,335	1,339
Inactive	330	367	376	383
Total	**1,700**	**1,709**	**1,710**	**1,722**
Trangie WSS				
Active	368	358	356	358
Inactive	126	129	129	130
Total	**494**	**487**	**485**	**488**
Tomingley non-potable WSS				
Active	14	17	16	14
Inactive	18	15	15	17
Total	**32**	**32**	**31**	**31**

The serviced area population was estimated by multiplying the number of "active" residential assessments by the estimated household size for each scheme from ABS (see Section 7.1). The estimated population serviced by water is given in Table 7-5.

Table 7-5: Estimated serviced population – water supply schemes

Scheme	2017/18	2018/19	2019/20	2020/21
Narromine	3,290	3,221	3,203	3,214
Trangie	809	787	783	788
Tomingley	33	40	37	33

7.3.2 Sewerage service area

The historical number of residential assessments in each sewerage service area is given in Table 7-6. Refer to Figure 12-1 and Figure 13-1 for the service area maps of Narromine and Trangie sewerage schemes respectively.

Table 7-6: Historical residential assessments in each sewerage scheme

	2017/18	2018/19	2019/20	2020/21
Narromine sewerage scheme				
Active	1,311	1,282	1,273	1,271
Inactive	78	117	130	132
Total	**1,389**	**1,399**	**1,403**	**1,403**
Trangie sewerage scheme				
Active	330	322	320	323
Inactive	26	34	36	34
Total	**356**	**356**	**356**	**356**

The serviced area population was estimated by multiplying the number of “active” residential assessments by the estimated household size for each scheme from ABS (see Section 7.1). The estimated population serviced by sewerage is given in Table 7-7.

Table 7-7: Estimated serviced population – sewerage schemes

Scheme	2017/18	2018/19	2019/20	2020/21
Narromine	3,146	3,077	3,055	3,051
Trangie	725	707	705	710

7.4 Economic outlook

The following was obtained from Council’s Local Strategic Planning Statement document [5]:

- Narromine Shire has an estimated Gross Regional Product of $378 million and represents 4.4% of the $6.893 billion value added in Orana region. The Agriculture, Forestry and Fishing sector contributes the largest proportion of value add, contributing more than $73 million. Narromine Shire is part of the rich Macquarie Valley, largely producing wheat, beef, sheep, wool and cotton. Irrigated agriculture in the Valley produces over 50% of the region’s gross value of agricultural production from less than 5% of the land area and less than 20% of available water resources. The Agriculture, Forestry and Fishing sector is the largest industry employing almost a third of the workforce. The Health and Social Assistance Sector and Retail Trade sectors are also significant employers within Narromine Shire.

- For Narromine Shire the new Inland Rail project represents a significant opportunity to create a secondary inland hub focussing on agricultural commodities and assist in removing congestion at Parkes. In addition, surrounding mining development such as Fifield, Tomingley and the newly proposed Alkane Zirconia mine near Dubbo may provide opportunities to centralise mining transport.

7.5 Nominated growth strategy

7.5.1 Narromine

Council provided development areas within Narromine, which is presented in Figure 7-1.

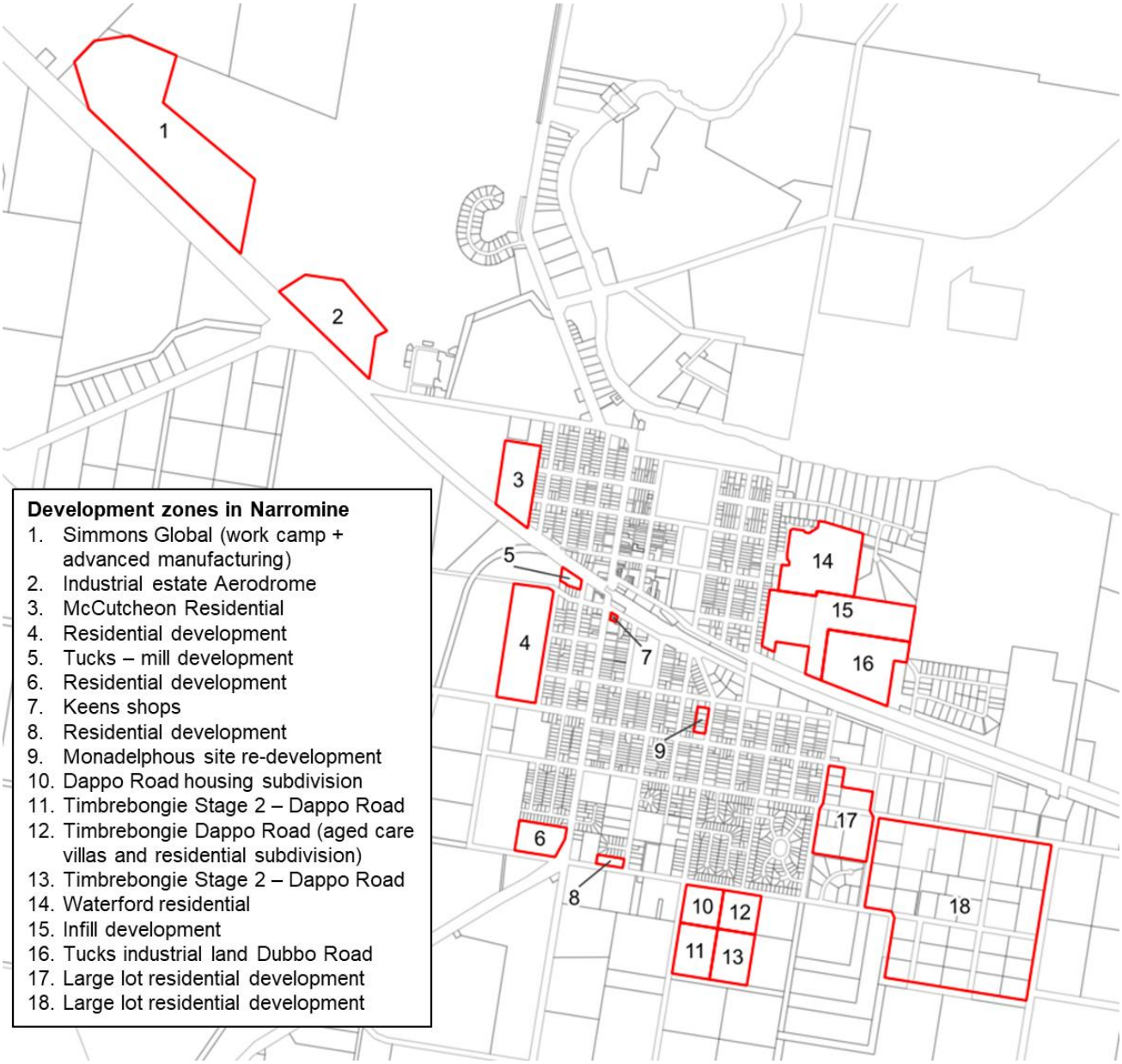

Figure 7-1: Development areas in Narromine township

Table 7-8 summarises the development zones in Narromine. Detailed ET calculations and timing of growth for each development area is included in Appendix B.

Table 7-8: Summary of development zones in Narromine

Development area no.	Development area	User class	ET	Development priority
1	Simmons Global			
	▪ Work camp	Non-Res	25	Industrial
	▪ Advanced manufacturing	Non-Res	10	Industrial
2	Industrial estate Aerodrome	Non-Res	0.6	Industrial
3	McCutcheon Residential	Res	50	Second
4	Residential development	Res	40	Fourth
5	Tucks – mill development	Res	15	Fifth
6	Residential development	Res	15	First
7	Keens shops	Res	1.6	Second
8	Residential development	Res	7	First
9	Monadelphous site re-development	Res	16	First
10	Dappo Road housing subdivision	Res	15	First
11	Timbrebongie Stage 2 – Dappo Road	Res	6	Second
12	Timbrebongie Dappo Road			
	▪ Aged care villas	Res	20.7	First
	▪ Residential subdivision	Res	16	First
13	Timbrebongie Stage 2 – Dappo Road	Res	20.7	Second
14	Waterford residential	Res	50	First
15	Infill development	Res	50	First
16	Tucks industrial land Dubbo Road	Non-Res	14	Industrial
17	Large lot residential development	Res	12	Third
18	Large lot residential development	Res	15	Third

7.5.2 Trangie

Two residential development areas are expected to occur in the Trangie township:

- Residential development due to the Trangie feedlot development, 20 ET
- Weemabah Street Aboriginal Elder housing development, 4 ET

The residential growth rate of 2 new dwellings per year in Trangie was assumed, which was obtained from the 2018 Narromine Shire Residential & Large Lot Residential (Land Use) Strategy. [6]

No non-residential growth is expected to occur in the Trangie township.

7.5.3 Tomingley

No growth is expected to occur within the Tomingley village.

7.6 Projections

7.6.1 Water supply schemes

The projected number of occupied dwellings and population serviced by each water supply scheme based on the nominated growth rates are given in Table 7-9.

Table 7-9: Projected dwellings and population – water serviced areas

	2022	2027	2032	2037	2042	2047	2052
Projected occupied dwellings							
Narromine	1,339	1,451	1,541	1,562	1,566	1,566	1,566
Trangie	358	364	374	382	382	382	382
Projected water supply serviced population							
Narromine	3,214	3,482	3,698	3,749	3,757	3,757	3,757
Trangie	788	801	823	841	841	841	841

7.6.2 Sewerage schemes

The projected number of occupied dwellings and population serviced by each sewerage scheme based on the nominated growth rates are given in Table 7-10.

Table 7-10: Projected dwellings and population – sewerage serviced areas

	2022	2027	2032	2037	2042	2047	2052
Projected occupied dwellings							
Narromine	1,271	1,417	1,521	1,625	1,648	1,648	1,648
Trangie	323	329	339	347	347	347	347
Projected sewer serviced population							
Narromine	3,051	3,401	3,651	3,901	3,956	3,956	3,956
Trangie	710	723	745	762	762	762	762

8. Narromine Potable Water Supply Scheme

The Narromine Potable Water Supply Scheme (WSS) provides potable water to 1,718 connections in the town of Narromine. The water is sourced from five groundwater bores.

Figure 8-1 shows the schematic diagram of the Narromine Potable WSS.

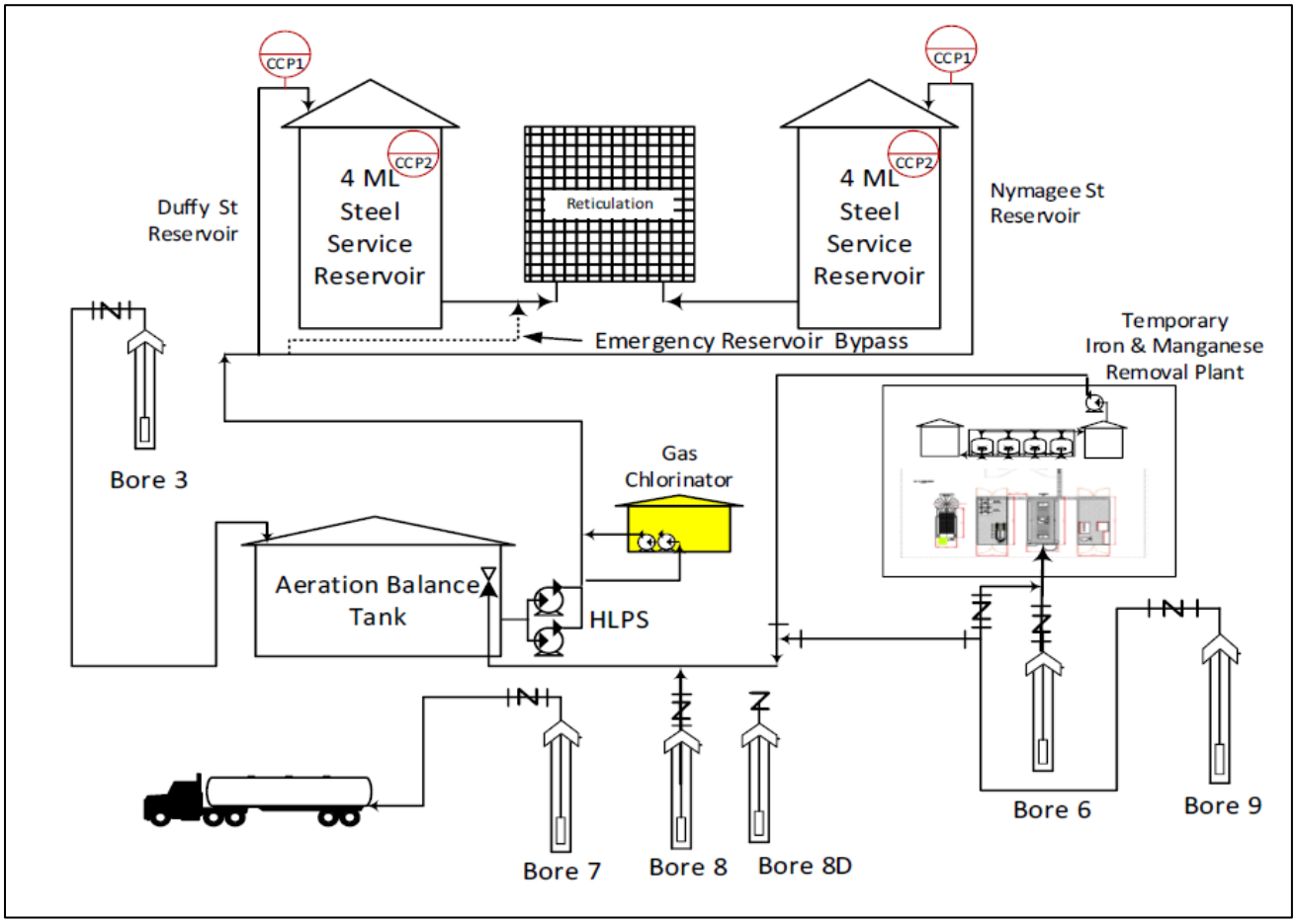

Figure 8-1: Narromine Potable WSS – schematic diagram

8.1 Raw water source

The potable water supply draws raw water from five active ground water bores in the upper and lower Pleistocene Quaternary Aquifers connected to the Macquarie River between the City of Dubbo and Narromine.

8.1.1 Water resource

The Macquarie River is located within the Macquarie-Bogan catchment. The catchment is in the central-west of NSW and has an area of 74,800 km^2. The headwaters of the Macquarie River originate in the Great Dividing Range south of Bathurst, with the river flowing north-westerly until it joins the Barwon River near Brewarrina. Major towns within this catchment include Bathurst, Orange and Oberon upstream of Burrendong Dam, and Dubbo, Wellington and Nyngan on the Macquarie River below Burrendong Dam. Mudgee, Peak Hill, Narromine, Warren, Lithgow and Brewarrina also draw their water from rivers in the catchment. Major water storages within this catchment include the Burrendong and Windemere Dams. The Macquarie-Bogan catchment supports a range of water users including local councils, water utilities, dryland agriculture, livestock grazing and some irrigated agriculture, such as cotton. [7]

The mean annual rainfall within the catchment ranges from over 1,200 mm in the south-east to around 300 mm in the north-west. There is a strong east-west evaporation gradient, with a mean Class A pan evaporation (i.e. open water evaporation) varying from around 900 mm/year in the south-east, to over 2,200 mm/year in the north-west, and is highly seasonal throughout the year. [8] The mean annual modelled runoff within the catchment is 35 mm/year (from 1985 to 2006) and is reasonably uniform throughout the year. [9]

The Macquarie-Bogan catchment is shown in Figure 8-2.

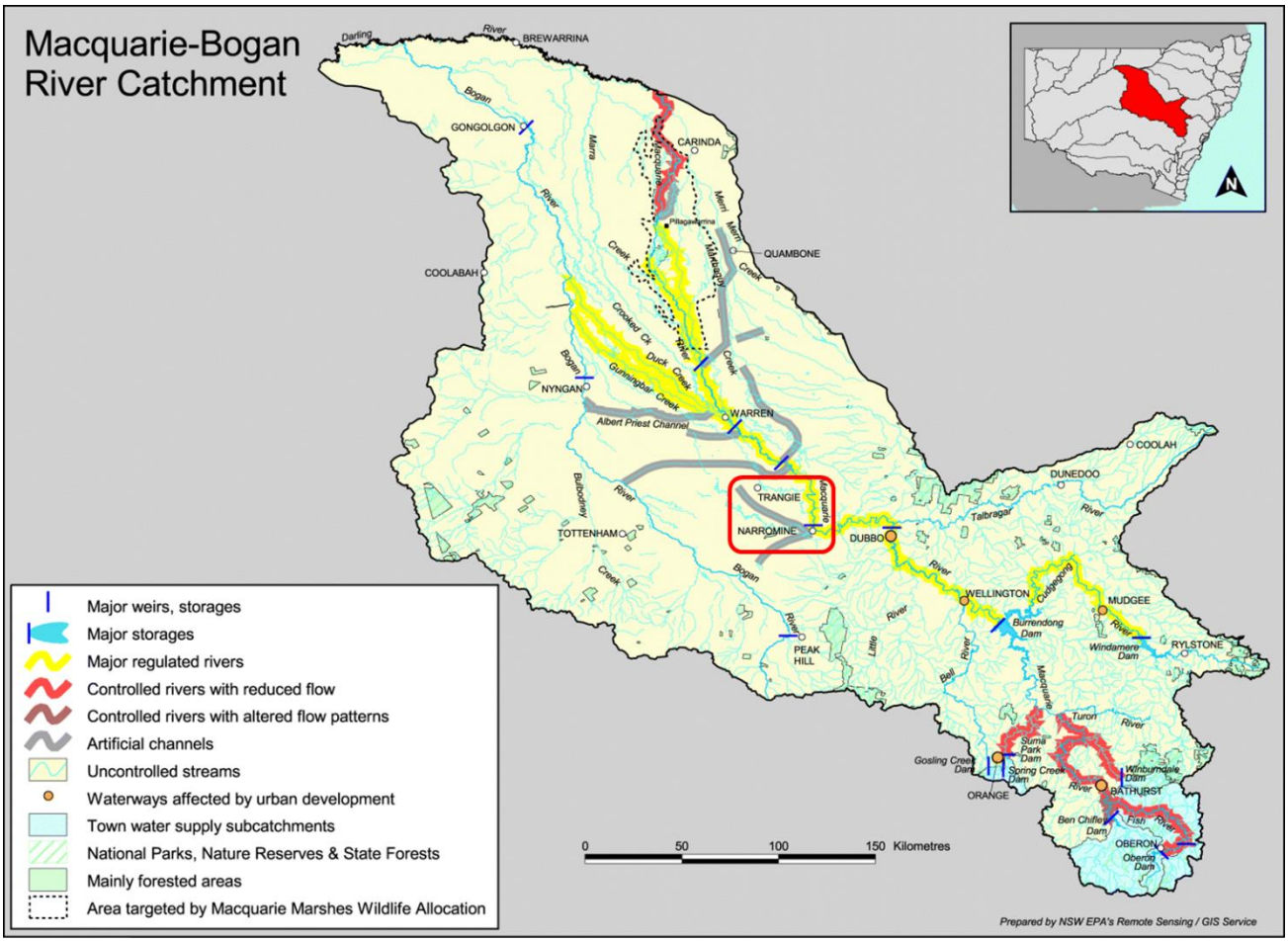

Figure 8-2: Macquarie-Bogan River catchment

8.1.2 Raw water extraction

The main sources of water are the five bores (3, 8, 8D, 6 and 9) located towards the Southern area of the Narromine township. Three of the five bores (3, 8 and 8D) pump directly into the aeration tank. The remaining Bores 6 and 9 currently operate, their water quality does not meet ADWG where iron and manganese levels are above ADWG aesthetic limits. A temporary WTP was built in 2020 to facilitate the use of Bores 6 and 9.

The bores currently active for town water supply are listed in Table 8-1. The locations of the listed bores are also provided in Figure 8-3. The pump flow rates are obtained from the 2015 Hydrogeological Status Report for the Narromine Town Water Supply Bore Network by Impax Group Pty Ltd. [10]

Table 8-1: Narromine active bore capacities

Bore ID (GW number)	Make - Serial	Install year	Flow rate (L/s)	Head (m)	Flow rate according to 2015 hydrogeological report (L/s) [10]
3 (GW021185) – shallow	N/A	1965	N/A	N/A	23.0
6D (GW042924)	Aquawest - FPS-140FS8-4E	2016	40.0	55.0	-
7D (GW273272)	-	2013	-	-	17.0
8D (GW030746) – constructed, not operational without treatment	Aquawest - FPS-140FS8-3B/L/N	2020	36.0	56.0	20.0
9D (GW062210)	Aquawest - FPS-110-FS-5I	2015	31.8	70.0	22.4

'D' indicates deep bores (bores accessing tertiary aquifers, at depths of >40m)
'S' indicates shallow bores (bores accessing the quaternary aquifers, at depths of 20-40m)

Figure 8-3: Narromine active bore locations

8.1.3 Water Access Licence

Council holds a *Local Water Utility* Water Access Licenses (WAL11603), issued under the *Water Management Act 2000*, which relates to the water supply to Narromine. The following apply to the WAL:

WAL license number	**WAL11603**
Category [Subcategory]	Local Water Utility
Entitlement	**2,000 ML/year**

Water Source	Lower Macquarie Zone 1 Groundwater Source
Water Sharing Plan (WSP)	Macquarie-Castlereagh Groundwater Sources 2020

Council has a works approval, number **80WA703150,** for the bores in Narromine to extract water from the water source nominated by WAL11603 for town water supply.

8.1.4 Raw water quality data

Council advised that the raw water quality is monitored by Council, but not on a regular basis.

PWA undertook a Scoping Study of the Narromine drinking water supply in April 2019. This study looked at the water quality of the current existing bores (Bores 3, 6, 7, 8 and 9) and new bores (Bores 6D, 7D and 9D), which had been tested by Council's operators as well as at an external NATA accredited laboratory (Forensic & Analytical Science Service – FASS). The water quality results from the current existing bores and new bores discussed from the Scoping Study are shown below:

Current existing bores (Bores 3, 6, 7, 8 and 9)

- The raw water quality of the existing bores complied with the health-based limits of the Australian Drinking Water Guidelines (ADWG) most of the time, except for a few exceedances in hardness, turbidity and corrosiveness.

New bores (Bores 6D, 7D and 9D)

- Turbidity – Bores 6D and 7D have shown regular turbidity levels above 10 NTU and levels as high as 40 NTU after aeration. For effective disinfection, the turbidity in the water should be below 1 NTU as per the NSW Department of Health CCP Circular issued in December 2018.
- Colour – Colour levels were much higher than the generally acceptable value of 15 HU which were seen in some of the bore samples after aeration.
- Iron – Bores 6D and 7D had an iron concentration in the order of 1.5 and 2.5 mg/L respectively, which both exceeded the ADWG taste/aesthetic threshold of 0.3 mg/L. Bore 9D had acceptable levels of iron concentration for most of the time except for a few occasions where the value is in the order of 0.4 mg/L.
- Manganese – all three new bores showed high manganese concentrations. Bore 7D had the highest concentration mostly ranging between 0.7 mg/L and 2.0 mg/L. Bore 9D had the lowest concentration with some samples having higher manganese levels of around 0.5 mg/L. These three bores all exceeded the ADWG taste/aesthetic threshold of 0.1 mg/L.
- Hardness – all three new bores showed high hardness levels ranging between 200 and 350 mg/L as $CaCO_3$.
- Corrosiveness – the water from all three new bores showed severe corrosive nature with CCPP (calcium carbonate precipitation potential) values in the order of -35 mg/L compared to a preferred value being closer to zero.

8.2 Water treatment

8.2.1 Treatment process

Treatment occurs in two stages, Bores 6 and 9 are initially treated at the Temporary Iron & Manganese Removal Plant (which will be referred as the "Temporary WTP") near Bores 6 and 9; treated water is transferred to the Aeration Balance Tank and chlorination facilities for further treatment. Extractions from Bores 3, 8 and 8D are also pumped and treated at the Aeration Balance Tank and chlorinated before distribution. The Narromine Temporary WTP can provide up to 2.5 ML/day of treated drinking water. The Temporary WTP is shown in Figure 8-4.

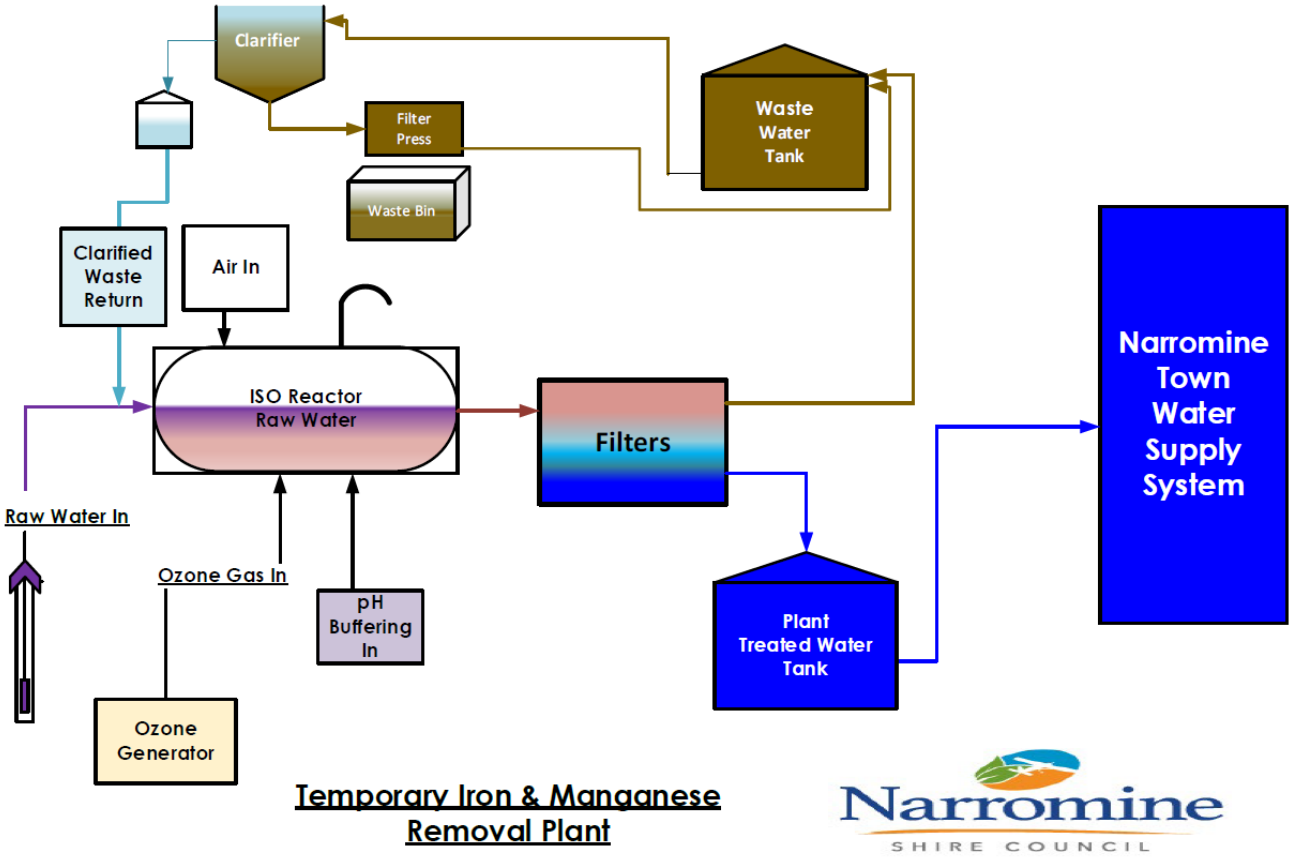

Figure 8-4: Narromine Temporary Iron & Manganese Removal Plant

8.2.2 Historical water production

Daily production data from January 2018 to June 2021 were available. Data was measured at the outlet of the High Lift Pump Station (HLPS).

The historical water production for Narromine is shown in Figure 8-5.

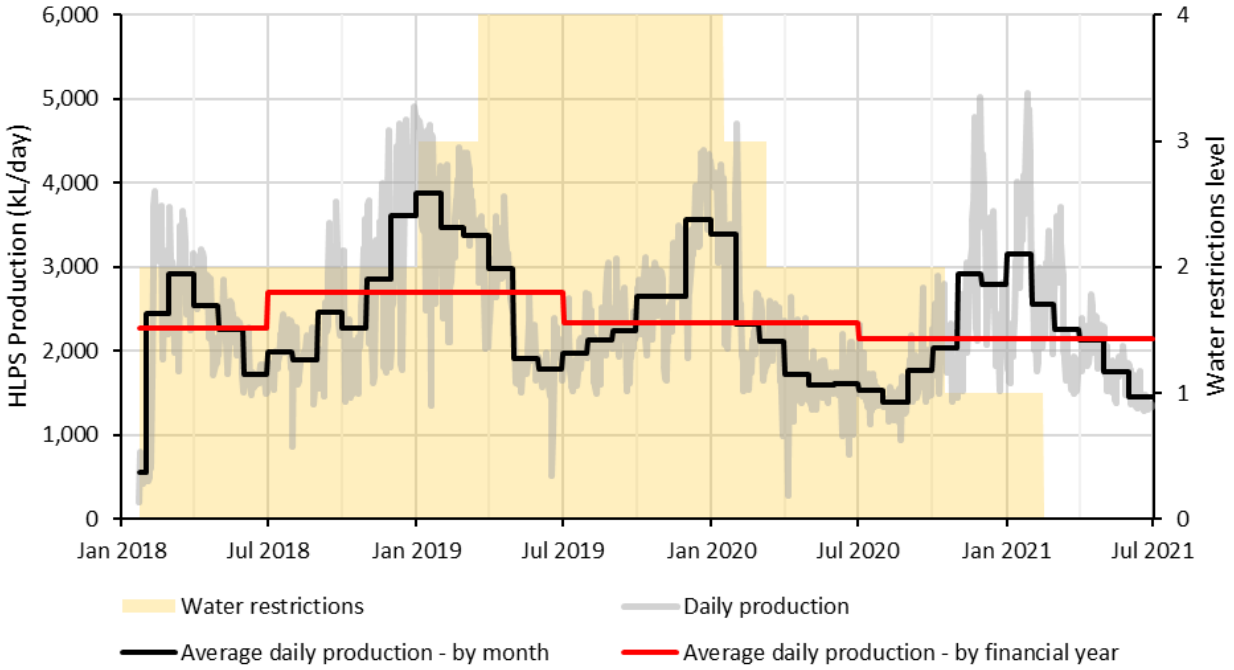

Figure 8-5: Historical daily production data for Narromine

The annual water production totals for 2008 to 2021 are shown in Table 8-2.

Table 8-2: Historical annual water production – Narromine (ML/year)

2017/18	2018/19	2019/20	2020/21
361	988	852	781

8.2.3 Peak production analysis

Potable water production data from February 2018 to June 2021 was used for peak usage analysis. The historical peak fortnight pattern for each financial year for the Narromine Potable WSS is shown in Figure 8-6.

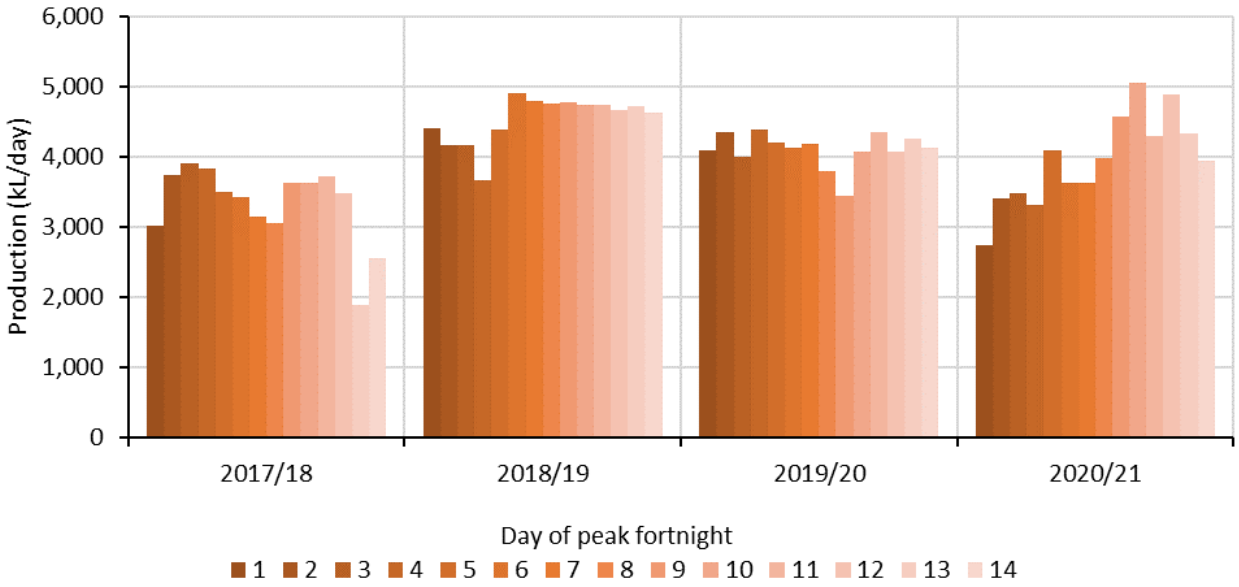

Figure 8-6: Peak fortnightly production patterns - Narromine High Lift Pump Station (2017/18 to 2020/21)

The highest daily WTP production recorded was 5.1 ML/day, which occurred on the 26 January 2021. The maximum temperatures leading up to this day ranged from 30 to 38.7°C.

The daily production during the peak week and peak fortnight demand is shown in Figure 8-7. The peak week occurs within the peak fortnight demand, as indicated by a lighter shade. The average daily production over the peak week (ADPW) and peak fortnight was 4.8 ML/day and 4.5 ML/day respectively.

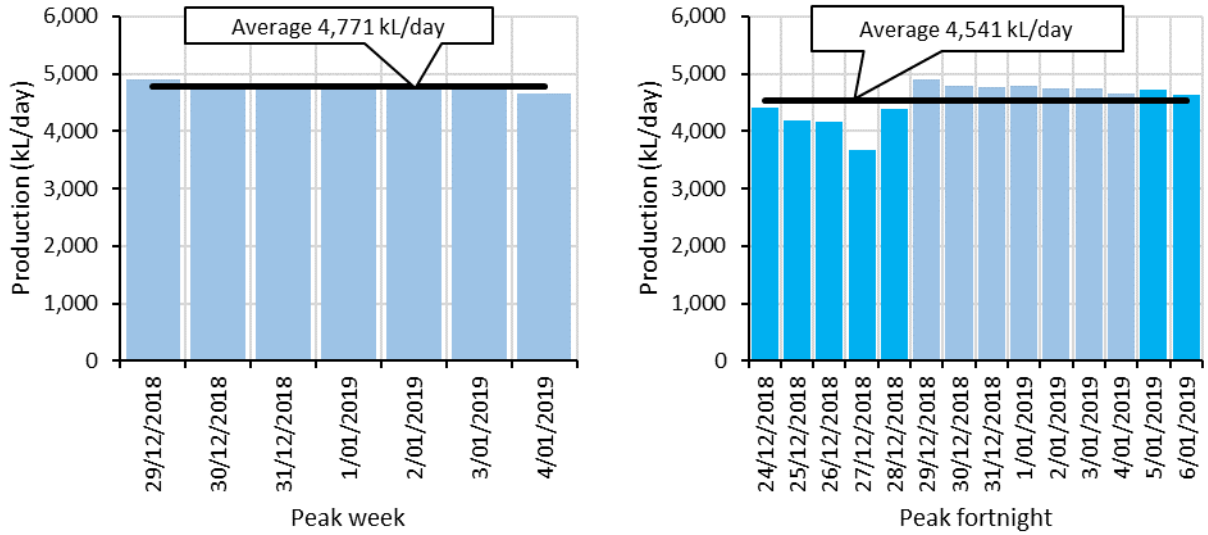

Figure 8-7: Peak week and peak fortnight production – Narromine Potable WSS

From the figure above, the ratio of the peak day (PD) production (5.1 ML/day) to the average daily peak week (ADPW) production (4.8 ML/day) for the data is 1.06. However, Council advised that there was a supply issue at the bores during the peak week production, as the pump rate of the HLPS is controlled by the ability of the bores to deliver water to the Aeration Tank. Therefore, the PD to ADPW ratio of **1.20** was nominated for this WSS, which is based on PWA's experience from a similar-sized WSS.

8.2.4 Treated water quality

Within the treatment process, there are critical control points (CCP) that measure the effectiveness of barriers. In the event that the critical limits are breached for any control points, an operator will cease operation of the plant to reduce risks of contamination.

Narromine Potable WSS has two CCPs adopted within the 2020 DWMS. The existing CCP targets are summarised in Table 8-3.

Table 8-3: Narromine Potable WSS – critical control points

CCP	Parameter	Location	Operational Target	Adjustment limit	Critical limit
CCP1 – Disinfection	Free chlorine	Duffy Street reservoir inlet Nymagee Street reservoir inlet	1 mg/L	< 0.7 mg/L or > 2.5 mg/L	< 0.3 mg/L or > 4.0 mg/L
CCP2 – Reservoir integrity	Reservoir integrity inspection (daily, weekly, monthly)	Duffy Street reservoir Nymagee Street reservoir	No breach of integrity	Any sign of integrity	Evidence of contamination

There were no CCP1 critical limit exceedances during the 2020 DWMS reporting period for the Narromine Potable WSS [11]. The CCP1 performance as reported in the 2020 DWMS is provided in Figure 8-8.

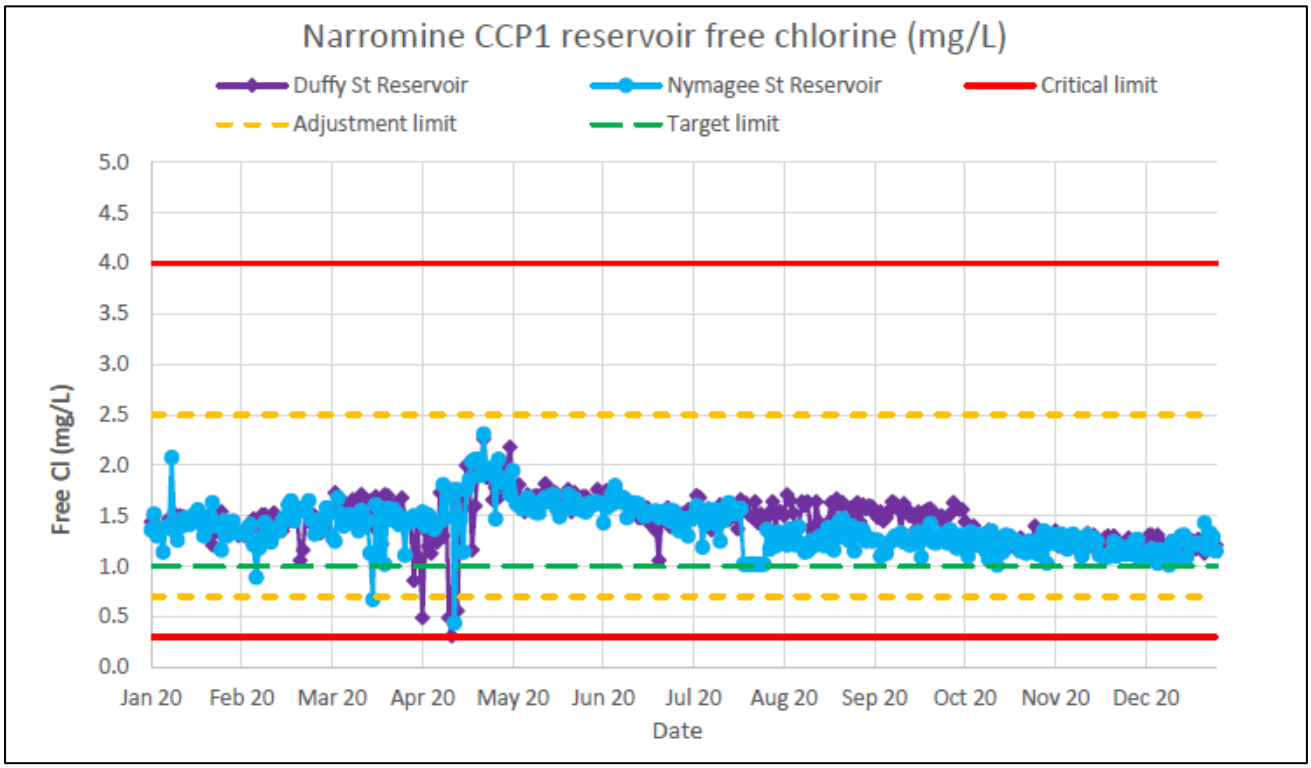

Figure 8-8: Narromine CCP1 performance (from 2020 DWMS annual report)

All results were consistently within the critical limits, only six samples from the two reservoirs had a free chlorine concentration below the adjustment limit in March/April 2020. These low free chlorine results occurred as part of the raw water quality issues in the first quarter of 2020 from Bore 9. This

bore was taken offline in April 2020 to reduce the free chlorine demand, from this time the CCP results returned to the target range [11].

As reported in the latest 2020 DWMS, the iron and manganese removal system has been installed which is owned and operated by an external contractor.

8.2.5 Water treatment plant performance

To include operational issues identified after APV condition assessment is completed and made available

Section 61 inspection and recommendations

The Narromine Potable WSS was inspected on 26 February 2020 by the DPIE Water utilities branch. At the time of inspection Council was experiencing dirty water complaints which appeared to be attributed to Bore 9D.

It was noted that after extensive testing undertaken by Council staff, it was confirmed that the dirty water is system wide and appears to be associated with turbidity, iron and manganese from Bore 9D.

Council now has an iron and manganese removal system installed which is owned and operated by an external contractor.

8.3 Distribution

8.3.1 Distribution system

Following treatment, potable water is pumped through duty/standby high lift pumps and flow paced disinfected with gaseous chlorine. Pumped water is stored at two separate 4.0 ML steel reservoirs, one on Nymagee Street and the other on Duffy Street both have top fill and bottom discharge. Reservoirs in the distribution system are interconnected via the rising main, with flows to Duffy Street reservoir restricted to manage the flow to both reservoirs.

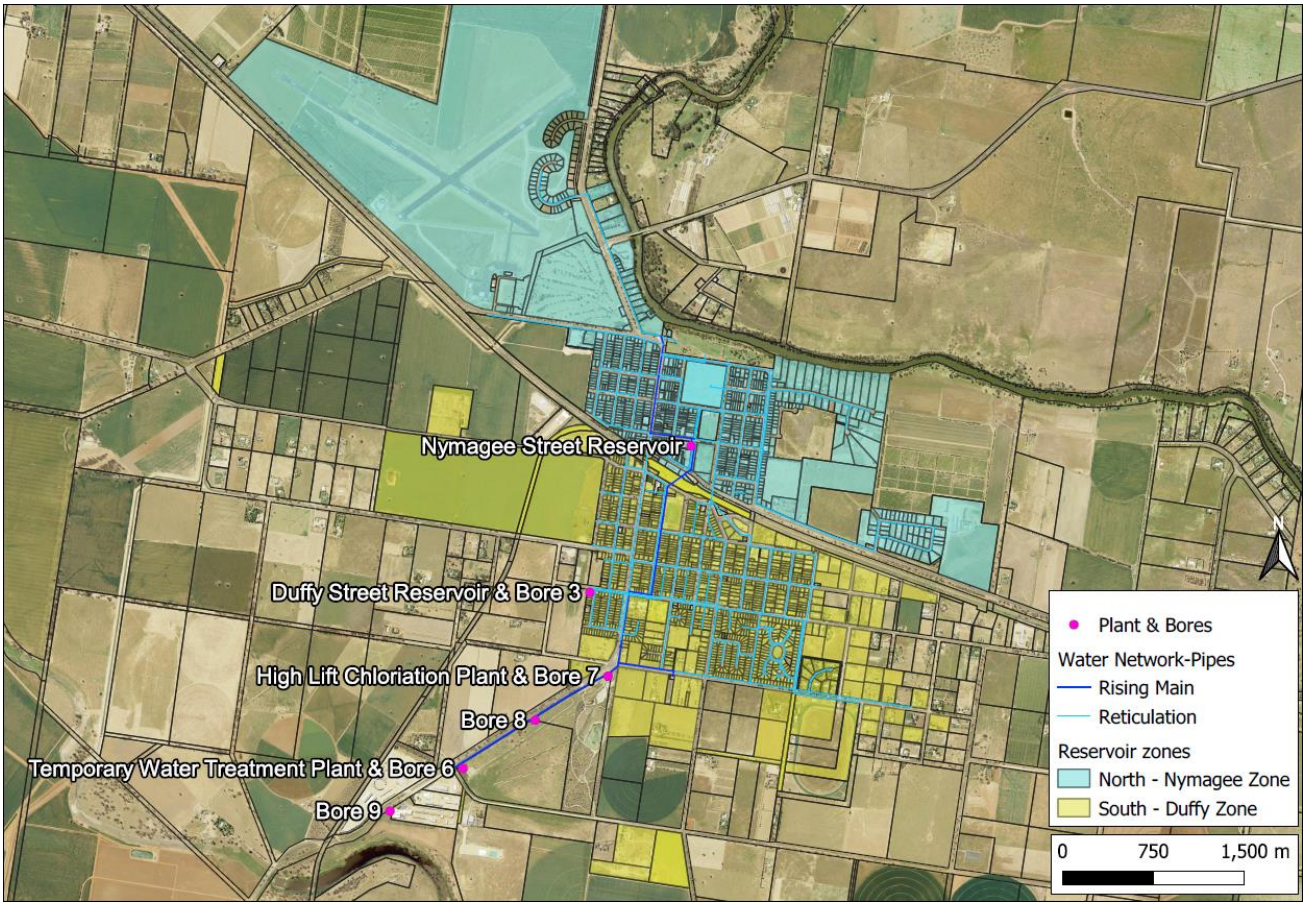

Figure 8-9: Narromine WSS distribution

Properties north of the rail line are serviced by the Nymagee Street reservoir, and properties south of the rail line are serviced by the Duffy Street reservoir. 'Nymagee Reservoir Zone' is referred to as 'North reservoir zone', and 'Duffy Reservoir Zone' is referred to as 'South reservoir zone' for the purposes of reporting.

8.3.2 Metered customer demand

Council supplied billing data for all users from 2017/18 to 2020/21, with meters being read four times a year. User classes from the billing data were residential, business, non-rateable, mixed development, business – industrial estate, farmland, strata parent and cancelled assessments.

The historical number of assessments (approximately equal to the number of connections) and the historical metered customer demand for the Narromine Potable WSS is given in Table 8-4 and Table 8-5 respectively.

Table 8-4: Historical number of assessments – Narromine Potable WSS

Financial year	2017/18	2018/19	2019/20	2020/21
Residential	1,465	1,474	1,476	1,488
Business	128	131	132	134
Non-Rateable	57	55	55	55
Mixed Development	2	2	2	2
Business - Industrial Estate	34	35	35	36
Farmland	2	2	2	1
Strata Parent	1	1	1	1

Financial year	2017/18	2018/19	2019/20	2020/21
Cancelled Assessment	11	9	8	7
Total	**1,700**	**1,709**	**1,710**	**1,722**

Table 8-5: Historical customer demand (ML/year) - Narromine Potable WSS

Financial year	2017/18	2018/19	2019/20	2020/21
Residential	647.5	596.5	492.0	457.5
Business	79.4	66.3	54.4	36.4
Non-Rateable	123.7	115.4	142.9	111.9
Mixed Development	0.9	0.7	0.5	0.6
Business - Industrial Estate	6.3	8.2	8.3	5.8
Farmland	1.5	3.3	2.5	0.0
Strata Parent	1.2	1.2	0.6	0.3
Cancelled Assessment	7.0	3.1	2.3	3.9
Total demand (ML)	**867.6**	**794.9**	**703.4**	**616.4**

Historical customer usage split has been around 74% residential to 26% non-residential.

The historical usage for all available billing periods for Narromine Potable WSS is given in Figure 8-10.

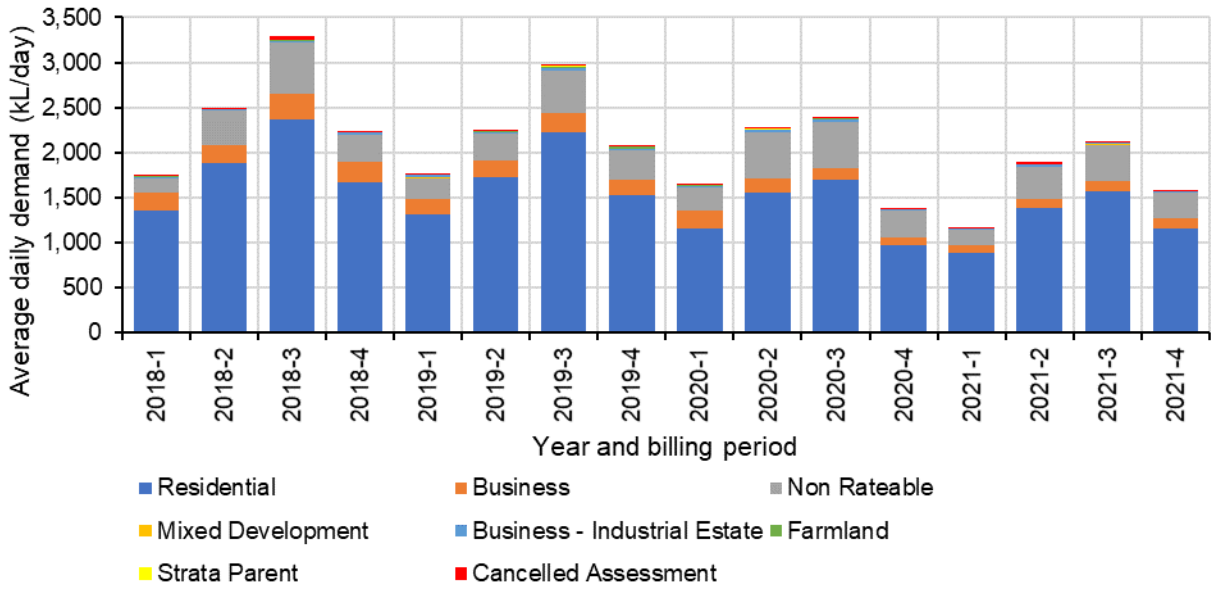

Figure 8-10: Historical customer demand by user category – Narromine Potable WSS

8.3.3 Major non-residential users

The criteria used to identify major non-residential users was any customers that used more than 3% of the total customer usage for Narromine Potable WSS in any financial year.

Four users met the criteria for a major non-residential user:

- Narromine Showgrounds: Average year demand of 46 ML/year and unrestricted future year demand of 70 ML/year
- Dundas Park: Average year demand of 23 ML/year and max year demand of 27 ML/year
- Narromine Aquatic Centre (assessment number 11460975): Average year demand of 15 ML/year and max year demand of 21 ML/year
- Rotary Park: Average year demand of 34 ML/year and unrestricted future year demand of 47 ML/year.

8.3.4 Water balance

A water balance is typically undertaken to estimate the water losses in the system. By taking the known volume of water supplied into the WSS, and subtracting the known water going out of the system (from metered demand), the difference can be attributed to losses in the system. Losses can be either apparent losses (meter under-registration) or real losses (such as leakage). This is shown in the table below.

<table>
<tr><td rowspan="4">System input volume</td><td>Authorised consumption</td><td colspan="2">Billed authorised consumption (metered/unmetered)</td><td>Revenue water</td></tr>
<tr><td rowspan="3">Water losses</td><td colspan="2">Unbilled authorised consumption (e.g., flushing, firefighting, public open spaces)</td><td rowspan="3">Non-revenue water</td></tr>
<tr><td>Apparent losses</td><td>▪ Unauthorised consumption
▪ Metering inaccuracies</td></tr>
<tr><td>Real losses</td><td>▪ Leakage on trunk and/or distribution mains
▪ Overflows at storage tanks
▪ Leaking on service connections</td></tr>
</table>

The historical water production data and water usage data (from customer billing data and standpipe usage data) was used to calculate a water balance over the Narromine Potable WSS. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force. The method used to calculate the different components of the water balance is given in Appendix C.2.

The water balance for Narromine Potable WSS is shown in Table 8-6 and shown graphically in Figure 8-11. The values used in the water balance are the historical averages over the years 2018/19 to 2020/21.

Table 8-6: Water balance – Narromine Potable WSS (ML/year)

Water supplied to system (production from High Lift Pump Station) **874 ML/year**	Authorised consumption **717 ML/year**	Billed metered consumption **711 ML/year**	Standpipe usage	**6**
			Residential*	**516**
			Business^	**53**
			Industrial	**7**
			Non-rateable	**67**
			Farmland	**2**
			Cancelled Assessment	**3**
			Parks and gardens	**56**
		Unbilled authorised consumption		**6**
	Water losses **157 ML/year**	Apparent losses (meter under-registration)		**14**
		Real losses **142 ML/year**	Avoidable real losses	**121**
			Unavoidable real losses from mains	**8**
			Unavoidable real losses from service connections	**13**

* includes strata parent user class

^ includes mixed development user class

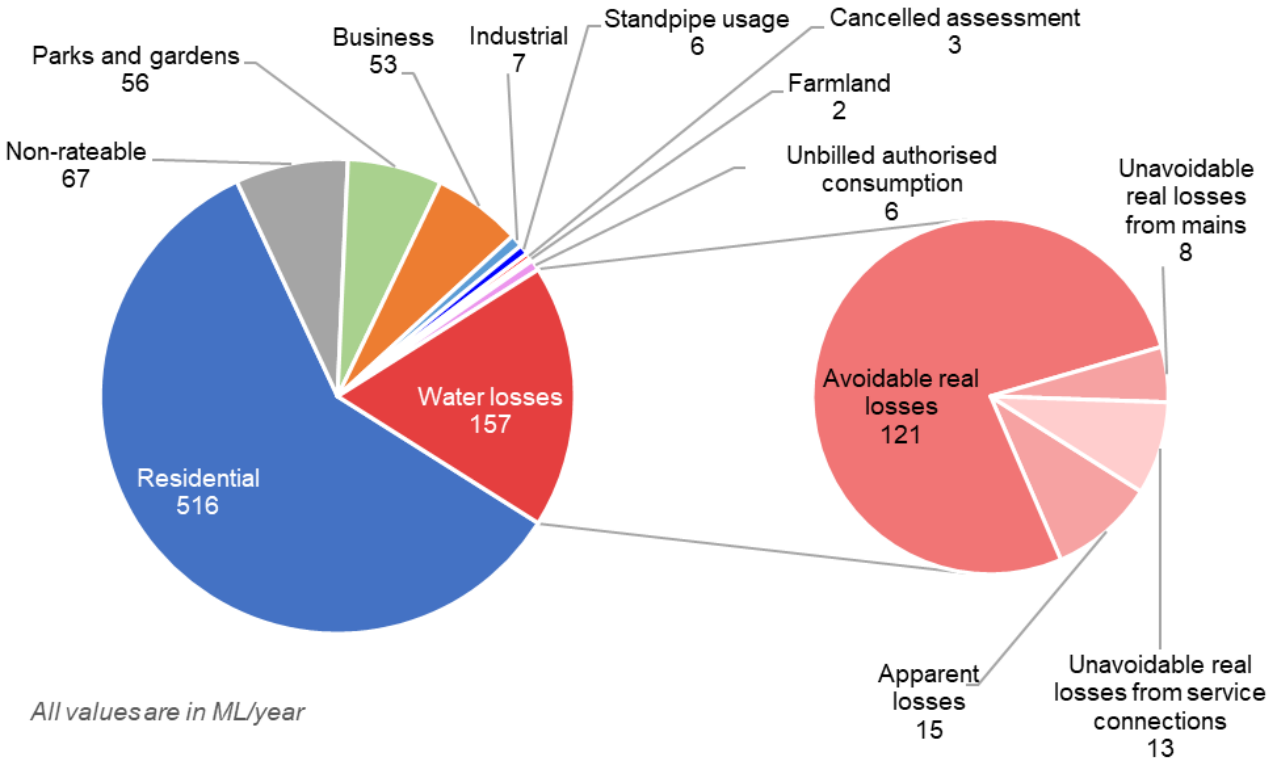

Figure 8-11: Water balance – Narromine Potable WSS

The infrastructure leakage index (ILI) is an indicator of how effectively real losses in the distribution system are being managed at the current operating pressures. It is the preferred indicator for state and national comparisons (metric benchmarking), and has been adopted by the International Water

Association as the preferred indicator for international comparisons (National Water Commission, 2014). The best performing LWUs in Australia have an ILI less than 1.5.

Based on the above water balance, the Narromine Potable WSS has an infrastructure leakage index (ILI: current annual real losses / unavoidable real losses) of 6.7. An ILI between 6 and 8 falls into the 'Poor' leakage performance category [12], which is described as "potential for marked improvements". Issue

On average, around 19% of the water produced in the Narromine Potable WSS is not accounted for and is considered a water loss. The unit water loss in 2020/21 was on average around 264 L/assessment/day, which is approximately three times the state median of 92 L/connection/day. Issue

The estimated water losses (total and unit) for each year for the Narromine Potable WSS is given in Appendix C.2.2.

8.3.5 Reticulated water quality

8.3.5.1 Council reticulated water quality monitoring

The reticulation monitoring for Narromine Potable WSS is undertaken on a weekly basis to ensure that Council's customers receive safe and acceptable water quality, which complies with the ADWG guideline limits. Sampling is rotated weekly through five different sample locations within the Narromine reticulation, these are located:

- Site 200 – 131 Fifth Avenue
- Site 201 – 15 Trangie Road
- Site 202 – Manildra Road
- Site 203 – Industrial Avenue
- Site 204 – 101 Birch Street

The reticulated water is monitored for free chlorine, turbidity, pH and total chlorine.

Free chlorine in reticulated water

A minimum of 0.2 mg/L free chlorine is recommended as per the LWU Circular 18 Barrier 3, explained in Section 8.4.3. The ADWG recommends an aesthetic limit of maximum 0.6 mg/L, and a health limit of maximum 5.0 mg/L.

From 2018 to 2020, the DWMS presented free chlorine levels have been 100% compliant with the recommendations. In the 2020 DWMS report, there were only two occasions when the results were below the adjustment limit making up less than 1% of the total 252 samples in 2020.

Turbidity in reticulated water

The ADWG recommends a turbidity aesthetic limit of maximum 5 NTU.

Results from the 2020 DWMS indicate no exceedances of the turbidity limit in the reticulation.

pH in reticulated water

The ADWG recommends pH between 6.5 to 8.5. Below 6.5 the water is corrosive, and above 8.5 water may cause scale and taste problems.

Results from the 2020 DWMS indicate no lower or upper limit exceedances of pH in the reticulation network.

Total chlorine in reticulated water

The ADWG recommends a maximum allowable total chlorine of 5 mg/L.

From the results of the 2020 DWMS, there were no cases of the total chlorine exceeding the ADWG limit.

8.3.5.2 NSW Health independent verification

Council participates in the NSW Health Drinking Water Monitoring Program. Samples are collected for testing of various chemicals and microbes including E. coli, pH, total coliforms, free chlorine, total chlorine and turbidity.

The water quality data obtained from Council's annual DWMS reports from the previous six years (2015 to 2021) were analysed. It is noted that the 2016 DWMS annual report could not be provided by Council as it was not completed. The parameters that exceeded the guideline values are summarised as follows:

- Total hardness as $CaCO_3$ (200 mg/L): 1 exception count in 2019 and 1 in 2018.
- pH (6.5 to 8.5): 1 exception count in 2017
- Free chlorine (0.2 to 5.0 mg/L): 2 exception counts in 2015

8.4 Best practice compliance – LWU Circular 18

This circular was prepared in 2014 to address LWUs of a new protocol to ensure safety of drinking water supplies across regional NSW. LWUs were required to review and update their standard operating procedures to ensure three key barriers were achieved.

8.4.1 Barrier 1: Effective distribution

LWU Circular 18 states that disinfection is the single process that has had the greatest impact on drinking water safety. Two actions should be undertaken to achieve effective disinfection.

Action 1: Monitoring of factors which affect disinfection

LWU Circular 18 recommends LWUs to monitor the factors which affect effective disinfection including chlorine residual, turbidity and pH levels. This is achieved with the implementation of CCPs.

Currently, only chlorine residual levels are a part of the Council's CCPs, see Section 8.2.4. The chlorine residual has remained within the CCP target limits in recent years.

It is recommended that Council include turbidity and pH in the CCPs.

Action 2: Maintain free chlorine residual to achieve minimum C.t value

Circular 18 recommends that a minimum C.t. value of 15 mg/L.min is achieved, as recommended by the ADWG.

For Narromine WSS, under normal operation conditions, water is delivered from the high lift pump station straight to the Duffy St reservoir and Nymagee St reservoir. The minimum chlorine contact time for each reservoir has been calculated in Table 8-7.

Table 8-7: Narromine WSS chlorine contact calculation

Reservoir	Plant flow (L/s)	Contact tank volume (kL)	Baffle factor	Minimum chlorine residual (mg/L)	C.t (mg.min/L)
Duffy St Reservoir	72 [a]	4,000	0.3 [b]	0.3 [c]	42
Nymagee St Reservoir	32 [d]	4,000	0.3 [b]	0.3 [c]	94

[a] Maximum pump rate of the High Lift Pump Station, and the maximum inlet flow to Duffy St reservoir (from DWMS [13])
[b] Baffle factor of 0.3 indicates 'single or multiple inlets and outlets with no intra-basin baffles' [14]
[c] Critical limit of CCP1. 2020 results show that 100% of samples are greater or equal to 0.3 mg/L
[d] Maximum inlet flow to Nymagee St Reservoir (from DWMS [13])

The contact time in both reservoirs achieve the minimum 15 mg/L.min as recommended by the LWU Circular 18.

8.4.2 Barrier 2: Distribution system integrity

Disinfected water should remain safe even as disinfectant residuals drop below the recommended levels. Enteric pathogens should not reappear within the distribution system unless there is a breach

in the integrity of the distribution system. Circular 18 recommends detailed examinations of all service reservoirs to ensure there are no breaches (from animals, leaks), and to ensure inspection hatches are secured to prevent unauthorised entry.

For Narromine, Council undertakes monitoring daily, weekly, and monthly using the Vault Check System that records the results online, there were no reservoir CCP breaches in 2020. Council also engaged an external contractor to inspect and clean the drinking water reservoirs in 2020.

8.4.3 Barrier 3: Maintain a free chlorine residual in the distribution system

Circular 18 recommends a minimum chlorine residual of 0.2 mg/L in the distribution system.

Refer to Section 8.3.5 for the reticulated water quality. Free chlorine concentration was above the Circular 18 recommended minimum concentration of 0.2 mg/L in 100% of the samples.

8.5 Analysis of production data

A water demand analysis is undertaken to calculate the unit demands, estimate the non-revenue water and forecast the following demands:

- Average (rainfall) year demands – for revenue planning
- Unrestricted future year demands – to assess drought security
- Peak day demands – to assess system reliability.

The 30-year forecasts, based on the nominated growth, are used to identify the issues in meeting the adopted water supply security and reliability objectives of the urban water supply system. Further explanation on the water demand analysis can be found in Appendix C.

Analysis and modelling were undertaken on the water production data (i.e. the water going into the system). For the Narromine Potable WSS, this was the volume recorded at the High Lift Pump Station.

8.5.1 Trend correction

Modelling was undertaken to understand the impact of various factors/trends (demographic, climatic, economic, etc.) on the variability of the town water demand.

The factors that were considered were:

- Historical water requirement for grass irrigation (lawns and public open spaces) obtained from the **simulated water use model developed by PWA**. The model uses location-specific historical rainfall and evaporation data, soil type and grass type.
- Historical water requirement for use of evaporative coolers. The model uses location-specific historical maximum temperature data.
- Water restrictions

The following factors were considered however shown to have little correlation:

- Change in number of connections (reflecting population growth) – population has been relatively steady
- Demand reduction in response to increase in price (based on the DPIE Water Local Water Utility Circular 11 – LWU 11) – prices of water have increased by around 13% since 2019/20, however this had an insignificant effect on the model
- Tourism – there is relatively low variation in visitor numbers throughout the year

The aim was to develop a model which, when input with historical factors/trends, would output a production that correlates well with the actual historic production. Details on modelling results for each scheme are available in Appendix C.3.

8.5.2 Production modelling

Water production records provided by Council were available from February 2018 to June 2021 for Narromine.

Council has imposed water restrictions for Narromine for the majority of the available production data. Council enforced the following restrictions mentioned below:

- Level 2 restrictions from January 2018 to January 2019.
- Level 3 restrictions from January 2019 to March 2019, and Level 4 restrictions from March 2019 to January 2020. This was due to drought impacting Narromine in the summer of 2018/19. Restrictions eased to Level 3 from January 2020 to March 2020.
- Restrictions eased to Level 2 from March 2020 to October 2020
- Restrictions eased to Level 1 from October 2020 to February 2021.
- Restrictions were lifted from Narromine since February 2021.

More details on the restriction periods in Narromine are included in Appendix C.4.

The modelling showed that the outdoor lawn irrigation and use of evaporative coolers were the most significant contributors to the water consumption patterns in the Narromine Potable WSS.

The production model was then hindcast over a 130-year period of available climatic data of historical temperature, rainfall and evaporation to estimate the annual demands if the current conditions of lot size, household size, number of connections, pricing and usage patterns were to prevail. The hindcast is shown in Figure 8-12.

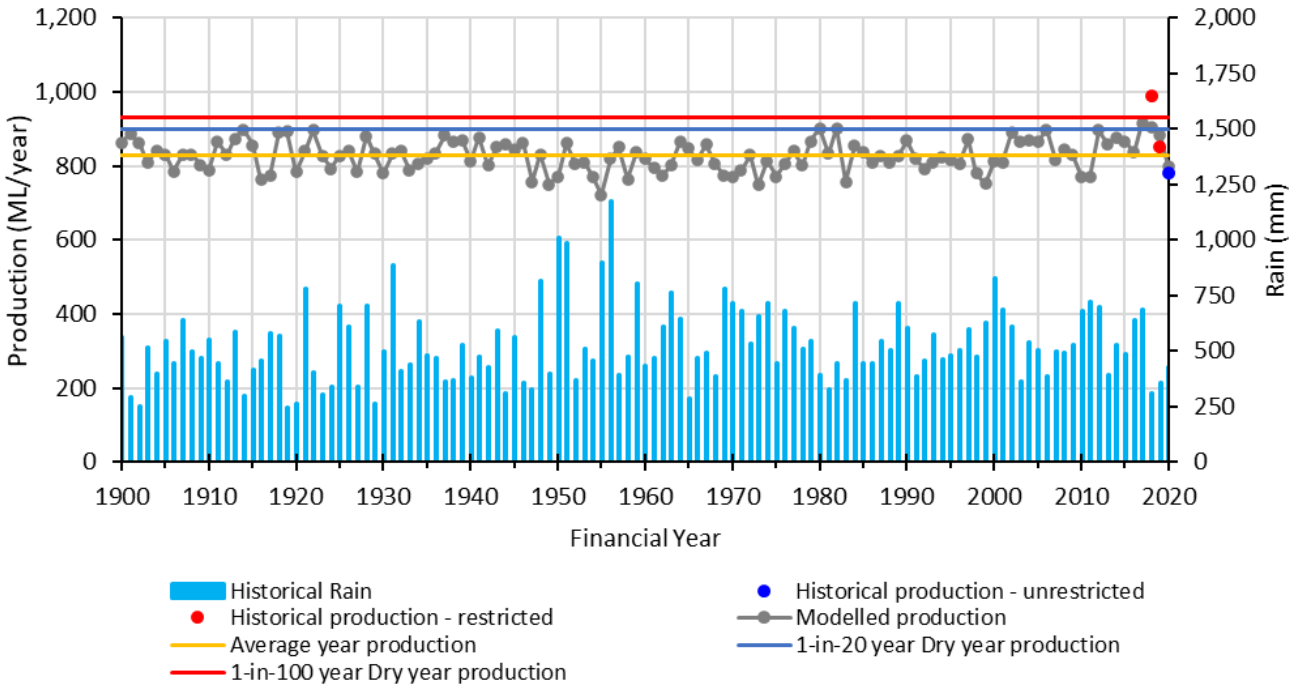

Figure 8-12: Production model hindcast – Narromine Potable WSS

The hindcast was also used to estimate the historical ADPW production, which was then multiplied by the PD to ADPW ratio of 1.2 (from Section 8.2.3) to obtain an estimate for the peak day production. For the analysis, the 99th percentile (1-in-100 year) unrestricted future production was selected from the hindcast as the starting points for the forecasts. However, Council can decide to select a different starting point based on the Levels of Service objective for supply reliability.

The model results, along with the actual average and maximum yearly production from the historical data, are compared in Table 8-8.

Table 8-8: Modelled unrestricted production compared to actual values – Narromine Potable WSS

Model outcomes		Historical data (2018 to 2021)	
Average year (ML/year)	819	Average year (ML/year)	874
99th percentile unrestricted future year (ML/year)	926	Max year (ML/year)	986
Max peak fortnight (ML/fortnight)	63	Peak fortnight (ML/fortnight)	64
Peak week (ML/week)	35	Peak week (ML/week)	33
Peak day (ML/day)	6.0	Peak day (ML/day)	5.1

The model estimates an average year and a 99th percentile unrestricted future year production that is lower than their respective historical values, particularly where the 2018/19 historical production is higher than the 99th percentile (1-in-100 year) unrestricted future production. This is because the model was trained over the period after the Level 3 and 4 restriction periods (referred to as "post-restriction period"), where there was a step change in water usage behaviour compared to the period before the Level 3 and 4 restriction periods (referred to as "pre-restriction period"). This is indicated by the decreasing water production during winter periods and the decrease in the climate independent (internal) demand between the pre- and post-restriction periods.

The modelled peak fortnight and peak week production values have been estimated to be very close to their respective historical values.

The modelled peak day production is slightly higher than the historical peak day production. As mentioned from Section 8.2.3, historical peak day production capped at around 5 ML/day as the pumps at the HLPS were at capacity. If these pumps were not at capacity, the historical peak day production may have been higher.

8.5.3 Effect of climate change

To assess likely future water demands that results from climate change, 15 different Global Climate Models (GCMs) based on 1°C warming were used in PWA's simulated water use model, described in Section 8.5.1. DPE Water provided the dataset which is from the NSW and ACT Regional Climate (NARClim) Model.

The historical water requirement for grass irrigation and evaporative coolers were calculated using PWA's simulated water use model for each of the GCMs as well as the historical data set. The results were then inputted to the water production model developed for the Narromine Potable WSS.

The model estimates the following changes in production for the Narromine Potable WSS Production for 1°C climate warming:

- Average year production will increase by **3.7%** to **849 ML/year**
- 99th percentile unrestricted future year production will increase by **2.9%** to **953 ML/year**

The impact of climate change on peak day production is an increase in the frequency of peak weeks by up to double, indicating that peak weeks are expected to occur twice as often in a 1°C warming condition.

Results from the NARCliM project for the Central West and Orana Region predicts that for the area of Dubbo, the average annual number of days above 35ºC will increase by 10-20 days in the near future (2020-2039) and 30-40 days in the far future (2060-2079) compared to the baseline period (1990-2009) [15]. This will put additional pressure on Council's assets and impact on their ability to meet the target level of service for system reliability. Prolonged dry periods may require extra storage or pumping capacity. Issue

8.6 Analysis of customer usage

8.6.1 Modelling of customer usage

Customer usage patterns were modelled in a similar way to production data. The modelling showed that the outdoor lawn irrigation and use of evaporative coolers were the most significant contributors to the water consumption patterns in the Narromine Potable WSS. Periods of Level 3 restriction has been omitted from the modelling.

For the analysis the maximum and 99th percentile (1-in-100 year) unrestricted future year demand was selected as the starting points for the forecasts. The model results are given in Table 8-9.

Table 8-9: Estimated customer usage by user class from climate correction – Narromine Potable WSS

User class	Average Year Demand (ML/year)	Dry Year Demand (ML/year)	Average Day (kL/day)	Peak Day (kL/day)
Residential*	448.0	482.4	1,226.5	2,924.5
Business	74.1	112.7	197.5	595.0
Non-Rateable*	114.1	124.1	312.4	885.2
Mixed Development	0.8	1.3	2.3	6.9
Business - Industrial Estate*	6.2	6.8	17.0	30.6
Farmland	2.3	4.8	8.3	25.1
Strata Parent*	0.4	0.6	1.0	10.5
Cancelled Assessment	5.1	10.0	17.5	52.7
Total*	**651.1**	**742.5**	**1,782.7**	**4,530.4**

*User classes were determined to have a usage pattern that was significantly climate dependent

Customer usage by reservoir zones

There are two reservoir zones in Narromine Potable WSS. For the purpose of capacity analysis of reservoir capacity and pumping arrangement in each zone, the customer demand has been analysed based on a zone level, and split into residential and non-residential group. The model results are given in Table 8-10.

Table 8-10: Estimated customer usage by reservoir zones from climate correction – Narromine Potable WSS

	Average Year Demand (ML/year)	Dry Year Demand (ML/year)	Average Day (kL/day)	Peak Day (kL/day)
North reservoir zone (Nymagee Street Reservoir)				
Residential	149.9	162.0	410.4	1,002.0
Non-residential	139.4	190.3	381.7	1,138.6
Total	**289.3**	**352.3**	**792.1**	**2,140.6**
South reservoir zone (Duffy Street Reservoir)				
Residential	298.1	320.4	816.1	1,922.5
Non-residential	63.7	69.8	174.4	467.3

	Average Year Demand (ML/year)	Dry Year Demand (ML/year)	Average Day (kL/day)	Peak Day (kL/day)
Total	**361.8**	**390.2**	**990.6**	**2,389.8**

Note that some customers are not serviced by either reservoir zones (such as the mine), and some cancelled assessments had no address linked to the billing data. Therefore, the sum of each reservoir zone is lower when compared to the total water supply scheme yearly demands.

8.6.2 Unit residential demands

The residential unit demands for each scheme were assessed by climate correcting historical data, using demand for lawn irrigation as well as evaporative cooler usage.

Using a threshold of 60 L/connection/day for an active connected residential property resulted in 91% of the assessments in Narromine Potable WSS being active, which corresponds to the occupancy ratio from ABS data.

The unit demand per active residential connection is then estimated from the number of active assessments. The results are given in Table 8-11.

Table 8-11: Unit demand per active residential assessment – Narromine Potable WSS

Average year demand (kL/year)	Unrestricted future year demand (kL/year)	Average day demand (L/day)	Peak day demand (L/day)	Climate independent (internal) demand (L/day)	Baseline internal demand per person (L/person/day)
407	498	1,114	3,049	635	264

The baseline internal demand for Narromine corresponds to the usage from a house with an average 1 Star WELS rating for water fixtures, according to *AS6400: Water efficient products – Rating and labelling*. There is potential to further reduce residential internal demand using water efficient fittings and appliances.

The average and peak day demand for Narromine residents is very high, which indicates that residents may be using a lot of water for irrigation and evaporative cooler during hot days. Most lots have a lawn area of at least 300 m^2.

Typically, peak day demands should be around 2 to 2.5 times the average day demand (or the PDD/ADD ratio should be around 2 to 2.5). For the Narromine Potable WSS, the PDD/ADD ratio is 2.7.

8.7 Projections

Average year demand projection will be used for revenue requirement planning, dry year demand for sizing of headworks, and peak day production used for sizing of water treatment works or pumping facilities.

Water demands for the Narromine Potable WSS are projected as follows:

- The 99th percentile unrestricted demand and the peak day demands estimated from the 120-year hindcast are used as the starting value.
- The residential demand is projected using the estimated increase in occupied residential dwellings and the residential unit demand. The increase in occupied residential dwellings is shown in Table 7-9.

- The non-residential demand is projected using the estimated increase in non-residential ET and the residential unit demand.
- Water losses are projected by assuming the infrastructure leakage index (ILI) stays at the current value of 6.7 in the 30-year planning horizon. See details of water losses and ILI in Section 8.3.4. Water losses are added to the demand to forecast the production.

The average year demand projection for the Narromine Potable WSS is shown in Table 8-12.

Table 8-12: Average year demand projections – Narromine Potable WSS (ML/year)

	2022	2027	2032	2037	2042	2047	2052
North reservoir zone (Nymagee Street Reservoir)							
Residential	158	180	215	222	222	222	222
Non-residential	142	155	157	158	160	160	160
Subtotal	**301**	**335**	**371**	**380**	**382**	**382**	**382**
South reservoir zone (Duffy Street Reservoir)							
Residential	298	327	335	370	379	379	379
Non-residential	64	64	64	64	64	64	64
Subtotal	**362**	**391**	**399**	**434**	**443**	**443**	**443**
Narromine Scheme							
Narromine Total Demand	**662**	**726**	**770**	**814**	**825**	**825**	**825**

The unrestricted future year extraction projection is completed on a scheme level to estimate the future 'dry year' extraction from the HLPS. The projection is shown in Table 8-13.

Table 8-13: Unrestricted future year extraction projection – Narromine Potable WSS (ML/year)

	2022	2027	2032	2037	2042	2047	2052
Water extraction from borefield	1,014	1,119	1,191	1,263	1,280	1,280	1,280

See Appendix C.5 for the breakdown of the unrestricted future year projections.

The peak day production projection for the Narromine Potable WSS is broken down into reservoir zones for the purpose of assessing reservoir/pumping capacities. The total peak day production is used to compare against the pumping capacity from the HLPS. The peak day projection is shown in Table 8-14.

Table 8-14: Peak day production projections – Narromine Potable WSS (ML/day)

	2022	2027	2032	2037	2042	2047	2052
North reservoir zone (Nymagee Street Reservoir)							
Residential	1.1	1.2	1.4	1.5	1.5	1.5	1.5
Non-residential	1.2	1.3	1.3	1.3	1.3	1.3	1.3
Subtotal	**2.2**	**2.5**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**
South reservoir zone (Duffy Street Reservoir)							
Residential	1.9	2.1	2.2	2.4	2.4	2.4	2.4
Non-residential	0.5	0.5	0.5	0.5	0.5	0.5	0.5

	2022	2027	2032	2037	2042	2047	2052
Subtotal	**2.4**	**2.6**	**2.6**	**2.9**	**2.9**	**2.9**	**2.9**
Narromine Scheme							
Losses on peak day	1.4	1.6	1.7	1.8	1.8	1.8	1.8
Peak day production	**6.1**	**6.6**	**7.0**	**7.4**	**7.5**	**7.5**	**7.5**

8.8 Water security assessment

Council's WAL entitlement to extract water from the borefield is 2,000 ML/year. The water security assessment is completed for the future unrestricted extraction which is based on the 99th percentile from the hindcast. The forecast unrestricted future extraction for the historical and 1°C warming climate is shown in Figure 8-13.

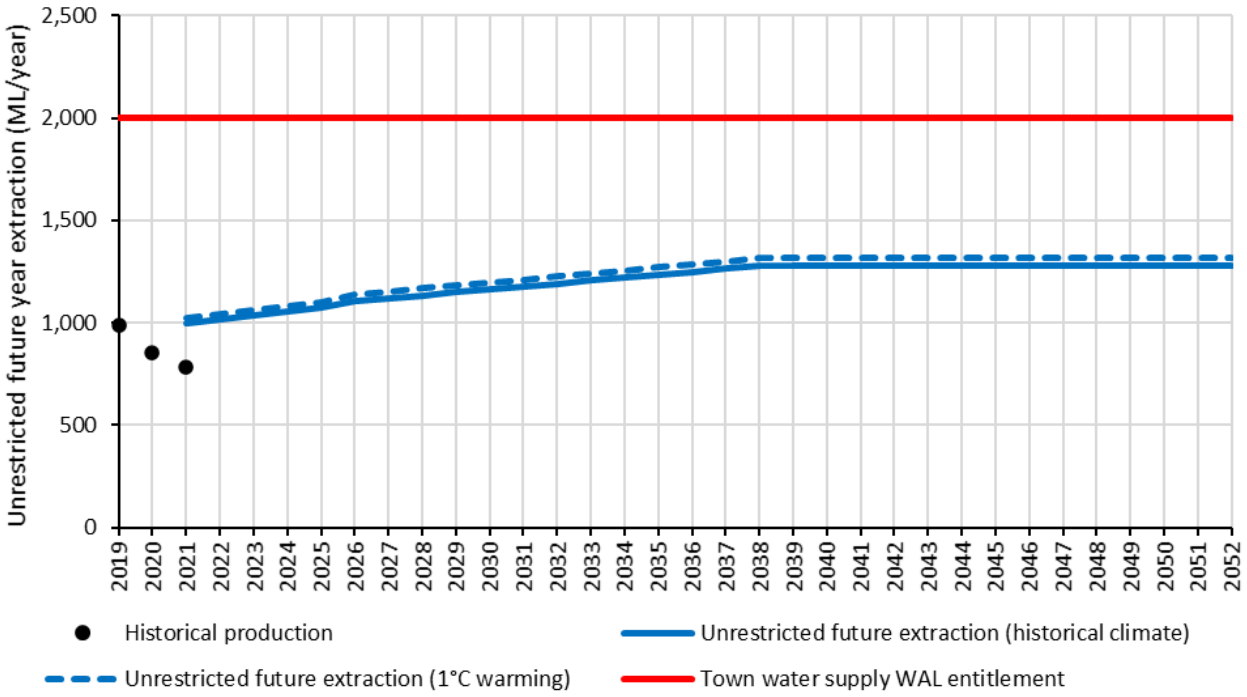

Figure 8-13: Projected unrestricted future extraction for the Narromine Potable WSS compared to WAL entitlement and historical production

The unrestricted future extraction is not expected to exceed Council's WAL entitlement.

8.9 Application of Health-Based Treatment Targets

The introduction of a microbial Health-Based Target (HBT) in the Australian Drinking Water Guidelines is being considered to determine the tolerably low level of microbial risk for drinking water. The HBT will provide the basis for determining the treatment requirements and will help define the performance standards that apply to treatment processes.

The application of HBTs requires that the source risk to a drinking water supply be assessed and quantified, and depending on the risk, a log-reduction in pathogens by treatment is required. If a system were not to meet the recommended Log Reduction Values (LRVs) then a potential issue would arise.

PWA has developed an HBT Assessment tool which categorised catchments into vulnerability categories (see assessment in Appendix D.1). The tool was used to assess the inherent microbial

risk from each water source catchment, the performance of the treatment barriers, and the residual microbial risk after treatment.

8.9.1 HBT assessment of threats

The water source of Narromine comes from five groundwater bores. The HBT assessment concludes that the Narromine water sources have an inherent risk of '**Very High**', since:

- Council has indicated that there are disused uncapped bores close to all the town water supply bores allowing ingress of surface water into aquifer. This is a significant risk to the town water supply as uncapped bores are direct sources of contamination for aquifers.
- Furthermore, Council has indicated that a large number of stock and domestic bores have failed. Issue

Within a 1 km radius, potential contamination sources are as follows:

- Several SPS, however there has been no known overflows
- The Narromine Waste Facility – landfill leachate may end up in the water source, however, based on EPA annual returns, there have been no exceedances in recorded pollutants
- Narromine Cemetery – potential for chemicals (such as formaldehyde), bacteria and viruses to pollute drinking water sources

8.9.2 HBT assessment of barriers

The treatment barrier assessment considers the treatment technology, along with historical records of treated water quality, from CCP monitoring. The historical CCP results have been provided in Section 8.2.4.

For chlorine sensitive pathogens

For chlorine sensitive pathogens, the following criteria is used to assess the effectiveness of the treatment barrier:

- Water turbidity < 1 NTU
- Chlorine contact > 15 mg.min/L

Based on the CCP results and the calculations in Table 8-7, the contact time of 15 mg.min/L is achieved. If the turbidity of the water (bore water or filtered water) is below 1 NTU, then the residual risk is '**Low**'.

For chlorine resistant pathogens

There are no treatment barriers (such as UV, ozone disinfection, or filtration plants) that control chlorine resistant pathogens in Narromine. Bore 6 and Bore 9 goes through a filtration plant, however the water is mixed into the aeration balance tank, where Bore 3 and Bore 8 water is unfiltered. Therefore, the filtration barrier cannot be considered as effective.

The residual risk of chlorine resistant pathogens: '**Very High**'. Issue

8.9.3 NSW Health preliminary cryptosporidium risk assessment

Based on a preliminary assessment by NSW Health, there is a 'High risk' of cryptosporidium in the raw water source for Narromine. NSW Health considers the rating based on the stock, STP and onsite systems in the catchment

8.10 Work health and safety

To be completed once APV condition assessment is completed and provided

9. Narromine Raw Water Supply Scheme

The Narromine Raw WSS provides raw untreated surface water in Narromine for the irrigation of public open spaces, with the system being confined to the northern side of Narromine. The raw water system services three major sporting ovals (Payten, Dundas and Rotary Parks) and also a 250 kL roofed elevated concrete tower reservoir which supplies a standpipe-type filling station. Raw water is sourced from the Macquarie River, and is supplied via the redundant town water treatment plant's river pump station, which can be connected when the General Security Water is not available to the drinking water system (Narromine Potable WSS). The drinking water system is protected via a certified backflow prevention device. The Macquarie River supply operates under a General Security licence with a 2 ML/year allocation plus carry over when held.

A flow schematic of the Narromine Raw WSS is shown in Figure 9-1.

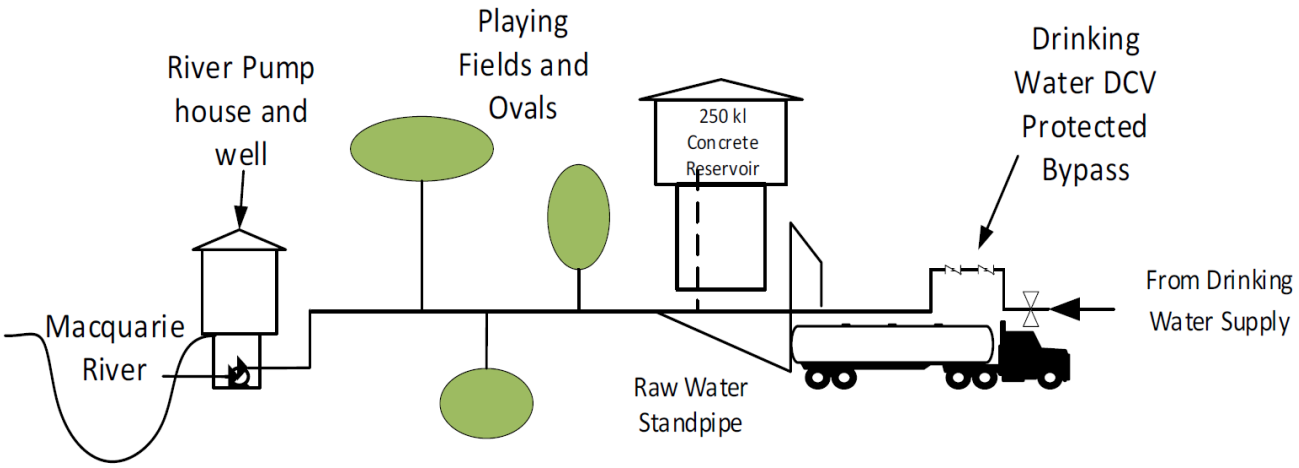

Figure 9-1: Narromine Raw WSS - flow schematic

Council has advised of the following regarding the Narromine Raw WSS:

- The raw water system has not been functioning for the last 3 years due to zero allocation during the 2018 drought.
- The river pumping station is currently out of service due to major WHS issues and requires significant upgrades.
- The scheme's infrastructure (pumping, storage and mains) are in very poor condition and will require significant investment before being able to be safely used again.

Council has also advised that there is no customer meter data nor production data available for the Narromine Raw WSS, as the raw water consumption is not recorded. Therefore, water demand analysis for this scheme could not be performed.

10. Trangie Water Supply Scheme

The Trangie WSS provides potable water to 497 connections in the town of Trangie. The water is sourced from three groundwater bores (1, 2 and 3). Council advised that Bore 4 will be removed due to the Natural Resources Access Regulator (NRAR) compliance issues.

Figure 8-1 shows the schematic diagram of the Trangie WSS.

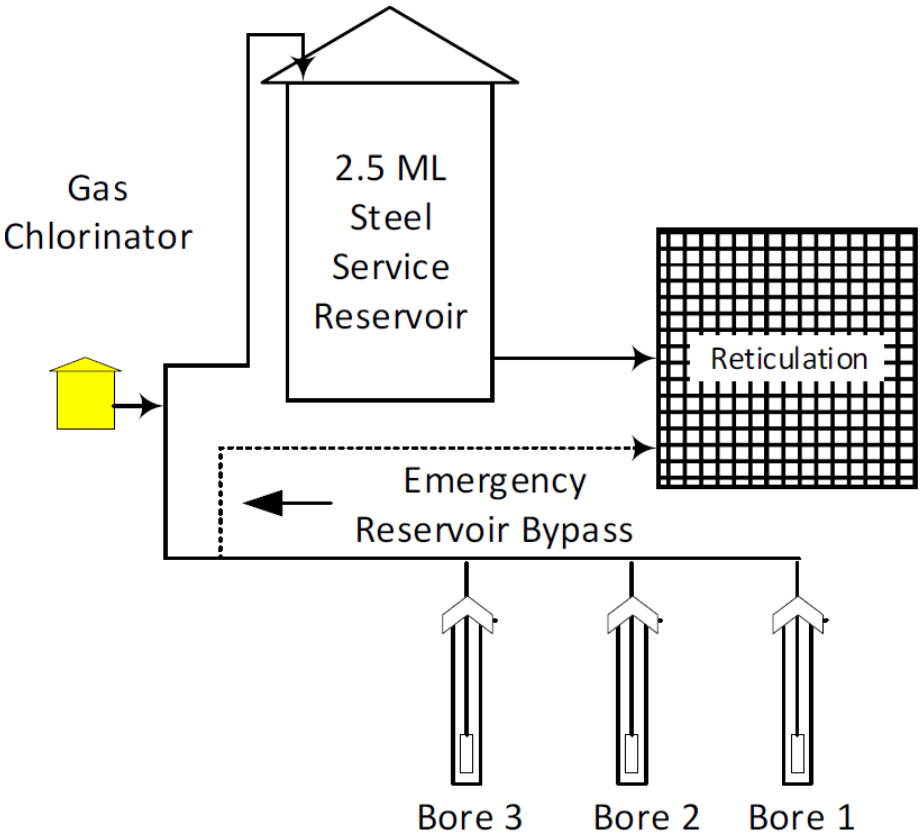

Figure 10-1: Trangie WSS – schematic diagram

10.1 Raw water source

10.1.1 Water resource

The Trangie WSS draws its raw water from four Sub Artesian Mesozoic sandstone bores all located within the Lower Macquarie Zone 3 Aquifer system. Refer to Section 8.1.1 for more details.

10.1.2 Raw water extraction

The main sources of water are the three bores (1, 2 and 3) located throughout the township of Trangie. The bores have an average depth of 100 m. Bores 1, 2 and 3 are 250 mm diameters. All bores combined have a maximum production capability of 6.33 ML/day (80 L/s) and are linked via a single rising main.

The locations of the four active bores are provided in Figure 10-2.

Figure 10-2: Trangie active bore locations

10.1.3 Water Access Licence

Council holds a *Local Water Utility* Water Access Licenses (WAL11645), issued under the *Water Management Act 2000*, which relates to the water supply to Trangie. The following apply to the WAL:

WAL license number	**WAL11645**
Category [Subcategory]	Local Water Utility
Entitlement	**350 ML/year**
Water Source	Lower Macquarie Zone 3 Groundwater Source
Water Sharing Plan (WSP)	Macquarie-Castlereagh Groundwater Sources 2020

Council has a works approval, number **80WA703153,** for the bores in Trangie to extract water from the water source nominated by WAL11645 for town water supply.

10.1.4 Raw water quality data

Raw water from the Trangie bores do not undergo filtration, only chlorination.

10.2 Water treatment

10.2.1 Treatment process

Water from all four bores is dosed with chlorine gas, direct inline injection prior to storage into the reservoir.

10.2.2 Historical water production

Daily production data from July 2018 to June 2021 were available. Data was measured at the inlet of the Trangie Reservoir, which is the accumulation production and extraction of the four bores in Trangie.

The historical water production for Trangie is shown in Figure 10-3.

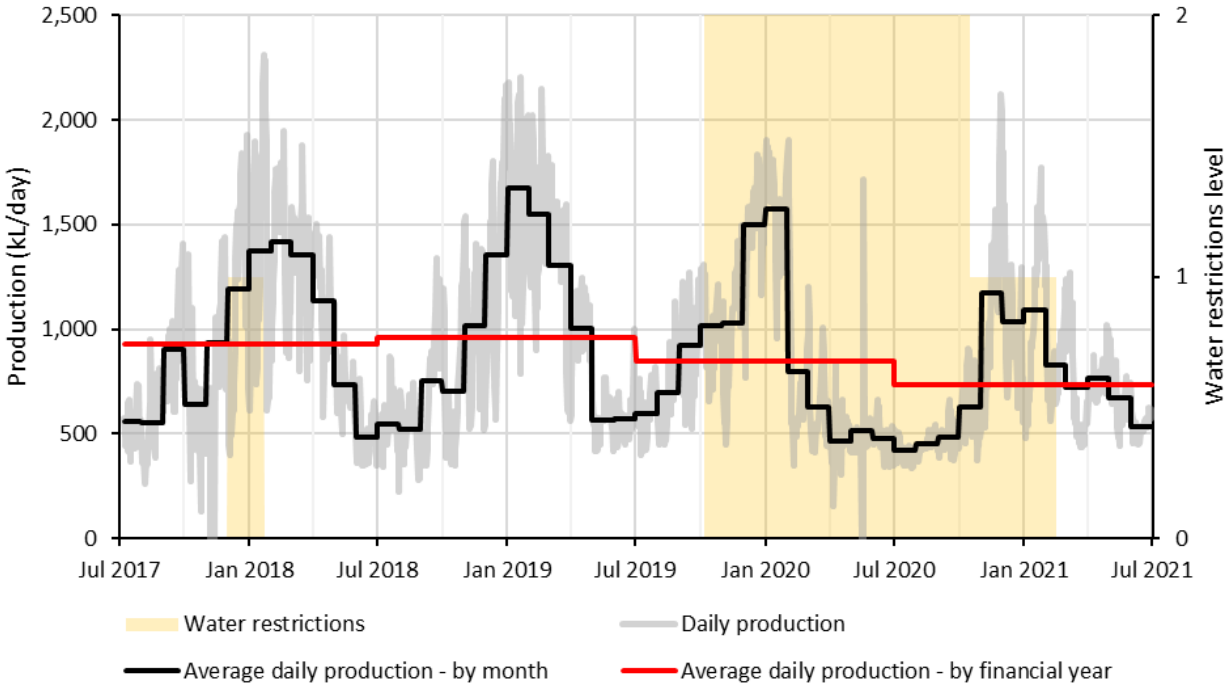

Figure 10-3: Historical daily production data for Trangie

The annual water production totals for 2008 to 2021 are shown in Table 8-2.

Table 10-1: Historical annual water production – Trangie (ML/year)

2017/18	2018/19	2019/20	2020/21
332	351	310	267

10.2.3 Peak production analysis

Potable water production data from July 2017 to June 2021 was used for peak usage analysis. The historical peak fortnight pattern for each financial year for the Trangie WSS is shown in Table 10-8.

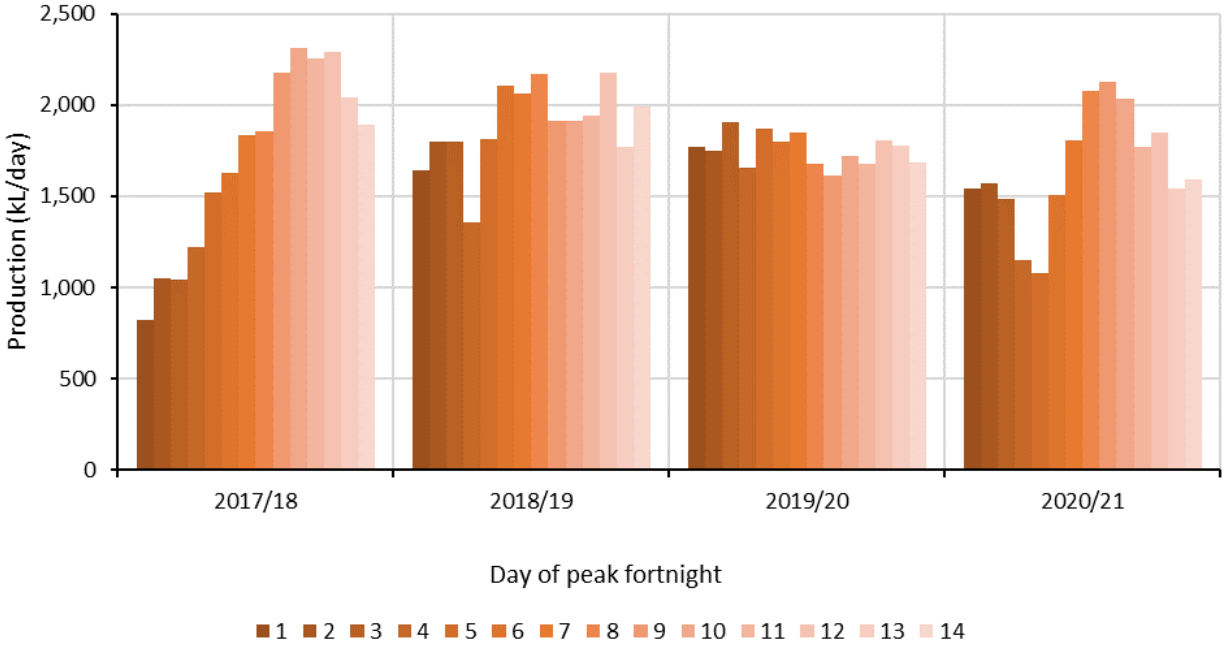

Figure 10-4: Peak fortnight production patterns – Trangie

The highest daily WTP production recorded was 2.3 ML/day, which occurred on the 21 January 2018. The maximum temperatures leading up to this day ranged from 31.3 to 41.9°C.

The daily production during the peak week and peak fortnight demand is shown in Figure 10-5. The peak week occurs within the peak fortnight demand, as indicated by a lighter shade. The average daily production over the peak week (ADPW) and peak fortnight was 2.1 ML/day and 1.9 ML/day respectively.

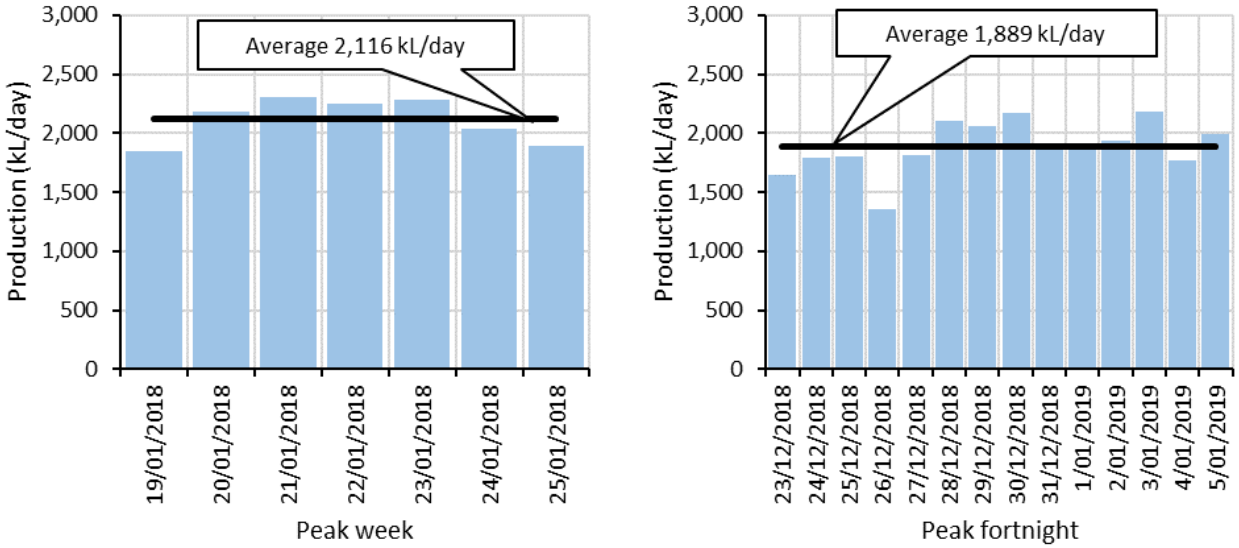

Figure 10-5: Peak week and peak fortnight – Trangie WSS

The ratio of the peak day (PD) production (2.3 ML/day) to the average daily peak week (ADPW) production (2.1 ML/day) for the data is **1.09** for the Trangie WSS.

10.2.4 Treated water quality

Within the treatment process, there are two critical control points (CCP) that apply to the Trangie WSS. These are provided in Table 10-2.

Table 10-2: Trangie WSS – Critical control points

CCP	Parameter	Location	Operational Target	Adjustment limit	Critical limit
CCP1 – Disinfection	Free chlorine	Harris St reservoir	1 mg/L	< 0.7 mg/L or > 2.5 mg/L	< 0.3 mg/L or > 4.0 mg/L
CCP2 – Reservoir integrity	Reservoir integrity inspection (daily, weekly, monthly)	Harris St reservoir	No breach of integrity	Any sign of integrity	Evidence of contamination

There were no CCP exceedances during the reporting period for the Trangie WSS. The CCP1 performance as reported in the 2020 DWMS is provided in Figure 10-6.

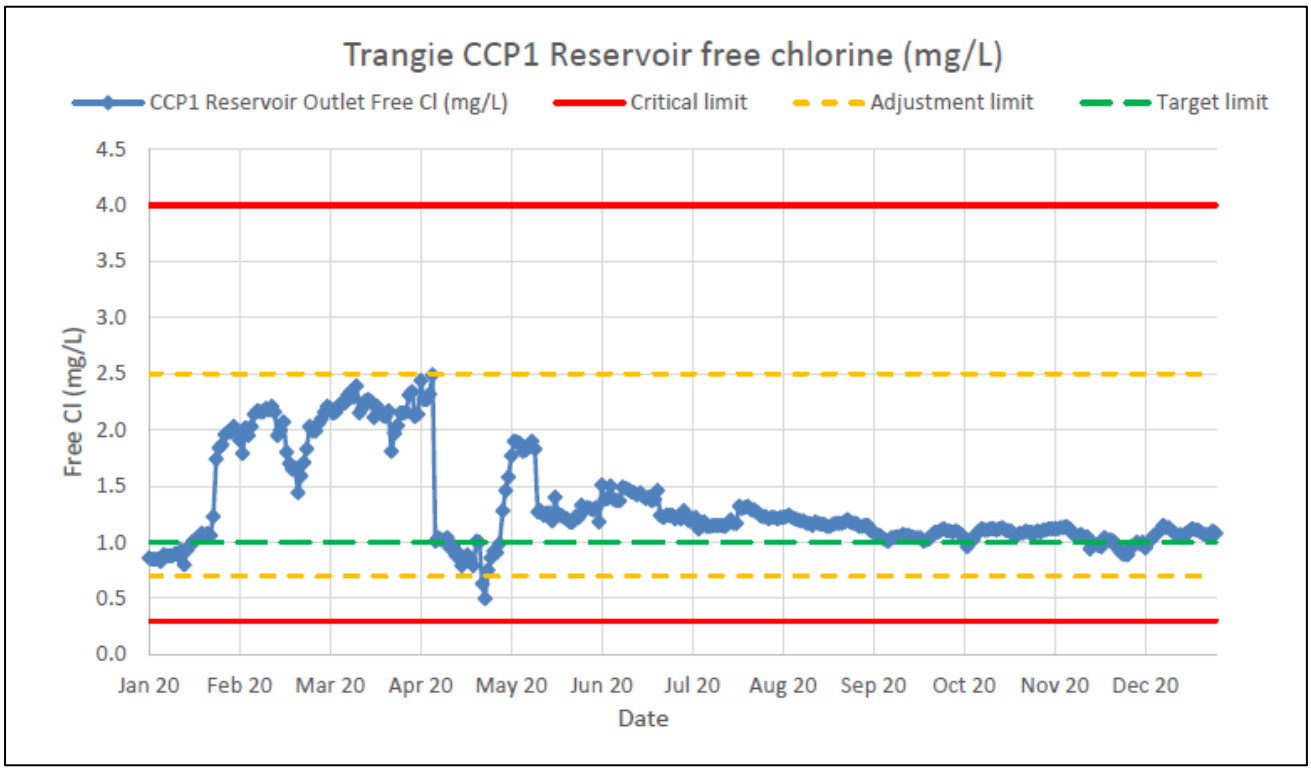

Figure 10-6: Trangie CCP1 performance

Section 61 inspection and recommendations

Council advised that the Trangie WSS has not yet been inspected by DPE Water. Data gap?

10.3 Distribution

10.3.1 Distribution system

Following treatment, potable water is chlorinated and stored in a 2.5 ML steel reservoir located on Harris St before gravitated to the customers of Trangie. The Harris St reservoir incorporates an internal mechanical mixer and is a top fill/ bottom discharge pipeline configuration. See Figure 10-7 for the distribution network for Trangie WSS.

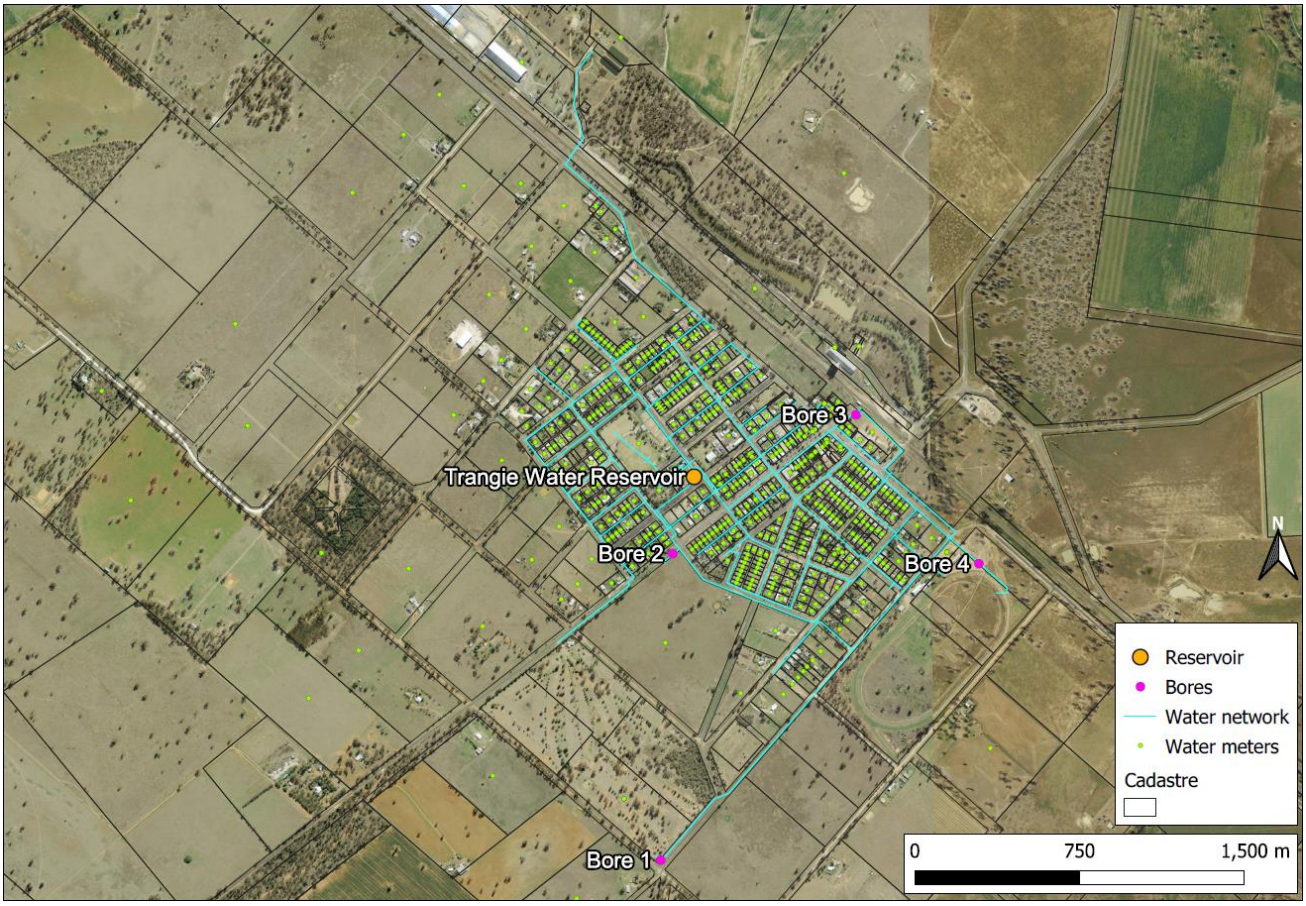

Figure 10-7: Trangie WSS distribution

From the reservoir, the water is distributed to customers by gravity. This reservoir supplies the entire water service area of Trangie as a single reservoir zone.

10.3.2 Metered customer demand

Council supplied billing data for all users from 2017/18 to 2020/21, with meters being read four times a year. User classes from the billing data were residential, business, non-rateable, farmland and cancelled assessments.

The historical number of assessments (approximately equal to the number of connections) and the historical metered customer demand for the Trangie WSS is given in Table 10-3 and Table 10-4 respectively.

Table 10-3: Historical number of assessments – Trangie WSS

Financial year	2017/18	2018/19	2019/20	2020/21
Residential	409	402	400	403
Business	56	56	58	58
Non-Rateable	25	25	25	25
Farmland	3	3	3	3
Cancelled Assessment	1	1	0	0
Total	**494**	**487**	**485**	**488**

Table 10-4: Historical metered customer demand (ML/year) – Trangie WSS

Financial year	2017/18	2018/19	2019/20	2020/21
Residential	184.7	183.1	158.6	122.7
Business	18.7	22.8	17.7	13.4
Non-Rateable	57.5	50.5	49.7	41.7
Farmland	0.5	0.9	0.4	0.2
Cancelled Assessment	0.4	0.4	0.1	0.0
Total	**261.8**	**257.6**	**226.5**	**178.1**

Historical customer usage split has been around 70% residential to 30% non-residential.

The historical usage for all available billing periods for Trangie WSS is given in Figure 10-8.

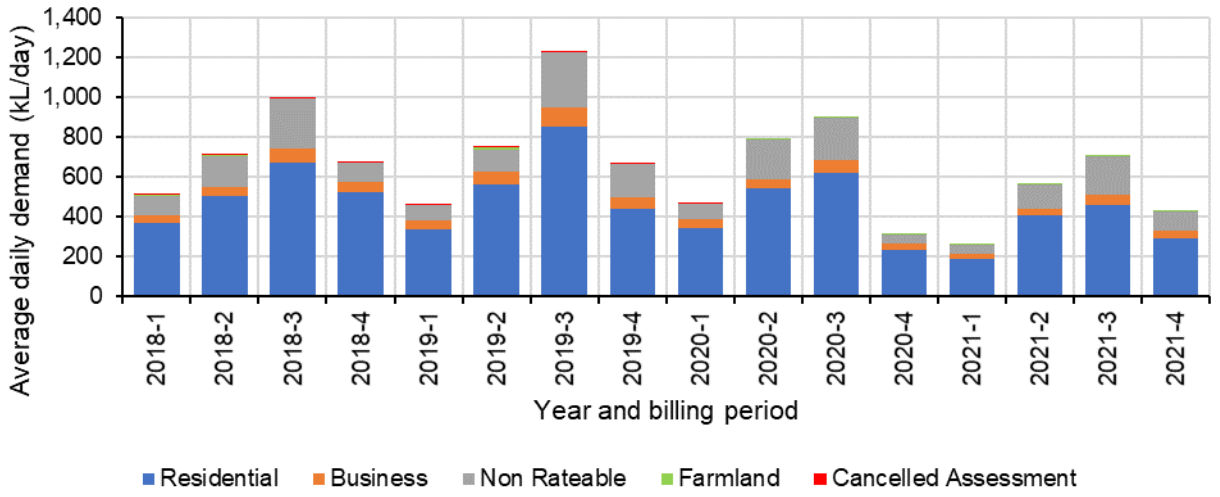

Figure 10-8: Historical usage by user category – Trangie WSS

10.3.3 Major non-residential users

The criteria used to identify major non-residential users was any customers that used more than 3% of the total customer usage for Trangie WSS in any financial year.

Three uses met the criteria for a major non-residential user:

- Trangie Oval: average year demand of 15.2 ML/year, max year demand of 19.1 ML/year
- Trangie Central School: average year demand of 10.0 ML/year, max year demand of 16.3 ML/year
- Trangie Racecourse: average year demand of 4.2 ML/year, max year demand of 6.6 ML/year

10.3.4 Water balance

The historical water production data and water usage data (from customer billing data and standpipe usage data) was used to calculate a water balance over the Trangie WSS. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force. The method used to calculate the different components of the water balance is given in Appendix C.2.

The water balance for Trangie WSS is shown in Table 10-5 and shown graphically in Figure 10-9. The values used in the water balance are the historical averages over the years 2017/18 to 2019/20.

Table 10-5: Water balance – Trangie WSS (ML/year)

Water supplied to system (production from inlet of Trangie Reservoir) **331 ML/year**	Authorised consumption **254 ML/year**	Billed metered consumption **250 ML/year**	Standpipe usage	1
			Residential	175
			Business	20
			Non-rateable	31
			Farmland	1
			Cancelled Assessment	0.3
			Parks and gardens	21
		Unbilled authorised consumption		4
	Water losses **77 ML/year**	Apparent losses (meter under-registration)		5
		Real losses **72 ML/year**	Avoidable real losses	66
			Unavoidable real losses from mains	2
			Unavoidable real losses from service connections	4

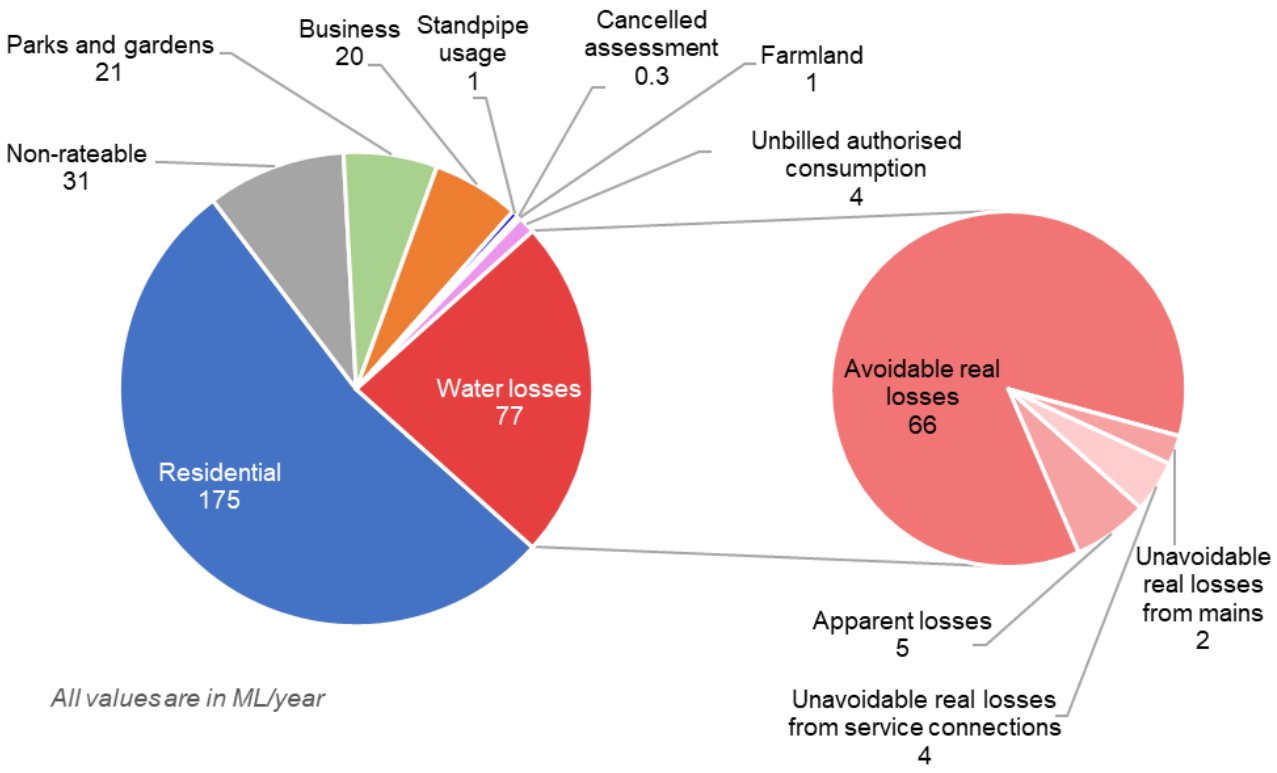

Figure 10-9: Water balance – Trangie WSS

Based on the above water balance, the Trangie WSS has an infrastructure leakage index (ILI: current annual real losses / unavoidable real losses) of 12.6. An ILI greater than 12 falls into the worst leakage performance category [12], which indicates that there is significant potential for Council to reduce leakage in the Trangie WSS. Issue

On average, around 24% of the water produced in the Trangie WSS is not accounted for and is considered a water loss. The unit water loss in 2019/20 was on average around 455 L/assessment/day, which is about five times the state median of 92 L/connection/day. Issue

The estimated water losses (total and unit) for each year for the Trangie WSS is given in Appendix C.2.2.

10.3.5 Reticulated water quality

10.3.5.1 Council reticulated water quality monitoring

The reticulation monitoring for Trangie WSS is collected five days a week to ensure that Council's customers receive safe and acceptable water quality, which complies with the ADWG guideline limits. Sampling is rotated weekly through five different sample locations within the Trangie reticulation, these are located:

- Site 301 – Lot 1 DP 225089 Bimblebox Lane
- Site 302 – Hydrant at 80 Temoin Street
- Site 303 – Hydrant at Narromine and John Street
- Site 304 – Hydrant at Belgrove and Derribong

The reticulated water is monitored for free chlorine, turbidity, pH and total chlorine.

Free chlorine in reticulated water

A minimum of 0.2 mg/L free chlorine is recommended as per the LWU Circular 18 Barrier 3, explained in Section 10.4.3. The ADWG recommends an aesthetic limit of maximum 0.6 mg/L, and a health limit of maximum 5.0 mg/L.

From 2018 to 2020, there was only one occasion reported in the DWMS where the free chlorine result was below the operational critical limit. Generally, the free chlorine concentration was above the Circular 18 recommendation minimum concentration of 0.2 mg/L in around 99.9% of samples.

Turbidity in reticulated water

The ADWG recommends a turbidity aesthetic limit of maximum 5 NTU.

Results from the 2020 DWMS indicate no exceedances of the turbidity limit in the reticulation.

pH in reticulated water

The ADWG recommends pH between 6.5 to 8.5. Below 6.5 the water is corrosive, and above 8.5 water may cause scale and taste problems.

Results from the 2020 DWMS is shown in Figure 10-10. The maximum pH observed during the 2020 DWMS was 8.72, slightly over the ADWG recommendation.

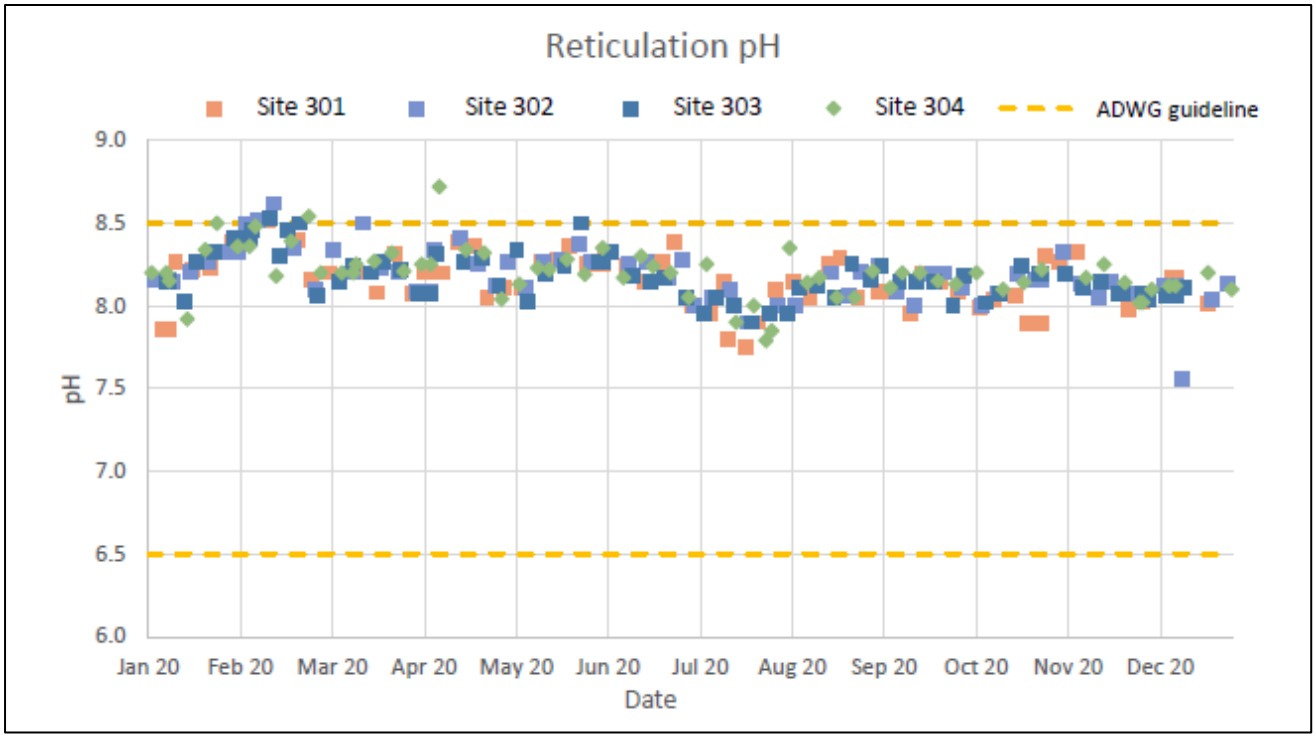

Figure 10-10: Trangie reticulation pH

Overall, majority of the pH samples were well within the recommended ADWG limits.

Total chlorine in reticulated water

The ADWG recommends a maximum allowable total chlorine of 5 mg/L.

From the results of the 2020 DWMS, there were no cases of the total chlorine exceeding the ADWG limit.

10.3.5.2 NSW Health independent verification

Council participates in the NSW Health Drinking Water Monitoring Program. Samples are collected for testing of various chemicals and microbes including E. coli, pH, total coliforms, free chlorine, total chlorine and turbidity.

The water quality data obtained from Council's annual DWMS reports from the previous six years (2015 to 2021) were analysed. It is noted that the 2016 DWMS annual report could not be provided by Council. The parameters that exceeded the guideline values are summarised as follows:

- Sodium (180 mg/L): 2 exception counts in 2020, 2 in 2019, 4 in 2018, 2 in 2017 and 2 in 2015 (100% of samples exceeded the aesthetic guideline value)
- pH (6.5 to 8.5): 3 exception counts in 2020 and 1 in 2019
- Free chlorine (0.2 to 5.0 mg/L): 1 exception count in 2020, 1 in 2017 and 2 in 2015
- Temperature (30 degrees C): 1 exception count in 2019 and 1 in 2018
- Total hardness as $CaCO_3$ (200 mg/L): 2 exception counts in 2015
- E. coli (0 mpn/100 mL): 1 exception count in 2015
- Turbidity (5 NTU): 1 exception count in 2015

Council notes that the high levels of sodium and pH is a known raw water issue that they have no control over. For sodium, all samples exceeded the 180 mg/L aesthetic guideline value based on the ADWG. No health-based guideline value is proposed for sodium. Medical practitioners treating people

with severe hypertension or congestive heart failure should be aware if the sodium concentration in the patient's drinking water exceeds 20 mg/L.

10.4 Best practice compliance – LWU Circular 18

This circular was prepared in 2014 to address LWUs of a new protocol to ensure safety of drinking water supplies across regional NSW. LWUs were required to review and update their standard operating procedures to ensure three key barriers were achieved.

10.4.1 Barrier 1: Effective distribution

LWU Circular 18 states that disinfection is the single process that has had the greatest impact on drinking water safety. Two actions should be undertaken to achieve effective disinfection.

Action 1: Monitoring of factors which affect disinfection

LWU Circular 18 recommends LWUs to monitor the factors which affect effective disinfection including chlorine residual, turbidity and pH levels. This is achieved with the implementation of CCPs.

Currently, only chlorine residual levels are a part of the Council's CCPs, see Section 8.2.4. Generally speaking, the chlorine residual in the Trangie reticulation network has remained within the CCP target limits.

It is recommended that Council include turbidity and pH in the CCPs.

Action 2: Maintain free chlorine residual to achieve minimum C.t value

Circular 18 recommends that a minimum C.t. value of 15 mg/L.min is achieved, as recommended by the ADWG.

For Trangie WSS, water is delivered from the bores straight to the Trangie reservoir. The minimum chlorine contact time for the reservoir has been calculated in Table 10-6.

Table 10-6: Trangie WSS chlorine contact calculation

Reservoir	Plant flow (L/s)	Contact tank volume (kL)	Baffle factor	Minimum chlorine residual (mg/L)	C.t (mg.min/L)
Trangie Reservoir	85 [a]	2,500	0.3 [b]	0.3 [c]	22

[a] Maximum combined bore production flow to Trangie Reservoir (from DWMS [13])
[b] Baffle factor of 0.3 indicates 'single or multiple inlets and outlets with no intra-basin baffles' [14]
[c] Critical limit of CCP1. 2020 results show that 100% of samples are greater or equal to 0.3 mg/L

The contact time in the reservoir achieves the minimum 15 mg/L.min as recommended by the LWU Circular 18.

10.4.2 Barrier 2: Distribution system integrity

Disinfected water should remain safe even as disinfectant residuals drop below the recommended levels. Enteric pathogens should not reappear within the distribution system unless there is a breach in the integrity of the distribution system. Circular 18 recommends detailed examinations of all service reservoirs to ensure there are no breaches (from animals, leaks), and to ensure inspection hatches are secured to prevent unauthorised entry.

For Trangie, Council undertakes monitoring daily, weekly, and monthly using the Vault Check System that records the results online, there were no reservoir CCP breaches in 2020. Council also engaged an external contractor to inspect and clean the drinking water reservoirs in 2020.

10.4.3 Barrier 3: Maintain a free chlorine residual in the distribution system

Circular 18 recommends a minimum chlorine residual of 0.2 mg/L in the distribution system.

Refer to Section 10.3.5 for the reticulated water quality. Free chlorine concentration was above the Circular 18 recommended minimum concentration of 0.2 mg/L in 99.9% of the samples.

10.5 Analysis of production data

10.5.1 Trend correction

Refer to Section 8.5.1 for the factors that were considered for in the production model.

Details on the modelling results for each scheme are available in Appendix C.3.1

10.5.2 Production modelling

Water production records provided by Council were available from July 2017 to June 2021 for Trangie.

Council has imposed water restrictions for Trangie, which are described below:

- Level 1 restrictions from December 2017 to January 2018.
- Level 2 restrictions from October 2019 to October 2020.
- Restrictions eased to Level 1 from October 2020 to February 2021.
- Restrictions were lifted from Trangie since February 2021.

More details on the restriction periods in Trangie are included in Appendix C.4.

For the purposes of modelling, Level 2 restrictions will have the most impact on the water use in Trangie. PWA have assumed that the Level 1 restriction does not have a large effect on the water demand pattern in Trangie, thus PWA has modelled the production (and water demand) by only disregarding production data during Level 2 restriction periods.

The modelling showed that the outdoor lawn irrigation and use of evaporative coolers were the most significant contributors to the water consumption patterns in the Narromine Potable WSS.

The production model was then hindcast over a 130-year period of available climatic data of historical temperature, rainfall and evaporation to estimate the annual demands if the current conditions of lot size, household size, number of connections, pricing and usage patterns were to prevail. The hindcast is shown in Figure 10-11.

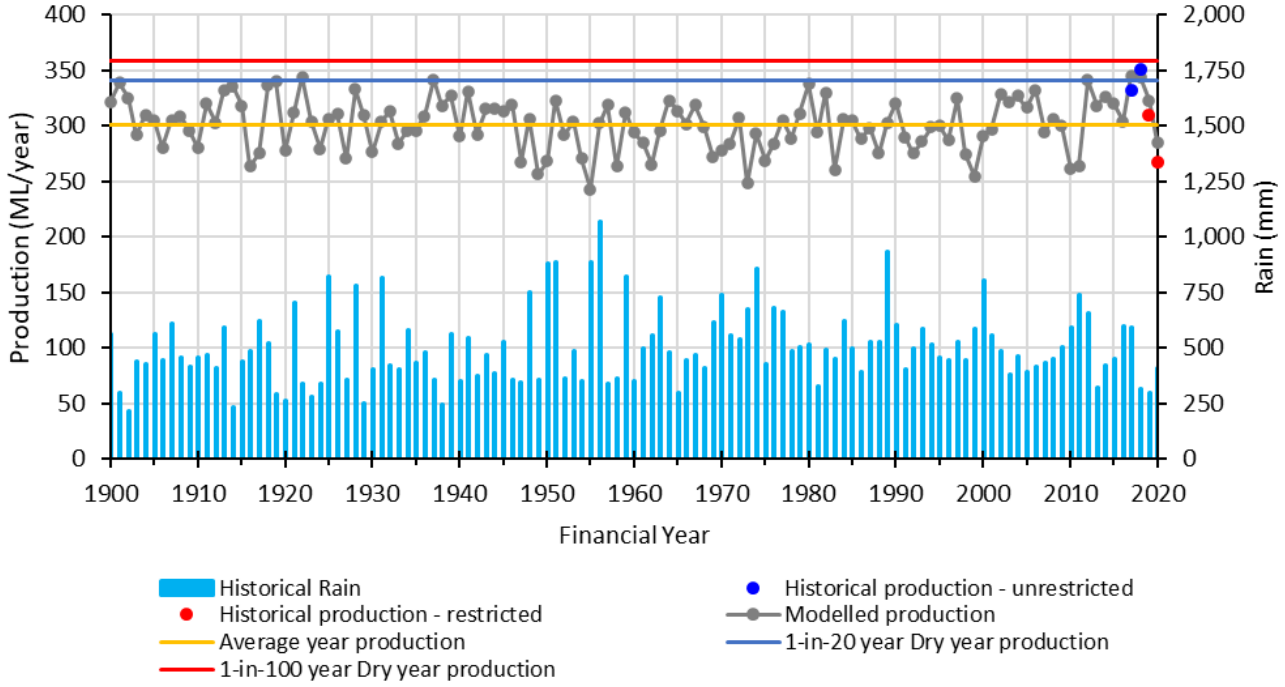

Figure 10-11: Production model hindcast – Trangie WSS

The hindcast was also used to estimate the historical ADPW production, which was then multiplied by the PD to ADPW ratio of 1.09 (from Section 10.2.3) to obtain an estimate for the PD production.

For the analysis, the 99th percentile (1-in-100 year) unrestricted future production was selected from the hindcast as the starting points for the forecasts. However, Council can decide to select a different starting point based on the Levels of Service objective for supply reliability.

The model results, along with the actual average and maximum yearly production from the historical data, are compared in Table 10-7.

Table 10-7: Modelled unrestricted production compared to actual values – Trangie WSS

Model outcomes		Historical data (2017 to 2021)	
Average year (ML/year)	301	Average year (ML/year)	315
99th percentile unrestricted future year (ML/year)	358	Max year (ML/year)	351
Peak fortnight (ML/fortnight)	28	Peak fortnight (ML/fortnight)	26
Peak week (ML/week)	15	Peak week (ML/week)	15
Peak day (ML/day)	2.4	Peak day (ML/day)	2.3

The model estimates an average year production that is lower than the historical average year production. This is because the years from 2017 to 2018 were drought years, which would explain the higher values in the historical data compared to the modelled values.

The modelled 99th percentile unrestricted future year, peak fortnight, peak week and peak day production values have been estimated to be very close to their respective historical values.

10.5.3 Effect of climate change

Refer to Section 8.5.3 for the climate change modelling methodology. The model estimates the following changes in production for the Trangie WSS Production for 1°C climate warming:

- Average year production will increase by **4.8%** to **307 ML/year**
- 99th percentile unrestricted future year production will increase by **3.3%** to **362 ML/year**

The impact of climate change on peak day production is an increase in the frequency of peak weeks by up to double, indicating that peak weeks are expected to occur twice as often in a 1°C warming condition.

Results from the NARCliM project for the Central West and Orana Region predicts that for the area of Dubbo, the average annual number of days above 35ºC will increase by 10-20 days in the near future (2020-2039) and 30-40 days in the far future (2060-2079) compared to the baseline period (1990-2009) [15]. This will put additional pressure on Council's assets and impact on their ability to meet the target level of service for system reliability. Prolonged dry periods may require extra storage or pumping capacity. Issue

10.6 Analysis of customer usage

10.6.1 Modelling of customer usage

Customer usage patterns were modelled in a similar way to production data. The modelling showed that the outdoor lawn irrigation and use of evaporative coolers were the most significant contributors to the water consumption patterns in the Trangie WSS. Periods of Level 2 restriction has been omitted from the modelling.

For the analysis the maximum and 99th percentile (1-in-100 year) unrestricted future year demand was selected as the starting points for the forecasts. The model results are given in Table 10-8.

Table 10-8: Estimated customer usage from climate correction – Trangie WSS

User class	Average Year Demand (ML/year)	Dry Year Demand (ML/year)	Average Day (kL/day)	Peak Day (kL/day)
Residential*	149.6	222.6	408.6	1,429.7
Business*	18.9	23.1	51.7	176.6
Non-Rateable*	44.4	57.0	121.2	525.4
Farmland	0.5	0.9	2.5	6.7
Cancelled Assessment	0.2	0.4	1.0	2.7
Total demand*	**213.6**	**304.0**	**584.9**	**2,141.1**

*User classes were determined to have a usage pattern that was significantly climate dependent

10.6.2 Unit residential demands

The residential unit demands for each scheme were assessed by climate correcting historical data, using demand for lawn irrigation as well as evaporative cooler usage.

Using a threshold of 60 L/connection/day for an active connected residential property resulted in 90% of the assessments in Trangie WSS being active, which corresponds to the occupancy ratio from ABS data.

The unit demand per active residential connection is then estimated from the number of active assessments. The results are given in Table 10-9.

Table 10-9: Unit demand per active residential assessment – Trangie WSS

Average year demand (kL/year)	Unrestricted future year demand (kL/year)	Average day demand (L/day)	Peak day demand (L/day)	Climate independent (internal) demand (L/day)	Baseline internal demand per person (L/person/day)
422	588	1,156	4,028	234	106

The baseline internal demand is low at 106 L/person/day. This may be an indication that residents are not using the water for drinking/cooking purposes, due to water quality issues. In late 2018, Council received feedback on social media from residents, concerned of high chlorine levels in the drinking water. Council has since tested the water quality and confirmed there has been no increase in chlorine levels. Upon further discussion with Council, Council has stated that residents in Trangie are more conscious about the water quality in Trangie due to historical aesthetical issues.

Typically, peak day demands should be around 2 to 2.5 times the average day demand (or the PDD/ADD ratio should be around 2 to 2.5). For Trangie WSS, the PDD/ADD ratio is 3.5. Issue

10.7 Projections

Average year demand projection will be used for revenue requirement planning, dry year demand for sizing of headworks, and peak day production used for sizing of water treatment works or pumping facilities.

Water demands for the Trangie WSS are projected as follows:

- The 99th percentile unrestricted demand and the peak day demands estimated from the 120-year hindcast are used as the starting value.

- The residential demand is projected using the estimated increase in occupied residential dwellings and the residential unit demand. The increase in occupied residential dwellings is shown in Table 7-9.
- The non-residential demand is projected using the estimated increase in non-residential ET and the residential unit demand.
- Water losses are projected by assuming the infrastructure leakage index (ILI) stays at the current value of 6.7 in the 30-year planning horizon. See details of water losses and ILI in Section 10.3.4. Water losses are added to the demand to forecast the production.

The average year demand projection for the Trangie WSS is shown in Table 10-10.

Table 10-10: Average year demand projections – Trangie WSS (ML/year)

	2022	2027	2032	2037	2042	2047	2052
Residential	150	152	156	160	160	160	160
Non-residential	64	64	64	64	64	64	64
Total Demand	**214**	**216**	**220**	**224**	**224**	**224**	**224**

The unrestricted future year extraction projection is completed on a scheme level to estimate the future 'dry year' extraction from the Trangie bores. The projection is shown in Table 10-11.

Table 10-11: Unrestricted future year extraction projection – Trangie WSS (ML/year)

	2022	2027	2032	2037	2042	2047	2052
Water extraction from borefield	352	354	360	364	364	364	364

See Appendix C.5 for the breakdown of the unrestricted future year projections.

The peak day production projection for the Trangie WSS is broken down into reservoir zones for the purpose of assessing reservoir/pumping capacities. The total peak day production is used to compare against the reservoir capacity in Trangie. The peak day projection is shown in Table 10-12.

Table 10-12: Peak day production projections – Trangie WSS (ML/day)

	2022	2027	2032	2037	2042	2047	2052
Residential	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Non-residential	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Losses on peak day	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Peak day production	**2.4**	**2.4**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**

10.8 Water security assessment

Council's WAL entitlement to extract water from the borefield is 350 ML/year. The water security assessment is completed for the future unrestricted extraction which is based on the 99th percentile from the hindcast. The forecast unrestricted future extraction for the historical and 1°C warming climate is shown in Figure 10-12.

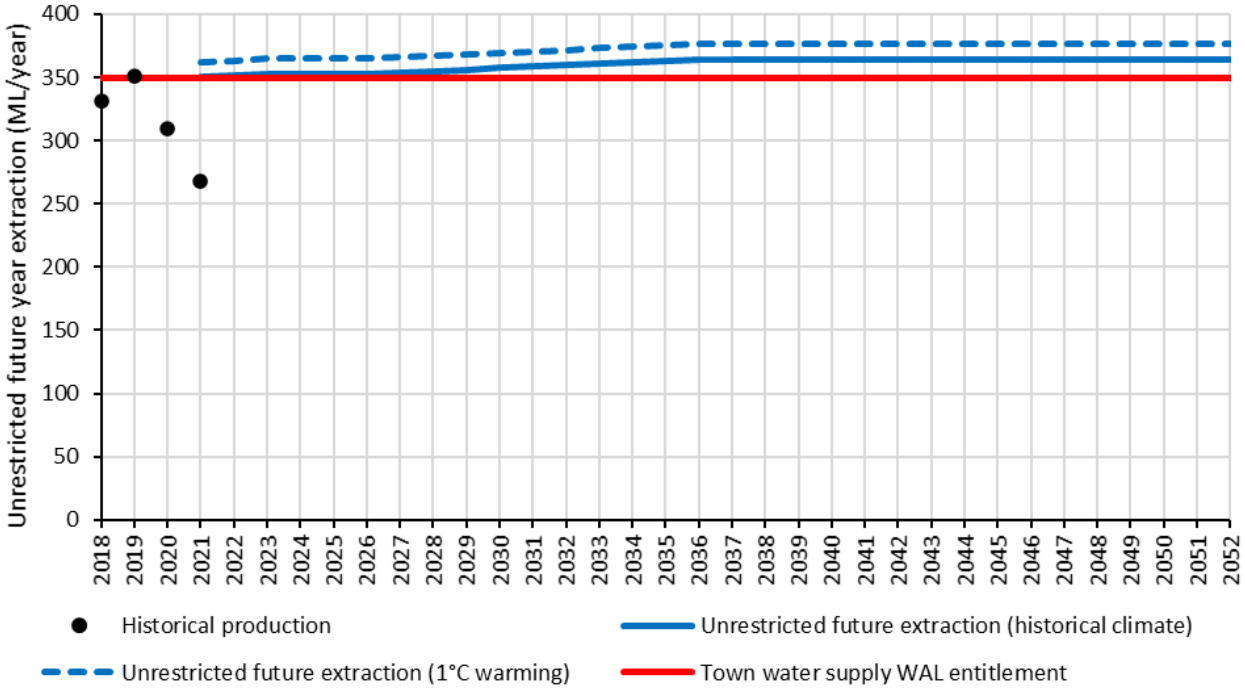

Figure 10-12: Projected unrestricted future extraction for the Trangie WSS compared to WAL entitlement and historical production

The unrestricted future extraction is expected to already exceed Council's WAL entitlement. Issue

10.9 System capacity assessment

The system capacity is defined as the combined capacity of all the bore pumps and the Trangie Reservoir (Harris Street Reservoir). The system capacity is assessed for the peak week for the following scenarios:

- Available historical data (2.31 ML/day)
- Selected 99th percentile from hindcast (2.40 ML/day)
- Selected 99th percentile and 2052 forecast (2.51 ML/day)

The largest peak week demand occurred from the 19th to 25th January 2018. The peak week demand persistence pattern is shown in Figure 10-13.

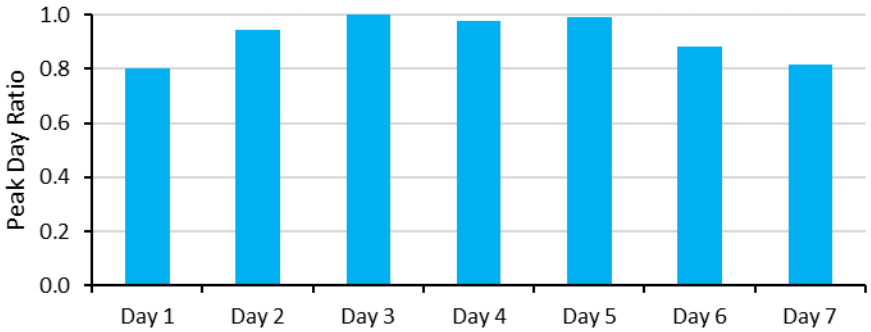

Figure 10-13: Trangie WSS peak week persistence pattern

The reservoir drawdown over the peak week for each of the scenarios is shown in Figure 10-14. Based on the topography, the water pressure will drop below 12 m (the typical LOS pressure target) when the reservoir level reaches around 45%.

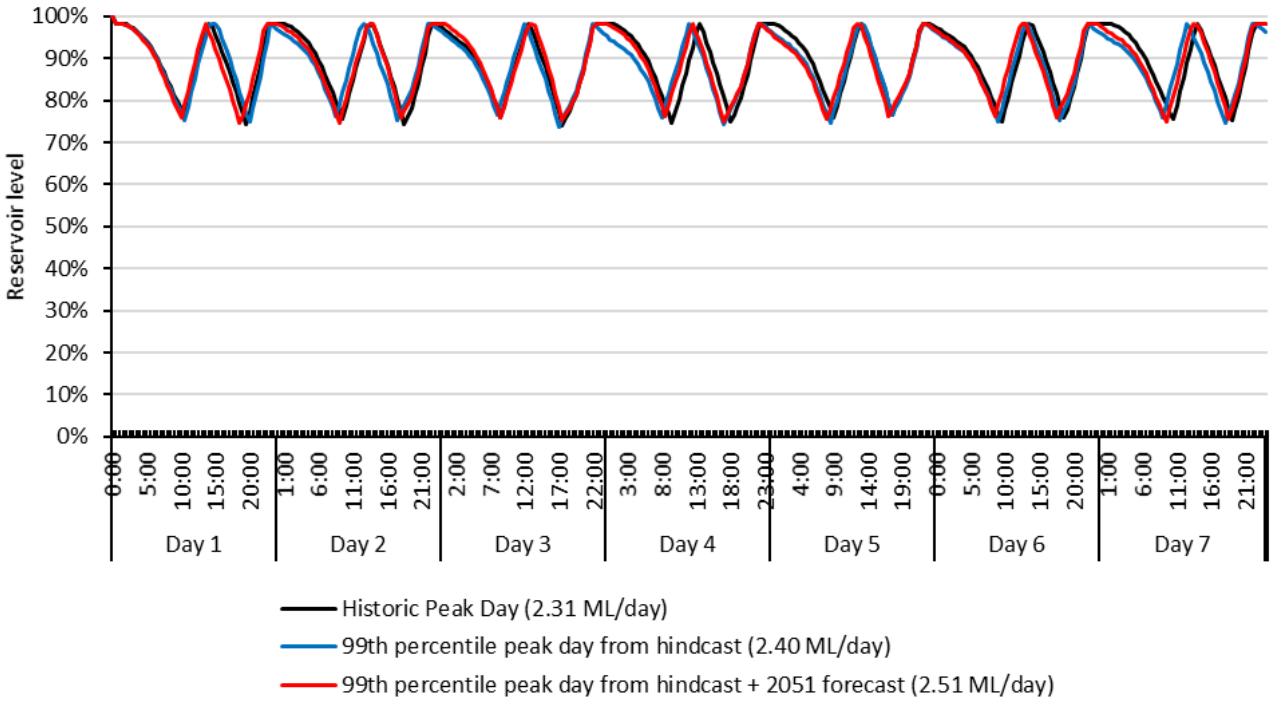

Figure 10-14: Trangie WSS reservoir simulated drawdown

The current system should not have any issues supplying the current and future peak day demand scenarios while maintaining pressure to the system.

10.10 Application of Health-Based Treatment Targets

10.10.1 HBT assessment of threats

For Trangie, the inherent risk of the water source has been assessed as '**Low**', as:

- The water is drawn from a sub-artesian basin, from depths of 90-110m
- The years of construction for Bores 1,2 and 3 are around 2015 and 2016

Sub-artesian basin water sources are considered to be protected catchments, and as long as bore caps and bore casings prevent ingress of surface water into the bores, the inherent risk of the water source is considered low.

10.10.2 HBT assessment of treatment barriers

For chlorine sensitive pathogens

The free chlorine CCP for the Trangie WSS has been maintained above 0.5 mg/L consistently in the year of 2020; and the chlorine contact was calculated to be above 15 mg.min/L (from Table 10-6).

As the HBT inherent risk is low, the residual risk for the Trangie WSS is considered '**Low**'.

For chlorine resistant pathogens

There are no treatment barriers (such as UV, ozone, or filtration plants) that control chlorine resistant pathogens in Trangie.

However, as the HBT inherent risk is low, the residual risk for the Trangie WSS is considered '**Low**'.

10.10.3 NSW Health preliminary cryptosporidium risk assessment

Based on a preliminary assessment by NSW Health, there is a 'Low risk' of cryptosporidium in the raw water source for Trangie.

10.11 Work health and safety

To be completed once APV condition assessment is completed and provided

11. Tomingley Water Supply Scheme

Tomingley is served by a reticulated filtered potable water supply for an approximate population of 50 people. The Tomingley WSS was a non-potable water supply until the commissioning of the new Tomingley WTP in April 2022, which provides drinking water supply to the WSS.

Figure 11-1 shows the schematic diagram of the Tomingley WSS.

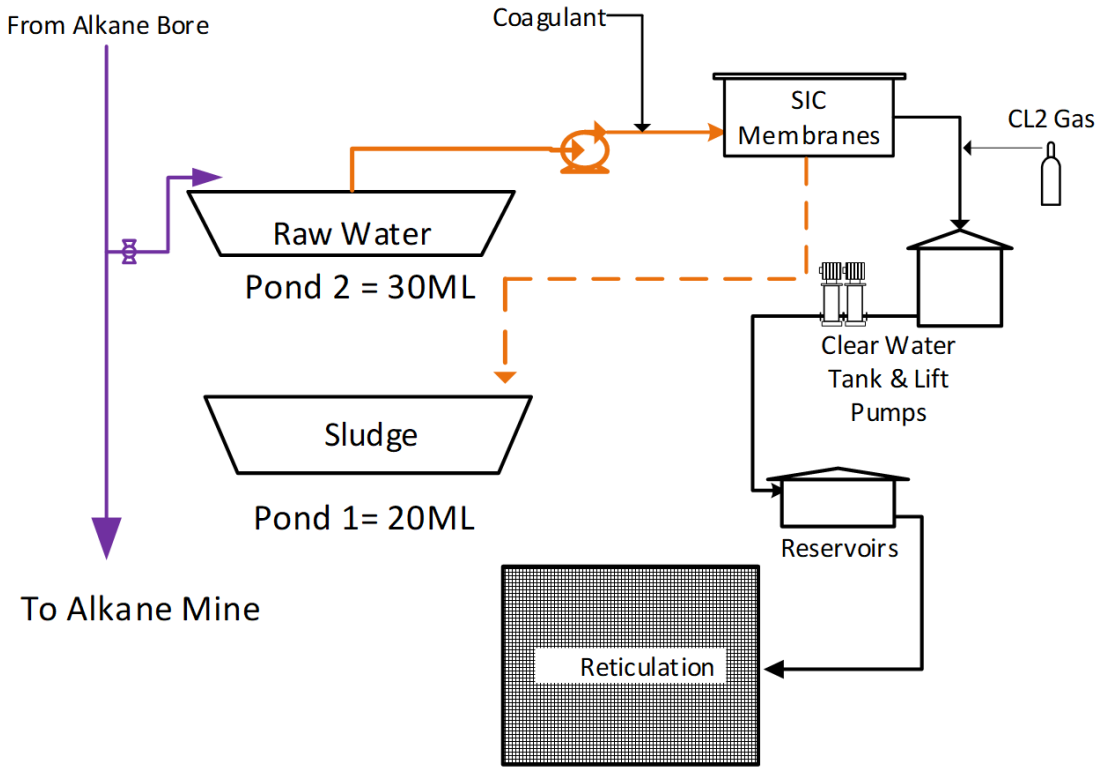

Figure 11-1: Tomingley WSS schematic diagram

During this study, Council has carried out an in-house re-design of a proposed treatment plant and negotiated a D&C supply of a treatment skid utilising silicon membranes as the primary treatment component.

11.1 Raw water source

11.1.1 Water resource

Previously, raw water was sourced from off-channel storages in Gundong Creek when it is flowing. These off-channel storages have not been a reliable supply of water. Historically, Tomingley has experienced water restrictions in the past due to no flow in the creek and water was carted from Narromine for a period of 18 months during the Millennium Drought from January 2010.

More recently, in 2018 a pipeline that supplies water to a nearby mine (ALKANE Resources Mine site) at Tomingley was extended and connected to the two raw water ground storage ponds at the treatment plant. This pipeline runs from a bore near Narromine to the mine near Tomingley. Council advised that the mine provides approximately 10 ML/year to the Tomingley WSS.

11.1.2 Raw water extraction

Council advised that the current water supply agreement for Tomingley is contained in an existing voluntary planning agreement but has no fixed amount or time of delivery.

Council is in the process of negotiating a secure water source agreement with ALKANE.

11.1.3 Water Access Licence

Council holds a *Local Water Utility* Water Access Licenses (WAL35321), issued under the *Water Management Act 2000*, which relates to the water supply to Tomingley. The following apply to the WAL:

WAL license number	**WAL35321**
Category [Subcategory]	Local Water Utility
Entitlement	**22 ML/year**
Water Source	Upper Bogan River Water Source
Water Sharing Plan (WSP)	Macquarie Bogan Unregulated Rivers Water Sources 2012

Council has a works approval, number **80CA719513** for the water supply infrastructure as nominated by WAL35321 for town water supply.

11.1.4 Raw water quality data

Raw water quality data not available at Tomingley.

11.2 Water treatment

11.2.1 Treatment process

Before the commissioning of the new Tomingley WTP in April 2022, raw water from the two off-channel storages were pumped to the sedimentation tanks that are arranged in series. A coagulant is dosed after the raw water pump that pumps water from the off-channel storages. Clarified water is then pumped into the sand filters. Filtered water from the sand filters are transferred to the elevated tank for distribution to the township.

Currently, raw water from Pond 2 (30 ML) is pumped and dosed with a coagulant to the silicon carbide (SIC) membranes for filtration. Filtered water is then chlorinated with chlorine gas and stored in the clear water tank. Lift pumps at the WTP site pumps treated water to the town reservoir for distribution to the township. Backwash from the SIC membranes are transferred to Pond 1 which has been re-purposed as a sludge lagoon.

11.2.2 Historical water production

The Tomingley Raw WSS is supplied exclusively from the ALKANE Bore, which is not metered. As such, there is no production data available for this scheme.

11.2.3 Peak production analysis

Could not be determined due to no production data available for this scheme.

11.2.4 Treated water quality

Treated water quality data is not yet available as the new Tomingley WTP was recently commissioned in April 2022.

11.2.5 Water treatment plant performance

As there is no water quality data available at Tomingley, the performance of the Tomingley WTP could not be assessed.

Section 61 inspection and recommendations

The Tomingley Raw WTP was inspected on 15 April 2021 by DPIE Water. The inspection showed the filtered water turbidity as “good” (0.75 NTU) considering the treatment only comprised on filtration and chlorination. It was recommended that Council re-introduce a small dosage of coagulant to enhance filter efficiency or at the very least maintain the coagulant dosing equipment on-site in working order to assist when the storage dams may experience higher turbidity from storm run-offs.

Council noted that dogs were freely entering the WTP compound. If the intention of any future WTP augmentation is to supply potable water, the WTP/storage ponds would require fencing to be made animal/people proof.

11.3 Distribution

11.3.1 Distribution system

Figure 11-2 shows an aerial view of the Tomingley village, and the location of customer meters.

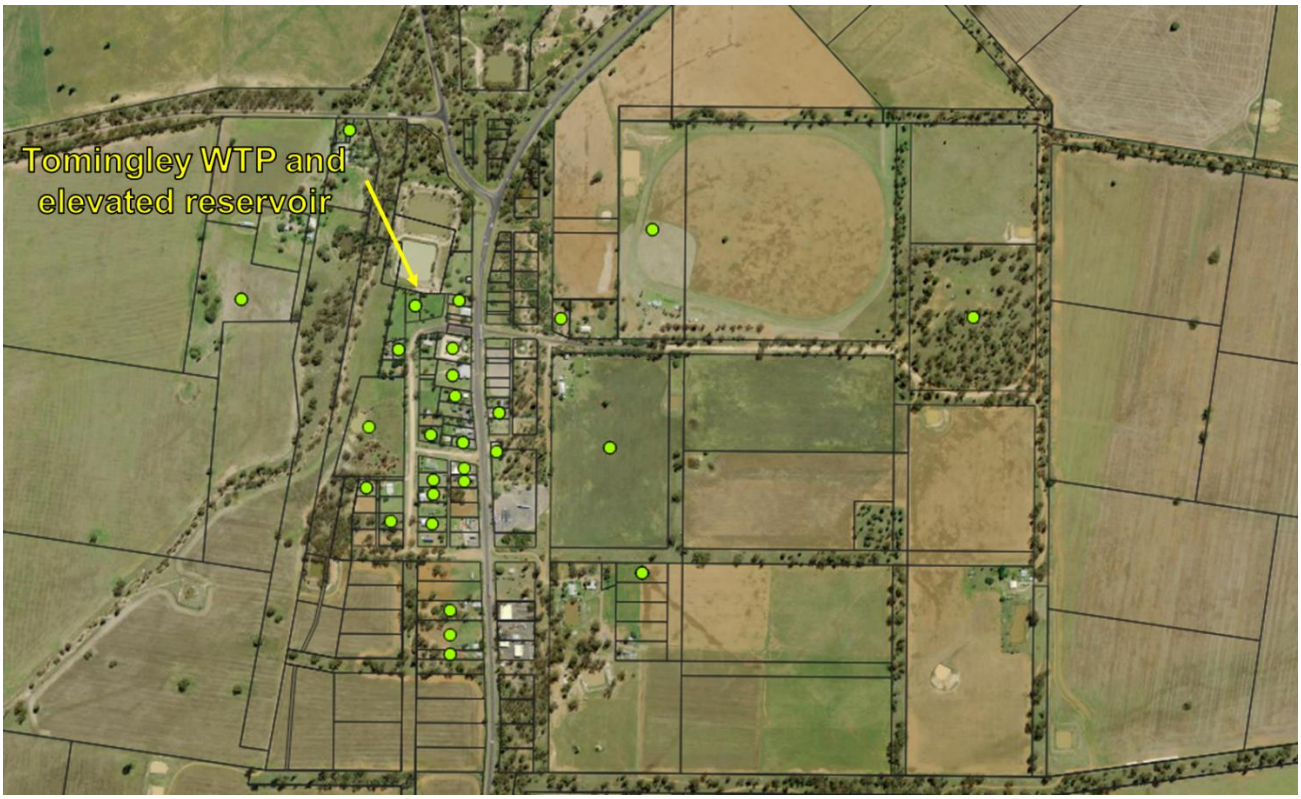

Figure 11-2: Customer meters in Tomingley

11.3.2 Metered customer demand

Council supplied billing data for all users from 2017/18 to 2020/21, with meters being read four times a year. User classes from the billing data were residential, business, non-rateable, and farmland.

The historical number of assessments (approximately equal to the number of connections) and the historical metered customer demand for the Tomingley WSS is given in Table 11-1 and Table 11-2 respectively.

Table 11-1: Historical number of assessments – Tomingley WSS

Financial year	2017/18	2018/19	2019/20	2020/21
Residential	21	21	21	21
Business	6	6	5	5
Non-Rateable	4	4	4	4
Farmland	1	1	1	1
Total	**32**	**32**	**31**	**31**

Table 11-2: Historical metered customer demand (ML/year) – Tomingley WSS

Financial year	2017/18	2018/19	2019/20	2020/21
Residential	2.5	3.0	2.2	1.7
Business	4.1	4.5	3.6	2.9
Non-Rateable	0.0	0.0	0.0	0.1
Farmland	0.1	0.1	0.1	0.3
Total	**6.8**	**7.6**	**5.9**	**5.0**

Historical customer usage split has been around 37% residential to 63% non-residential.

The historical usage for all available billing periods for Tomingley WSS is given in Figure 11-3.

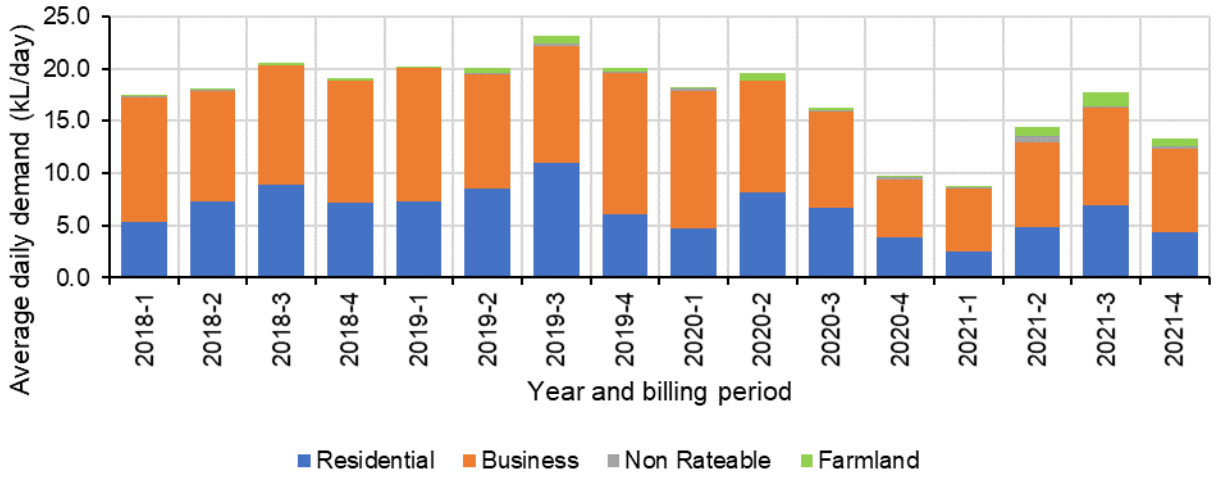

Figure 11-3: Historical usage by user category – Tomingley WSS

11.3.3 Major non-residential users

As there are very small number of assessments in Tomingley, the criteria used to identify major non-residential users was any customers that used more than 10% of the total customer usage in any financial year.

Three businesses met the criteria for a major-non-residential user:

- Tomingley Motel: Average year demand of 1.6 ML/year, maximum year demand of 2.4 ML/year
- Cross Roads Hotel: Average year demand of 1.2 ML/year, maximum year demand of 1.3 ML/year
- BP Truckstop: Average year demand of 0.9 ML/year, maximum year demand of 0.9 ML/year

11.3.4 Water balance

The volume of water supplied into the Tomingley WSS is not recorded, which means **a complete water balance cannot be undertaken**. This could be resolved by metering the volume of water supplied to and after the Tomingley WTP once it has been commissioned.

11.4 Analysis of production data

Analysis of production data for Tomingley could not be performed as there was no production data available.

11.5 Analysis of customer usage

11.5.1 Modelling of customer usage

Customer usage patterns were modelled in a similar way to production data. The modelling showed that the outdoor lawn irrigation was the most significant contributors to the water consumption patterns in the Tomingley WSS. Periods of Level 2 restriction has been omitted from the modelling.

For the analysis the maximum and 99th percentile (1-in-100 year) unrestricted future year demand was selected as the starting points for the forecasts. The model results are given in Table 11-3.

Table 11-3: Estimated customer usage from climate correction – Tomingley WSS

User class	Average Year Demand (ML/year)	Dry Year Demand (ML/year)	Average Day (kL/day)	Peak Day (kL/day)
Residential*	2.3	3.0	6.3	20.7
Business	4.18	4.09	11.2	13.7
Non-Rateable	0.06	0.09	0.2	0.3
Farmland	0.18	0.25	0.7	0.8
Total*	**6.7**	**7.4**	**18.4**	**35.5**

*User classes were determined to have a usage pattern that was significantly climate dependent

11.5.2 Unit residential demands

The residential unit demands for each scheme were assessed by climate correcting historical data, using demand for lawn irrigation as well as evaporative cooler usage.

Using a threshold of 60 L/connection/day for an active connected residential property resulted in 72% of the assessments in Tomingley WSS being active. Note that the SA1 boundary covering Tomingley is much wider than the village.

The unit demand per active residential connection is then estimated from the number of active assessments. The results are given in Table 11-4.

Table 11-4: Unit demand per active residential assessment – Tomingley WSS

Average year demand (kL/year)	Unrestricted future year demand (kL/year)	Average day demand (L/day)	Peak day demand (L/day)
153	185	418	1,113

As the water is non-potable, internal plumbing is likely not connected to the reticulation. Instead, rainwater tanks or private bores may be used for internal usage. Therefore, internal usage has not been estimated.

11.6 Projections

Council is not expecting growth to occur in Tomingley. Therefore, demand forecast is not required.

11.7 Water security assessment

Council holds a WAL entitlement of 22 ML/year, with the modelled customer demand showing unrestricted (dry) year demand of about 7.6 ML/year (including the effects of climate change). As there is no production data available for the Tomingley WSS, assuming that typically about 7-10% of water is lost in the Tomingley WTP due to filter backwashing, the unrestricted (dry) year production for Tomingley is estimated to be about 8.1 ML/year, which is below the WAL entitlement of 22 ML/year.

Council is not expecting growth to occur in Tomingley, therefore there is no requirement to increase the entitlement volume.

11.8 System capacity assessment

System capacity assessment for the Tomingley WSS could not be performed as there is no production data available.

11.9 Work health and safety

To be completed once APV condition assessment is completed and provided

12. Narromine Sewerage Scheme

12.1 Sewage collection and transfer

The Narromine Sewerage Scheme (SS) is a gravity sewage collection system that services a catchment made up of urban and some light industrial properties. This system is comprised of 31.8 km of gravity collection mains with 484 manholes, 11 pump stations and 12 km of pressure mains. Eight of the pump stations plus the collection from SPS 1 pump approximately 7 km to the Narromine Sewage Treatment Plant (STP).

The existing serviced area of the Narromine SS is shown in Figure 12-1, and the SPS pump hierarchy diagram is shown in Figure 12-2.

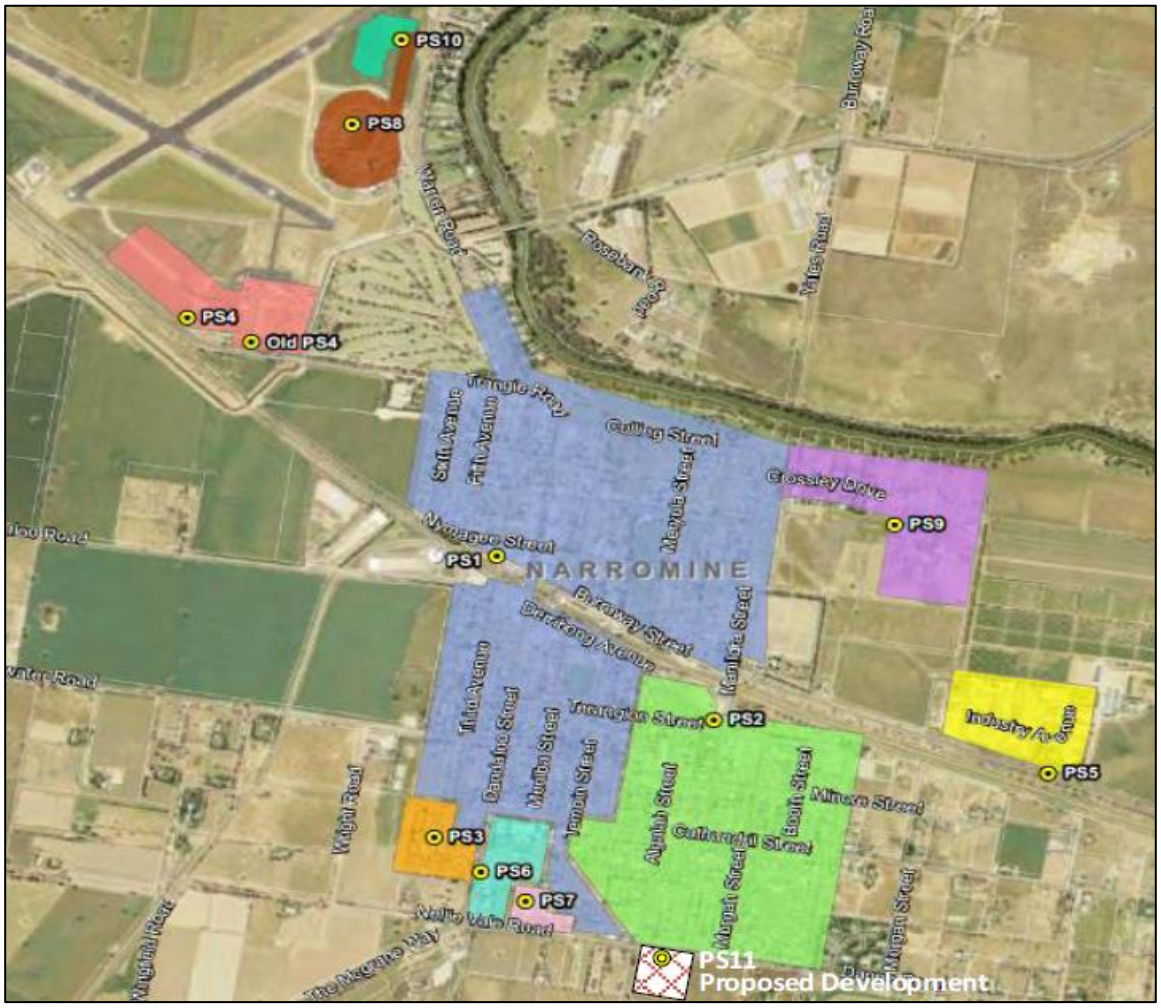

Figure 12-1: Narromine sewerage transfer system

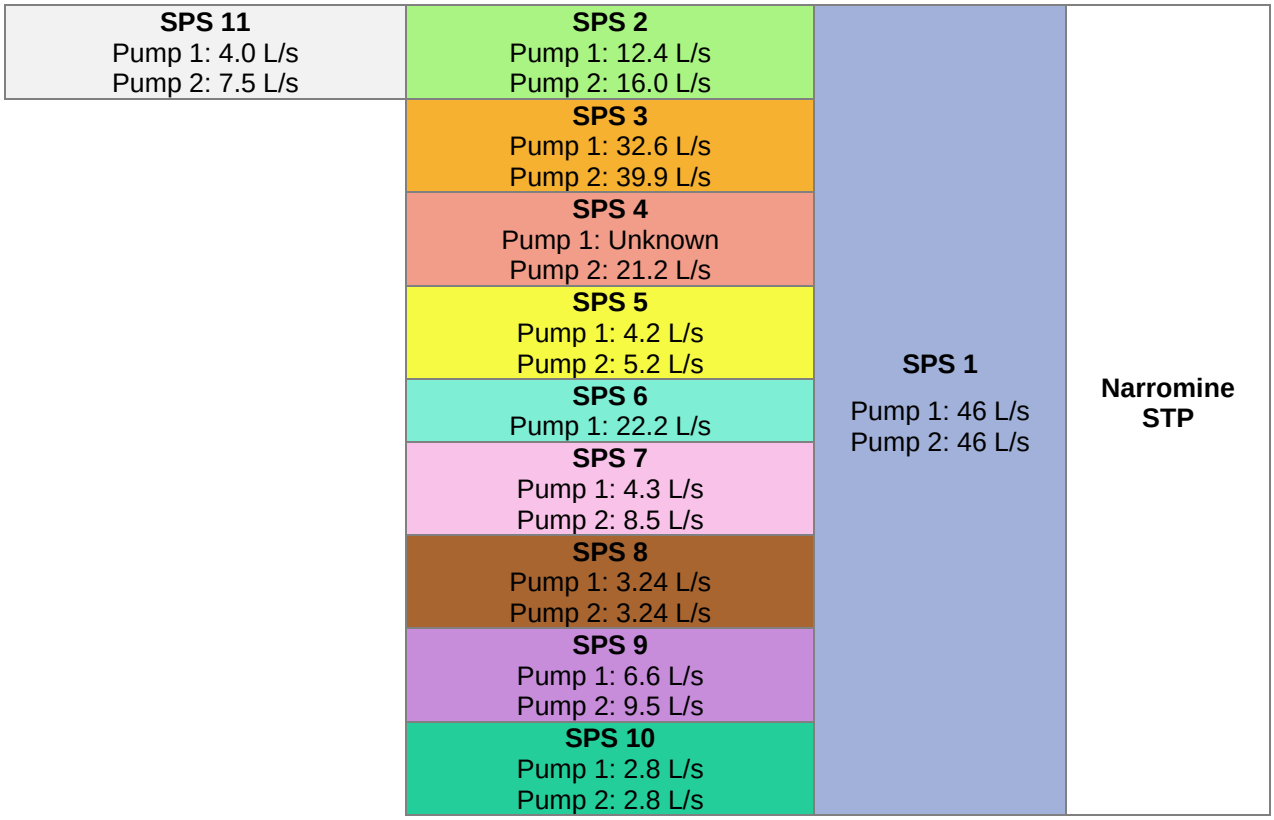

Figure 12-2: Narromine SPS pump hierarchy

All SPSs are of the conventional wet well type and equipped with dual submersible sewage pumps for operation on 1 duty, 1 standby basis. If available, both pump capacities were provided above.

Council has identified equipment failure for about a year at SPS4.

12.2 Sewage treatment

12.2.1 STP description

The Narromine STP was constructed in 2004/05. It is an oxidation pond plant with a 45 ha pivot irrigation reuse system that has a design loading of 5,000 EP, and unit loadings of 200 L/EP/day and 60g BOD/EP/day [16]. The plant consists of a primary oxidation pond with a deep inlet zone plus a shallow secondary oxidation pond. These are followed by a maturation pond, an effluent storage pond and a 45 ha pivot irrigated reuse area. Pond dimensions are provided in Table 12-1.

Table 12-1: Narromine STP design basis [16]

Pond		
Oxidation Ponds	Base length x width	= 260 m x 74 m per pond*
	Side slopes	= 3(H) : 1(V)
	Depth to TWL	= 1.2 m with 600 mm freeboard
	Depth of inlet zone	= 1.8 m
	Volume per pond	= 32.9 ML
	Surface area at TWL	= 2.9 ha
	BOD loading	= 110 kg/ha/day
Maturation Pond	Base length x width	= 260 m x 47 m*
	Side slopes	= 3(H) : 1(V)
	Depth to TWL	= 1.2 m with 600 mm freeboard

Pond		
	Volume	= 21.5 ML
Effluent Storage Pond	Base length x width	= 260 m x 210 m*
	Side slopes	= 3(H) : 1(V)
	Depth to TWL	= 1.0 m in shallow section and 2.7 m in deepened section
	Volume at TWL	= 110 ML

*Measured from Six Maps as the 1999 Narromine Concept Design report showed different dimensions

The reuse area is bunded, and any overflow captured will be collected in an emergency catch pond, which automatically returns any overflow of the bunded reuse area back to the effluent storage pond.

An aerial image showing the existing STP layout is shown in Figure 12-3. A more detailed layout of the Narromine STP is included in Appendix F. The STP process flow diagram is shown in Figure 12-4.

Figure 12-3: Narromine STP aerial photo

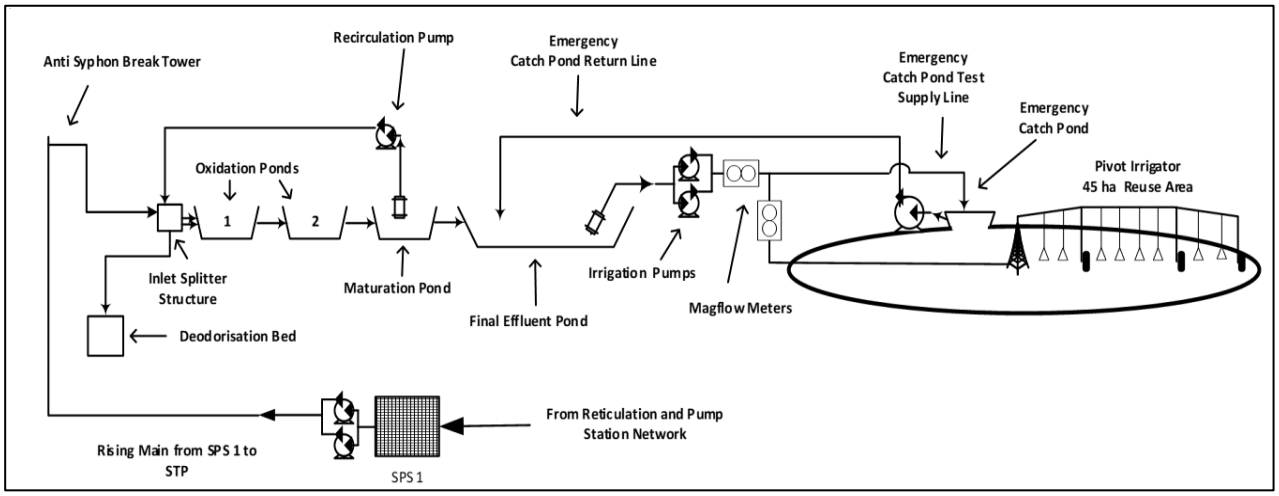

Figure 12-4: Narromine STP process flow diagram

Council has identified that raw sewage is not screened, and it is unknown what build-up of solids (screenings) and grit has occurred over time. Issue

12.2.2 Historical flows

STP inflow is recorded at SPS1, as there is no inflow meter at the STP. Daily data was available from September 2017 to June 2021. Daily rainfall data is obtained from the Bureau of Meteorology (BOM weather station number 51115 – Narromine Airport) and SILO data from the Queensland Government.

The historical sewage inflow to the Narromine STP is shown in Figure 12-5 and Figure 12-6.

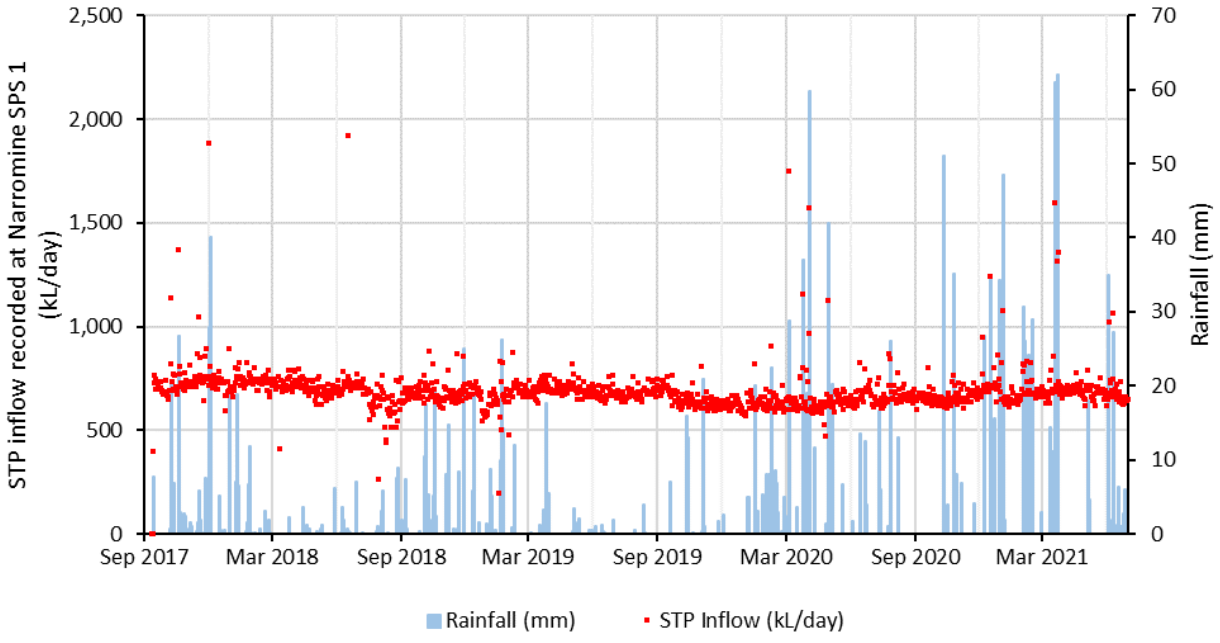

Figure 12-5: Historical daily sewage inflow to the Narromine STP and rainfall

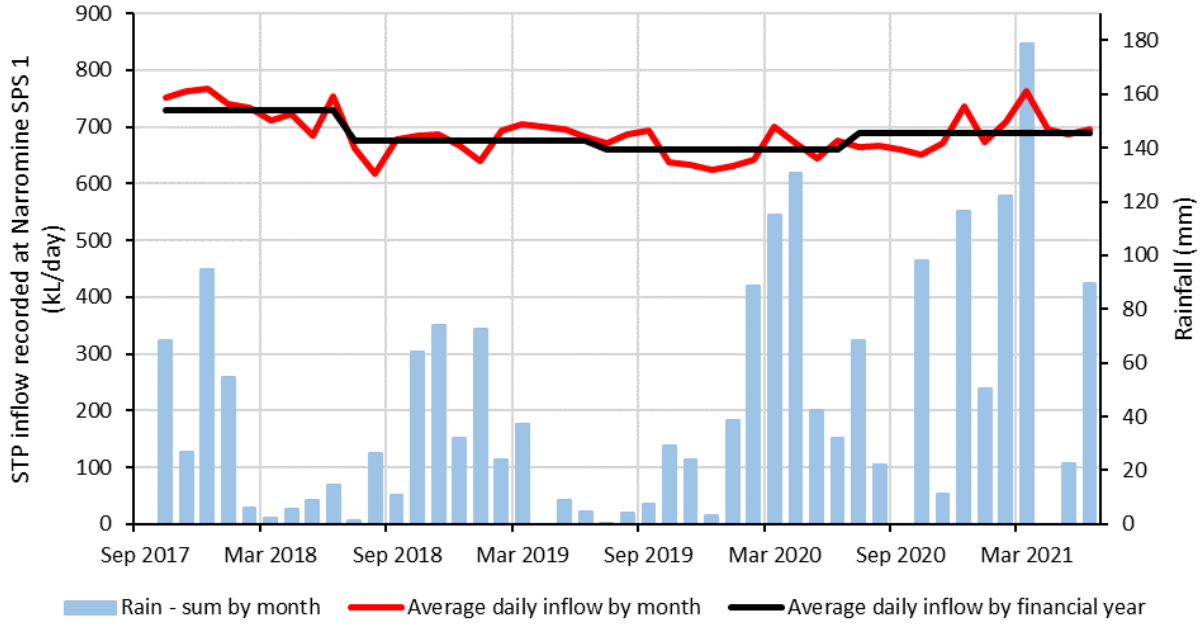

Figure 12-6: Historical monthly sewage inflow to the Narromine STP and rainfall

The STP inflow increases when there are rain events, which indicates that there is some inflow and infiltration occurring in the sewerage system.

12.3 STP inflow analysis

Average dry weather flow (ADWF) estimated from STP inflow data

STP daily inflow data was analysed to estimate the average dry weather flow (ADWF). To estimate historical ADWF, a dry day was taken as a day with less than 2 mm of rainfall on that day, any of the five preceding days and one day following. All historical rainfall data was obtained from the Bureau of Meteorology (BOM).

The estimated ADWF for the Narromine STP is shown in Table 12-2.

Table 12-2: Narromine STP – ADWF estimated from STP inflow data

FY	2017/18	2018/19	2019/20	2020/21
ADWF (kL/day)	700	671	653	668

Based on the STP inflow data, the ADWF for the Narromine STP is around 670 kL/day in the 2020/21 financial year.

ADWF estimated from customer billing data

The ADWF was also estimated from the water billing data as a cross-check. For residential users, the estimated internal water consumption is assumed to be discharged to the sewer, while the outdoor irrigation does not contribute into the sewer. For non-residential users, the sewer load was estimated by taking the winter demand of the water consumption multiplied by the sewage discharge factor.

The water billing data for Narromine, graphed against the Narromine STP inflow is shown in Figure 12-7.

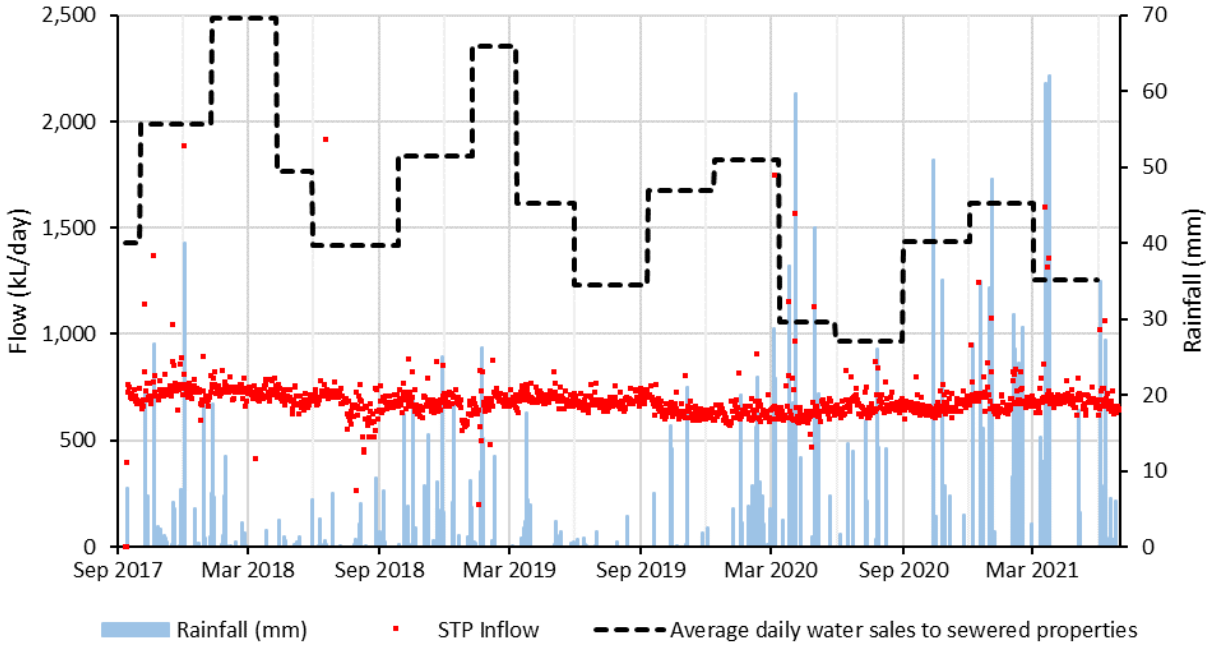

Figure 12-7: Metered water consumption in Narromine compared to STP inflow

The winter demand is used to estimate the ADWF, as increase in water sales in summer is attributed to outdoor (irrigation) usage. The estimated ADWF from the water billing data is **963 kL/day**. This is much higher than the ADWF estimated from the STP inflow data at 670 kL/day.

Based on the analysis, the following observations were made:

- Council has advised that customers in Narromine use a lot of water for watering lawns and gardens. Council to advise if customers are using lots of water for irrigating lawns/gardens even during winter? This may explain the high water sales relative to the STP inflow volumes, as this is external demand which is not contributing into the sewerage network.
- It is also possible that sewage could be exfiltrating from the sewer to groundwater, however evidence of infiltration is not evident in the STP inflow data, i.e. the inflow quickly returns to ADWF after a rain event instead of persisting for days.

Council has advised that the Narromine SPS 1 flow meter is accurate and is not under-reading flows. Therefore, the ADWF recorded from the Narromine SPS 1 as the STP inflow data, **670 kL/day**, was taken to be the nominated ADWF for the Narromine SS, which will be used as the starting point for projections. The ADWF estimated from the water billing data was not used because of high garden watering in Narromine which was inaccurately attributed to the residential sewage load.

Nominated ADWF and unit hydraulic loading

The ADWF estimated from the Narromine SPS 1 as the STP inflow data, **670 kL/day**, is the nominated ADWF for the Narromine SS.

The total Equivalent Person (EP) for the Narromine SS has been estimated as **3,987 EP**, which is explained in more detail in Section 12.8. Using this EP, the unit sewage loading is calculated to be **164 L/EP/day**.

Peak dry weather flow (PDWF)

Calculated values for peak dry weather flow (PDWF) are based on the methodology in the Public Works sewer design manual.

The total Equivalent Tenement (ET) for the Narromine SS has been estimated as **1,520 ET**, which is explained in more detail in Section 12.8. The peaking factor ('r') was calculated to be 2.2 using the number of ET, and the PDWF was estimated to be 17 L/s.

Peak wet weather flow (PWWF)

Narromine SPS 1 is the only SPS that pumps directly to the Narromine STP. This SPS has a pump rate of 46 L/s. During wet weather, this pump rate will be the peak wet weather flow (PWWF) at the STP.

The PWWF in each SPS catchment is calculated using the method in the Public Works sewer design manual. The results are provided in Section 12.10.3. The PWWF from all catchments in the Narromine SS is estimated to be 105 L/s. If SPS 1 pump capacity is upgraded, the PWWF to the STP will increase.

Historical wet weather flows at the Narromine STP

Based on the historical data provided (from September 2017 to June 2021), the highest sewage inflow into the STP was 1,918 kL/day recorded on the 18 June 2018. However, this inflow reading is likely to be an outlier as the rainfall event during this high inflow reading recorded 1.2 mm rain falling over two days. This rainfall amount is unlikely to have caused this high reading, with average inflows during this period being around 720 kL/day.

The second highest sewage inflow into the STP was 1,884 kL/day recorded on the 2 December 2017. The wet weather event was a 1-in-4 year 2 day rainfall event, with 82 mm rainfall falling over two days.

12.3.1 Biological and nutrient loading

The normal range for BOD load in small communities is 55 to 65g BOD/EP/day. Council does not have biological and nutrient loading data available for the Narromine STP. Where specific data is not available, a BOD loading of 60 g/EP/day is considered for Council's sewerage schemes.

Council currently does not have any biological and nutrient loading data into the Narromine STP. As such, a BOD loading of 60 g/EP/day was assumed for the Narromine SS.

72-hour flow monitoring would provide an accurate estimate of the actual biological and nutrient loading to the STP. Agreed by Council – to be completed in separate engagement

12.3.2 Section 61 inspections and recommendations

No Section 61 inspection report was available from DPE Water regarding Narromine STP.

12.4 STP capacity assessment

The Narromine STP process involves two oxidation ponds in series, one maturation pond for treatment, followed by an effluent pond. The STP design capacity is 5,000 EP.

Oxidation pond

The area of Oxidation Pond 1 is approximately 2.1 ha, as measured from aerial images of the Narromine STP. Using the estimated influent BOD concentration of 357 mg/L (based on unit loadings of 60g BOD/EP/day and 168 L/EP/day) and a pond depth of 1.2 m, the treatment capacity is calculated to be 845 kL/day, using the method by Bliss. This is about **5,030 EP** at the current assessed loading of 168 L/EP/day.

The assessed capacity of the oxidation pond (Pond 1) is higher than the current loading (3,987 EP) and the 30-year projected loading (5,010 EP).

Maturation pond

The capacity of the maturation pond is assessed using the current assessed unit loading of 168 L/EP/day (from Section 12.3) and a design criteria of 25 days detention time. The results are shown in Table 12-3.

Table 12-3: Capacity assessment of the maturation pond in the Narromine STP

	Units	Value
Pond area	m^2	14,500
Pond depth	m	1.2
Total pond volume	m^3	17,400
Hydraulic capacity @ 25 days detention time	kL/day	696
Design capacity @ 200 L/EP/day and 25 days detention time	EP	3,480
Assessed capacity @ 168 L/EP/day and 25 days detention time	**EP**	**4,143**

The assessed capacity of the maturation pond is higher than the current loading of 3,987 EP for the Narromine SS, which means the 25 days detention time is achieved. However, due to growth in the Narromine SS, the assessed capacity will be lower than the 30-year projected loading of 5,010 EP. Issue

Effluent pond

To assess the capacity of the effluent pond, PWA used historical daily rainfall and evaporation data from 2004 (when the STP was constructed) to 2020 to develop a water balance model of the Narromine STP to conduct an overflow assessment from the effluent pond. The model considers the sewage load (including wet weather flows), mass balances over the oxidation ponds, maturation pond and effluent pond, and effluent loss by evaporation and effluent reuse.

The model calculated that for the current loading of 3,987 EP (ADWF of 670 kL/day at 168 L/EP/day), the effluent pond overflows in every year since 2004. On average, about 325 kL/day overflows from the effluent pond. The modelled overflow and evaporation volumes from the effluent pond are shown in Figure 12-8.

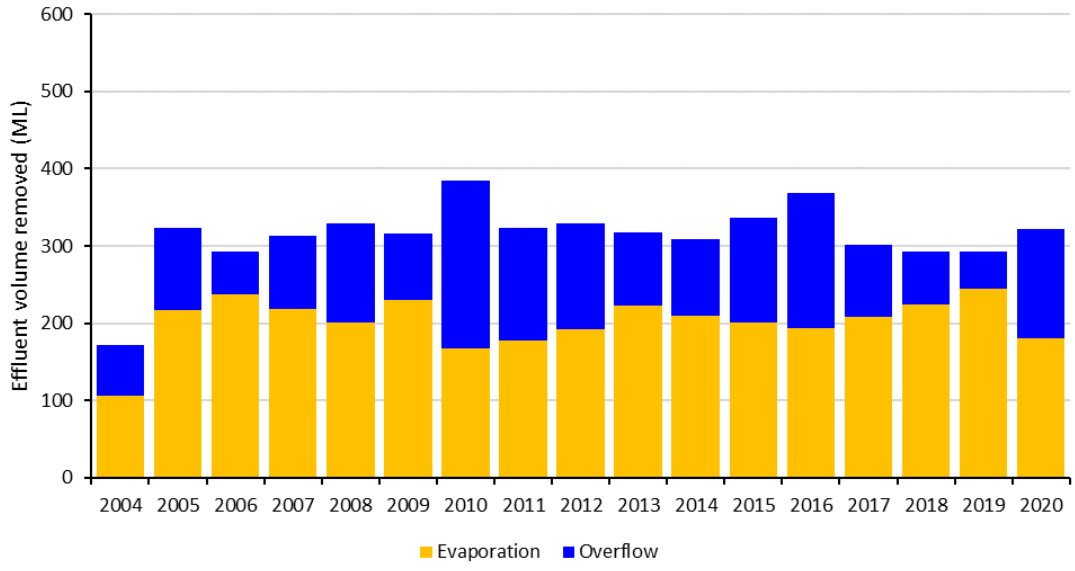

Figure 12-8: Modelled effluent loss by evaporation and overflow from the effluent pond at the current loading of 3,987 EP

Council has indicated that the STP ponds have never overflowed, and also that there have been no effluent reuse flows at Narromine since 2015-16. From these considerations, it may potentially be possible that the effluent stored in the ponds are leaking through the clay liner base and into the ground. Issue

12.5 Effluent management

12.5.1 Discharge to environment

Potential overflows from the effluent storage pond are discharged to the tree buffer area located between the ponds and the Mitchell Highway via a small spillway/overflow structure constructed in the embankment of the effluent storage pond. [16]

12.5.2 Environment Protection Licence requirements

Council operates Narromine STP under the Environmental Protection Licence (EPL) number 11715. The EPL monitoring requirements, volume and concentration limits are provided in Appendix G.

The location of the monitoring points are shown in Figure 12-9.

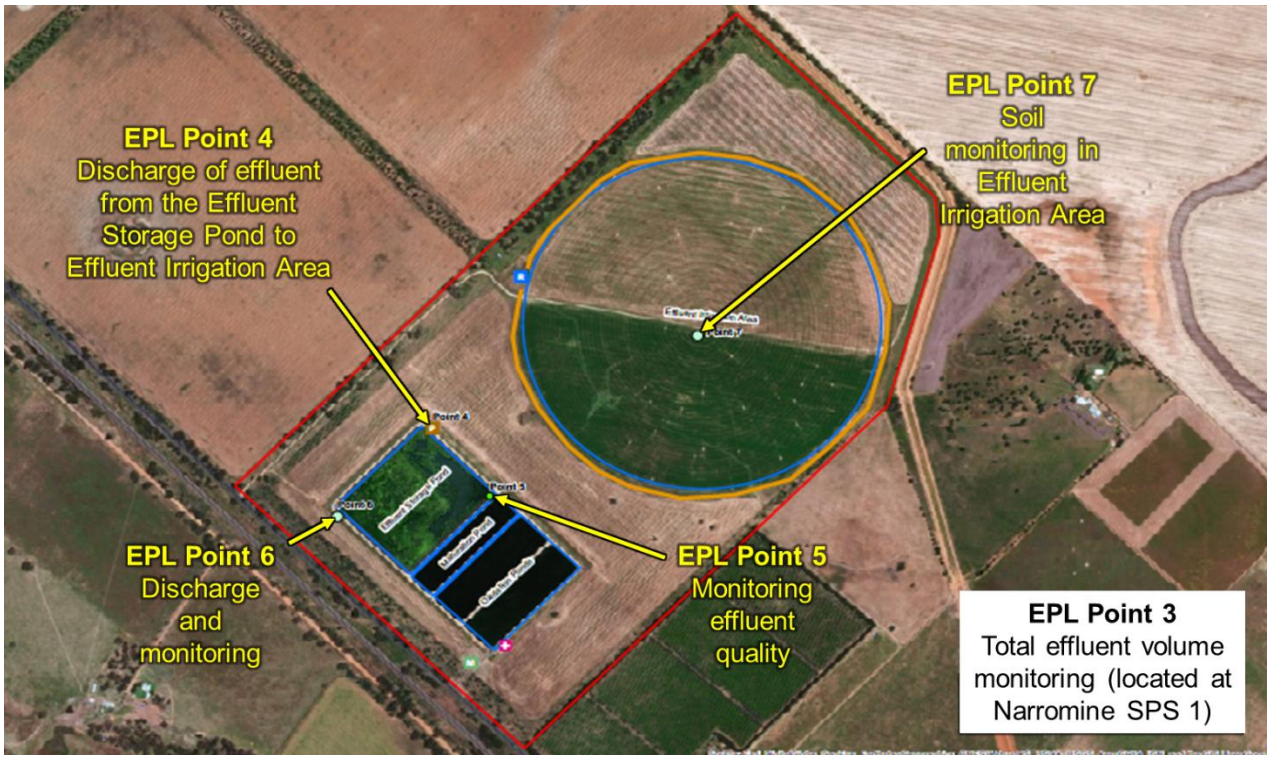

Figure 12-9: EPA monitoring points for EPL 11715 (Narromine STP)

The EPL non-compliances over the last ten years are given in Appendix D. In the past ten years, Council has not had many non-compliances, with the most recent non-compliance in 2019 being the exceedance of total suspended solids and BOD which did not discharge into the environment. The action to address this non-compliance was for Council to investigate the cause of the increased pollutant concentrations. Non-compliances previous to this were no sampling undertaken at Point 7 (occurring in 2018), and shut-off of flow meter at Point 3 and exceedance of 1,000 kL/day volumetric limit (occurring in 2016). The action was for EPA to monitor future compliance with this condition.

It is noted that there is no volumetric limit in the EPL, which was last updated on 30 November 2018.

12.5.3 Effluent reuse

Effluent from the Effluent Storage Pond is pumped by an irrigation pump station to the 45 ha Effluent Irrigation Area.

12.6 Effluent reuse performance assessment

12.6.1 LRV assessment

PWA undertook a preliminary assessment of the log reduction values (LRVs) for the Narromine effluent reuse scheme. The LRVs for each process are based on the LRV range from the NSW Guidelines for Recycled Water Management Systems. The LRVs for each treatment process was nominated based on the following considerations:

- Lagoon storage – the detention time in the maturation ponds were calculated to be 26 days based on the current loading. However the 30-year projected loading will reduce the detention time to 23 days. Therefore, the minimum LRV was nominated.

The RWMS Guideline states that no more than 3 LRVs can be attributed to non-treatment barriers for the irrigation of non-food crops.

The target and achieved LRVs for the existing Narromine effluent reuse is shown in Table 12-4.

Table 12-4: Target and potential LRVs achieved by the existing treatment process at Narromine for its effluent reuse scheme

Treatment	Protozoa		Virus		Bacteria	
	LRV range	Nominated LRV	LRV range	Nominated LRV	LRV range	Nominated LRV
Indicative LRV for treatment processes						
Lagoon storage (maturation ponds)	1.0 – 3.5	1.0	1.0 – 4.0	1.0	1.0 – 5.0	1.0
Total LRV (from treatment process)		**1.0**		**1.0**		**1.0**
Non-treatment barriers						
No public access during irrigation		2.0		2.0		2.0
Total LRV (from non-treatment barriers)		**2.0**		**2.0**		**2.0**

End use	Target LRV	Achieved LRV	Target LRV	Achieved LRV	Target LRV	Achieved LRV
Target LRV						
Irrigation of non-food crops	3.7	✗ 3.0	5.2	✗ 3.0	4.0	✗ 3.0

The assessment above indicates that the current treatment and non-treatment barriers do not achieve the target LRV for the removal of protozoa, viruses, and bacteria for the irrigation of agricultural non-food crops. Issue

12.6.2 Reuse scheme sustainability

Council has advised that there have been no effluent reuse flows at Narromine since 2015-16, with the amount of available effluent during growing times has been very minimal and has made cropping unviable. Therefore, the reuse scheme sustainability could not be performed.

12.7 Biosolids management

From the Narromine STP Concept Design Report by DPWS (report number WE98140R1), biosolids will accumulate primarily within Oxidation Pond 1, and is expected that the pond will require desludging at least every ten years. Removal of the biosolids are undertaken by taking Oxidation Pond 1 offline, removing biosolids from the inlet zone of Oxidation Pond 1 and drying out, and diverting incoming sewage directly to Oxidation Pond 2. [16]

The Concept Report indicates that the biosolids are taken to a bunded area adjacent to Oxidation Pond 1 to dry out the biosolids. The bunded area was proposed to be constructed when desludging is required. [16]

Based on the STP process, it is expected that the biosolids are classified as Stabilisation Grade C, and hence classified as Contaminant Grade E, which is not suitable for use, based on the NSW EPA Guidelines for Use and Disposal of Biosolids Products. [17]

Council advised that there has been no biosolids management that has occurred.

12.8 EP and ET estimates

An Equivalent Person (EP) is defined as the quantity and/or quality of sewage discharge for a person resident in a detached house. For a non-residential establishment, the EP represents the number of persons who would contribute the same quantity and/or quality of domestic sewage as the non-residential establishment. An Equivalent Tenement (ET) is similar to EP, but instead of a person used in the definition, an occupied detached house is used. For more information, the reader is referred to the *Section 64 Determinations of Equivalent Tenements Guidelines* document published by the Water Directorate.

The residential sewer ET in each sewer catchment is equal to the number of occupied private residential dwellings, estimated from customer billing data. The non-residential ET is calculated by dividing the non-residential winter sewer discharge by the unit residential sewage discharge. EP is then calculated by multiplying ET by the household size for that scheme, from Table 12-5.

The estimated 2020/21 ET and EP for each sewer catchment is given in Table 13-2.

Table 12-5: Narromine sewerage scheme - estimated ET and EP for each sewer catchment

Sewer catchment	ET			EP		
	Res	Non-Res	Total	Res	Non-Res	Total
Narromine SPS1	665	335	**1,000**	1,597	803	**2,400**
Narromine SPS2	455	18	**473**	1,091	44	**1,135**
Narromine SPS3	62	0	**62**	148	0	**148**
Narromine SPS4	1	0	**1**	3	0	**3**
Narromine SPS5	0	37	**37**	0	88	**88**
Narromine SPS6	21	0	**21**	50	0	**50**
Narromine SPS7	13	0	**13**	32	0	**32**
Narromine SPS8	26	0	**26**	61	0	**61**
Narromine SPS9	29	0	**29**	69	0	**69**
Narromine SPS10	0	0	**0**	0	0	**0**
Total to STP	**1,271**	**390**	**1,661**	**3,051**	**936**	**3,987**

12.9 EP and ET projections

The growth strategy for Narromine is discussed in Section 7.5.

Using the growth rates as discussed in Section, the ET projections for each SPS catchment are given in Table 12-6.

Table 12-6: Narromine sewerage scheme – projected ET by SPS catchment

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Residential							
SPS1	673	728	815	873	888	888	888
SPS2	455	455	455	482	482	482	482
SPS3	62	77	77	77	77	77	77
SPS4	1	1	1	1	1	1	1
SPS5	0	0	0	0	0	0	0
SPS6	21	21	21	21	21	21	21
SPS7	13	20	20	20	20	20	20
SPS8	26	26	26	26	26	26	26
SPS9	29	29	29	29	29	29	29
SPS10	14	27	27	27	27	27	27
SPS11	0	34	52	71	78	78	78
Total residential	**1,292**	**1,417**	**1,521**	**1,625**	**1,648**	**1,648**	**1,648**

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Non-residential							
SPS1	335	335	335	335	335	335	335
SPS2	18	18	18	18	18	18	18
SPS3	0	0	0	0	0	0	0
SPS4	7	35	36	36	36	36	36
SPS5	37	40	44	47	51	51	51
SPS6	0	0	0	0	0	0	0
SPS7	0	0	0	0	0	0	0
SPS8	0	0	0	0	0	0	0
SPS9	0	0	0	0	0	0	0
SPS10	0	0	0	0	0	0	0
SPS11	0	0	0	0	0	0	0
Total non-residential	**397**	**428**	**433**	**436**	**439**	**439**	**439**
Total							
SPS1	1,007	1,063	1,149	1,208	1,223	1,223	1,223
SPS2	473	473	473	500	500	500	500
SPS3	62	77	77	77	77	77	77
SPS4	8	37	37	37	37	37	37
SPS5	37	40	44	47	51	51	51
SPS6	21	21	21	21	21	21	21
SPS7	13	20	20	20	20	20	20
SPS8	26	26	26	26	26	26	26
SPS9	29	29	29	29	29	29	29
SPS10	14	27	27	27	27	27	27
SPS11	0	34	52	71	78	78	78
Total to Narromine STP	**1,689**	**1,845**	**1,954**	**2,061**	**2,088**	**2,088**	**2,088**

The 30-year residential and non-residential EP projections for the Narromine SS are presented in Table 12-7. The ET projections from the above table have been converted to EP by multiplying by the projected household size in Narromine. The full EP projections for each SPS catchment are given in Appendix E.2.

Table 12-7: Narromine sewerage scheme – projected EP by user class

User class	2022	2027	2032	2037	2042	2047	2052
Residential	3,101	3,401	3,651	3,901	3,956	3,956	3,956
Non-residential	953	1,028	1,039	1,046	1,055	1,055	1,055
Total	**4,054**	**4,429**	**4,690**	**4,947**	**5,010**	**5,010**	**5,010**

12.10 Sewer system flow projections

12.10.1 System ADWF projections

The estimated ADWF projections for the Narromine SS are shown in Table 12-8. The ADWF has been projected using the unit hydraulic load of 168 L/EP/day, calculated from Section 12.3.

Table 12-8: Narromine sewerage scheme – projected ADWF by SPS catchment (kL/day)

SPS catchment	2022	2027	2032	2037	2042	2047	2052
SPS1	406	429	464	487	493	493	493
SPS2	191	191	191	202	202	202	202
SPS3	25	31	31	31	31	31	31
SPS4	3	15	15	15	15	15	15
SPS5	15	16	18	19	20	20	20
SPS6	8	8	8	8	8	8	8
SPS7	5	8	8	8	8	8	8
SPS8	10	10	10	10	10	10	10
SPS9	12	12	12	12	12	12	12
SPS10	5	11	11	11	11	11	11
SPS11	0	14	21	28	32	32	32
Total to Narromine STP	**681**	**744**	**788**	**831**	**842**	**842**	**842**

See Appendix E.3 for more detailed ADWF projections.

12.10.2 System PDWF projections

The projected PDWF for the Narromine SS is shown in Table 12-9. The projected PDWF was calculated using the Public Works Sewer Design Manual where the total ETs were taken from Table 12-6.

Table 12-9: Narromine sewerage scheme – projected PDWF (kL/hr)

STP	2022	2027	2032	2037	2042	2047	2052
Narromine	74	82	86	90	91	91	91

12.10.3 System PWWF projections

The projected PWWF for the Narromine SS is shown in Table 12-10. The projected PWWF was calculated using the Public Works Sewer Design Manual where the total ETs were taken from Table 12-6. It should be noted that the PWWF reported here is the combined PWWF from all sewer catchments in Narromine and does not take into account the SPS pump rates. The PWWF to each SPS catchment is assessed later in Section 12.11.2.

Table 12-10: Narromine sewerage scheme – projected PWWF (L/s)

STP	2022	2027	2032	2037	2042	2047	2052
Narromine	119	130	137	144	146	146	146

12.11 SPS current performance and projections

The specifications for the SPS in Narromine are shown in Appendix E.1. The current SPS performance is assessed with respect to the following factors:

- the pump run time in dry weather and weather – to assess the capacity
- the emergency storage volume – to assess if the response time is adequate
- the odour/septicity potential in the rising main.

12.11.1 Pump run time in dry weather

As a rule of thumb PWWF is around seven times ADWF for a gravity system, therefore if a pump is running more than three hours at ADWF it may indicate that the SPS may not have the capacity to pump out the excess flow during wet weather, and sewage overflow may occur.

The results are given in Table 12-11. Instances where the average daily pump run time exceeds three hours is highlighted in red.

Table 12-11: Narromine sewerage scheme – SPS projections – pump run time (hours)

SPS catchment	Pump rate (L/s)	2022	2027	2032	2037	2042	2047	2052
SPS1	**46.0**	4.1	4.5	4.8	5.0	5.1	5.1	5.1
SPS2	**14.2**	3.7	4.0	4.1	4.5	4.6	4.6	4.6
SPS3	**36.3**	0.2	0.2	0.2	0.2	0.2	0.2	0.2
SPS4	**21.2**	0.0	0.2	0.2	0.2	0.2	0.2	0.2
SPS5	**4.7**	0.9	0.9	1.1	1.1	1.2	1.2	1.2
SPS6	**22.2**	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SPS7	**6.4**	0.2	0.4	0.4	0.4	0.4	0.4	0.4
SPS8	**3.2**	0.9	0.9	0.9	0.9	0.9	0.9	0.9
SPS9	**8.1**	0.4	0.4	0.4	0.4	0.4	0.4	0.4
SPS10	**2.8**	0.5	1.1	1.1	1.1	1.1	1.1	1.1
SPS11	**5.8**	0.0	0.7	1.0	1.4	1.5	1.5	1.5

SPS 1 and 2 are expected to have exceeded three hours of pump run time daily, and is expected to increase slightly due to growth in the next 30 years. Potential issue

12.11.2 Pump rate compared to PWWF

The PWWF in each SPS catchment is calculated using the method in the Public Works Sewer Design Manual. A PDWF and storm allowance is calculated for each catchment based on the estimate ET, which combined give the PWWF.

The PWWF to each SPS is shown in Figure 12-10. The PWWF in each catchment is shown in red text.

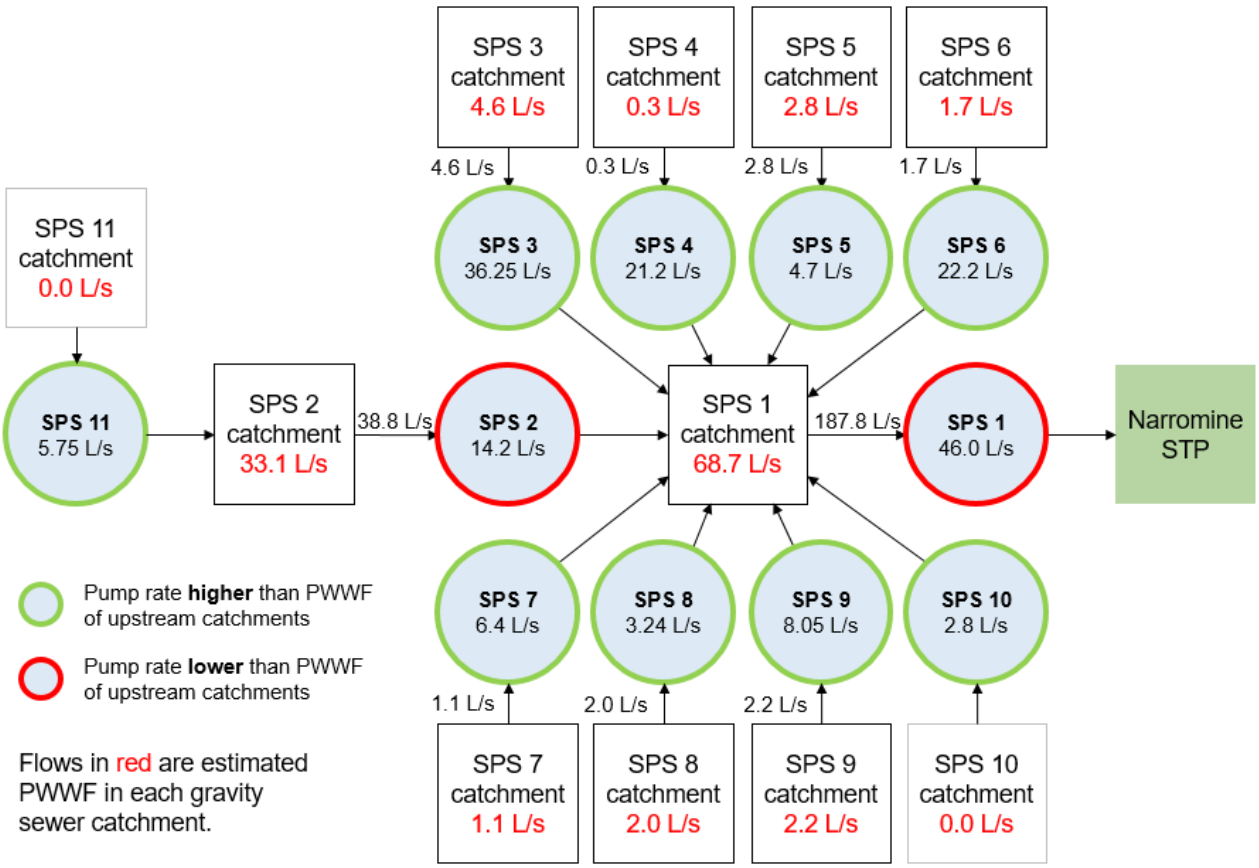

Figure 12-10: Estimated PWWF to each SPS in Narromine SS

From the PWWF assessment, the following SPS may be undersized to pump wet weather flows:

- SPS 1 (46.0 L/s) – the PWWF from all catchments is estimated to be 117.0 L/s. Issue
- SPS 2 (14.2 L/s) – the PWWF from the SPS 2 catchment is estimated to be 39.0 L/s. Issue

The following imbalances in the SPS pump rate are also identified:

- The combined pump rate from SPSs 2 to 10 (119 L/s) is higher than the pump rate of SPS 1 (46.0 L/s).

It is noted that there are currently no flows from the SPS 10 and 11 catchments, however due to growth within these two catchments the projected 30-year PWWF will be 2.1 L/s and 5.8 L/s respectively. These are both lower than their respective SPS pump rates.

The PWWF to an SPS was projected using the method in the Public Works sewer design manual and the projected ET in each SPS catchment. The pump rate of any SPS that are directly upstream of the catchment also contribute to the estimated PWWF. The projected PWWF to the SPS is shown in Table 12-12, with instances where the PWWF exceeds the pump rate highlighted in red.

Table 12-12: Narromine sewerage scheme – SPS projections for PWWF to the SPS (L/s)

SPS catchment	Pump rate (L/s)	2022	2027	2032	2037	2042	2047	2052
SPS1	**46.0**	118.6	127.1	133.2	139.2	140.5	140.5	140.5
SPS2	**14.2**	33.1	35.7	36.9	40.1	40.7	40.7	40.7

SPS catchment	Pump rate (L/s)	2022	2027	2032	2037	2042	2047	2052
SPS3	**36.3**	4.6	5.7	5.7	5.7	5.7	5.7	5.7
SPS4	**21.2**	0.8	2.8	2.8	2.8	2.8	2.8	2.8
SPS5	**4.7**	2.8	3.0	3.3	3.6	3.8	3.8	3.8
SPS6	**22.2**	1.7	1.7	1.7	1.7	1.7	1.7	1.7
SPS7	**6.4**	1.1	1.6	1.6	1.6	1.6	1.6	1.6
SPS8	**3.2**	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SPS9	**8.1**	2.2	2.2	2.2	2.2	2.2	2.2	2.2
SPS10	**2.8**	1.2	2.1	2.1	2.1	2.1	2.1	2.1
SPS11	**5.8**	0.0	2.6	3.9	5.2	5.8	5.8	5.8

The pumps at SPS 1 and 2 are estimated to have exceeded their pump duties during PWWF. Issue

12.11.3 Emergency storage time

If a technical issue causes a pump to stop working, the emergency storage volume in the pump well should be able to store the incoming volume of sewage without overflow until Council can restore the operation of the pump. This is an issue when the time before overflow is less than Council's LOS response time target for sewerage incidents.

For 'Priority 1' incidents (failure to contain sewage within the sewer system or any problem affecting a critical user at a critical time), Council has indicated an emergency response time target of 60 minutes during working hours, and 120 minutes after hours (see Section 6.1). The emergency storage time is compared to Council's emergency response time target (1 hour) in Table 12-13. Emergency storage time of less than 1 hour during ADWF conditions are highlighted in red.

Table 12-13: Narromine sewerage scheme – SPS projections for emergency storage time at ADWF (hours)

SPS catchment	Emergency storage volume (m^3)	2022	2027	2032	2037	2042	2047	2052
SPS1	**88.5**	5.2	5.0	4.6	4.4	4.3	4.3	4.3
SPS2	**114.1**	14.4	14.4	14.4	13.6	13.6	13.6	13.6
SPS3	**11.2**	10.8	8.7	8.7	8.7	8.7	8.7	8.7
SPS4	**27.0**	192.5	43.9	43.6	43.6	43.6	43.6	43.6
SPS5	**15.0**	24.3	22.5	20.2	18.9	17.6	17.6	17.6
SPS6	**8.5**	24.1	24.1	24.1	24.1	24.1	24.1	24.1
SPS7	**10.0**	44.9	29.4	29.4	29.4	29.4	29.4	29.4
SPS8	**12.4**	28.9	28.9	28.9	28.9	28.9	28.9	28.9
SPS9	**25.0**	51.6	51.6	51.6	51.6	51.6	51.6	51.6
SPS10	**8.2**	36.1	18.1	18.1	18.1	18.1	18.1	18.1
SPS11	**21.3**	0.0*	37.0	24.5	18.0	16.2	16.2	16.2

*This sewer catchment has recently been developed, therefore there is currently no flows from this catchment. Growth in this catchment will start from 2024.

All SPSs have an emergency storage time greater than Council's LOS response time for sewerage incidents.

12.11.4 Odour/septicity potential

Septicity potential is generally assessed by reviewing sewage detention times in SPS rising mains. According to WSA Guidelines, sewage with a detention time between four and eight hours has a medium risk of septicity, and above eight hours has a high risk of septicity.

The projected rising main detention time are shown in Table 12-14. Detention time greater than four hours, but less than eight hours are highlighted in yellow, and detention time greater than eight hours are highlighted in red.

Table 12-14: Narromine sewerage scheme – SPS projections for rising main detention time (hours)

SPS catchment	Rising main volume (m^3)	2022	2027	2032	2037	2042	2047	2052
SPS1	**217.9**	7.7	7.0	6.6	6.3	6.2	6.2	6.2
SPS2	**6.9**	0.9	0.8	0.8	0.7	0.7	0.7	0.7
SPS3	**0.1**	0.1	0.0	0.0	0.0	0.0	0.0	0.0
SPS4	**18.9**	134.8	30.7	30.5	30.5	30.5	30.5	30.5
SPS5	**7.0**	11.3	10.5	9.4	8.8	8.2	8.2	8.2
SPS6	**2.2**	6.3	6.3	6.3	6.3	6.3	6.3	6.3
SPS7	**0.3**	1.5	1.0	1.0	1.0	1.0	1.0	1.0
SPS8	**16.9**	39.4	39.4	39.4	39.4	39.4	39.4	39.4
SPS9	**4.2**	8.7	8.7	8.7	8.7	8.7	8.7	8.7
SPS10	**Unknown***	-	-	-	-	-	-	-
SPS11	**3.6**	0.0^	6.3	4.2	3.0	2.7	2.7	2.7

*Rising main diameter provided however rising main length could not be found, therefore the rising main volume could not be calculated.

^This sewer catchment has recently been developed, therefore there is currently no flows from this catchment. Growth in this catchment will start from 2024.

The estimated detention time in the rising mains for SPS 4, 5, 8 and 9 are currently over eight hours, which indicates a high risk of odour and septicity issues. Potential issue

The estimated detention time in the rising mains for SPS 1 and 6 are currently over four hours, which indicates a medium risk of odour and septicity issues. Potential issue

The estimated detention time in the rising main for SPS 11 is currently over four hours, indicating a medium risk of odour and septicity issues. However, this is not an issue as the SPS 11 catchment has recently been developed, with growth anticipated to occur within this catchment, the risk of odour and septicity will downgrade to low risk by 2037.

12.12 STP current performance and projections

The Narromine STP has a design capacity of 5,000 EP. The design hydraulic loading is 1,000 kL/day (at 200 L/EP/day) and the design biological loading is 300kg BOD/day (at 60g BOD/EP/day).

The projected hydraulic and biological loading to the STP is shown in Figure 12-11.

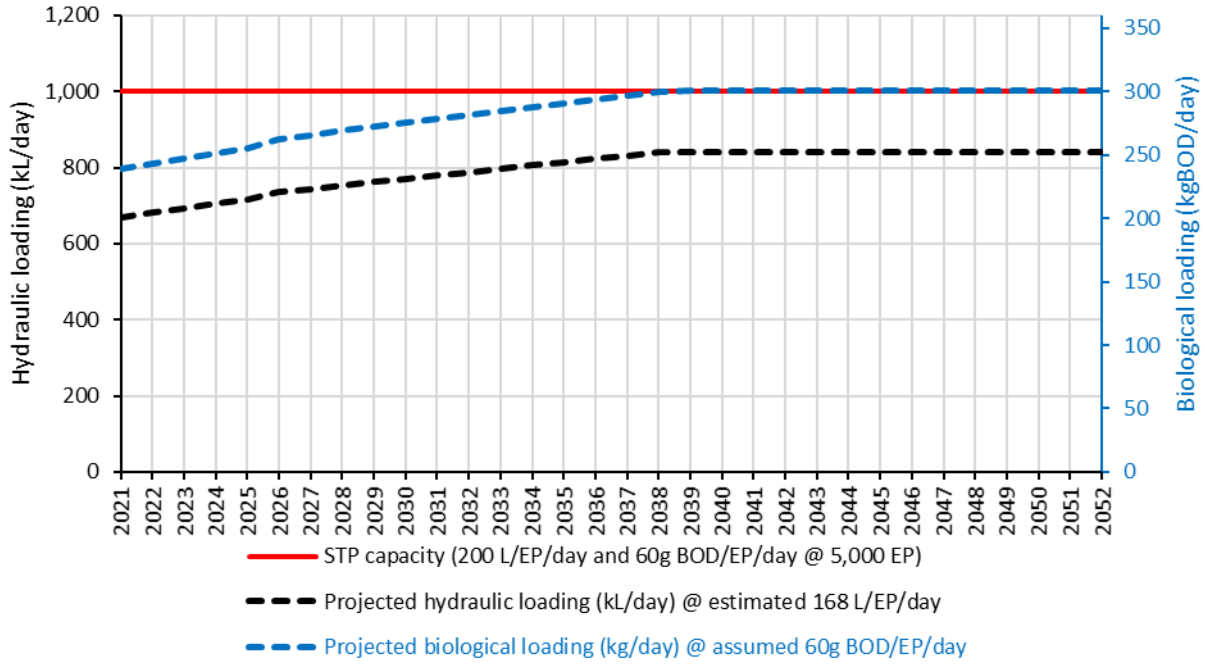

Figure 12-11: Narromine STP - projected loadings against STP design capacity

From the figure above, the 30-year projected biological loading is on the STP capacity. The STP has sufficient capacity to handle the 30-year projected hydraulic loading.

12.13 Work Health and Safety

To be completed once APV condition assessment is completed and provided

13. Trangie Sewerage Scheme

13.1 Sewage collection and transfer

Trangie has a gravity collection sewage system that services a catchment made up of urban and light industrial properties. This system comprises of 11.8 km of gravity collection mains with 201 manholes, 4 pump stations and 2.78 km of pressure mains. The four SPSs are all fitted with twin submersible pumps of various sizes between 10 and 20 L/s capacity with head of 25 metres and are telemetry controlled and monitored.

The existing serviced area of the Trangie sewerage scheme is shown in Figure 13-1, and the SPS pump hierarchy diagram is shown in Figure 13-2.

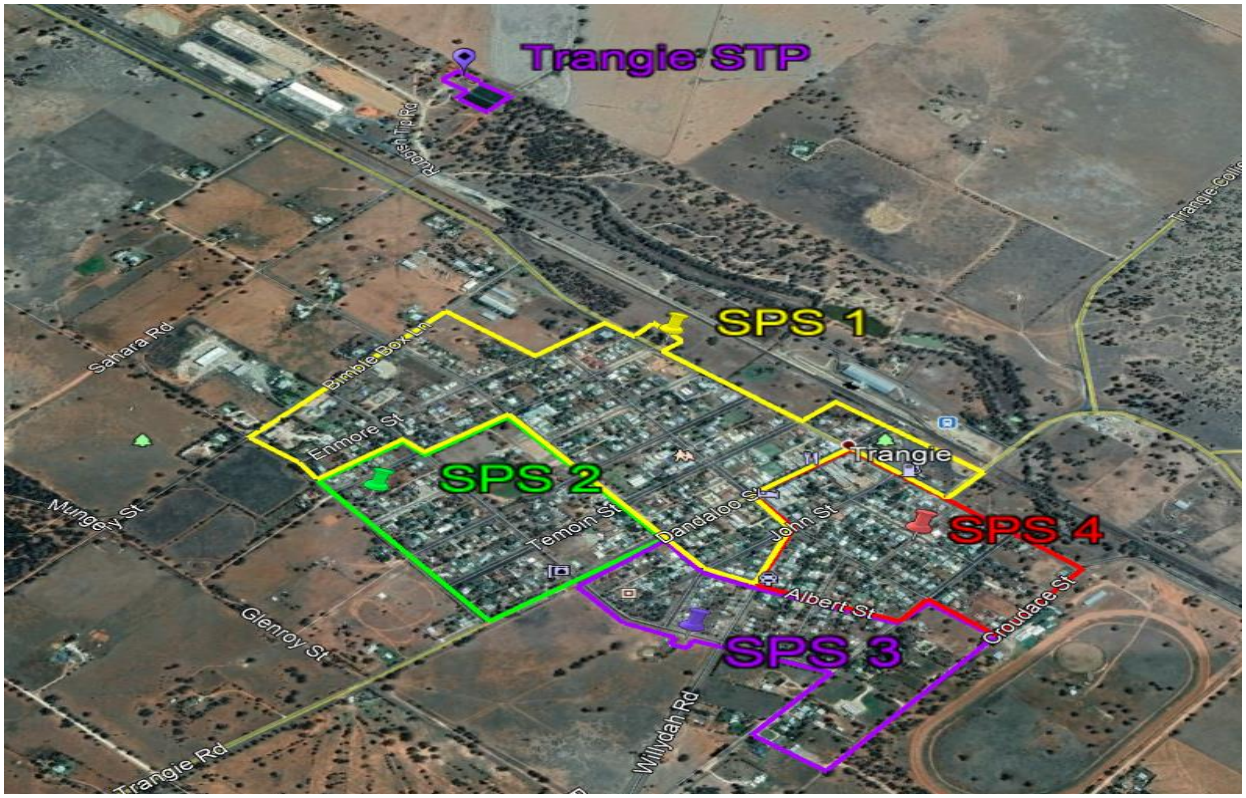

Figure 13-1: Trangie sewerage transfer system

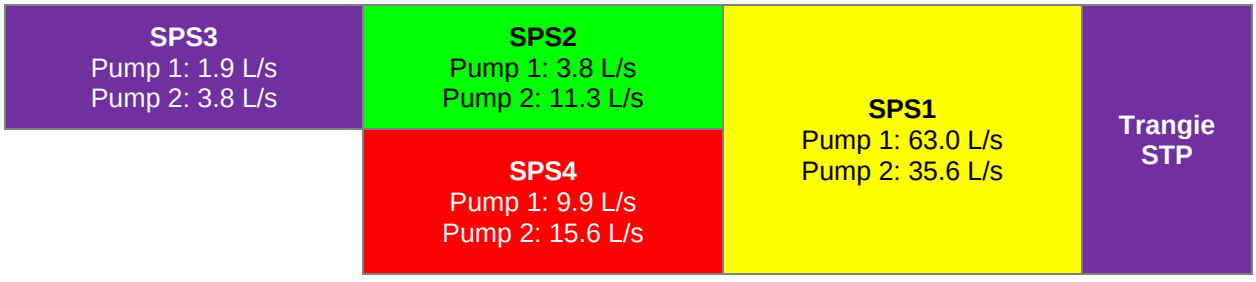

Figure 13-2: Trangie SPS pump hierarchy

The system utilises the relay pumping model where the pump stations pump from one sector to another prior to the final station in the system which then pumps to the STP. In the event of problems at one station, the upstream systems may be impacted. Therefore, a feature of the control of SPS 1, 2 and 3 is the ability to inhibit the upstream stations.

13.2 Sewage treatment

13.2.1 STP description

The Trangie STP is a Pasveer Channel activated sludge treatment plant built in 1977 which has undergone significant maintenance over the last three years including full refurbishment of both aeration pontoons, replacement of the sludge pump and refurbishment of the decant lift system. The current STP has a design capacity of 1,000 EP based on a unit hydraulic loading of 240 L/EP/day and a standard biological loading of 70g BOD/EP/day [18].

- Bar screening
- Pasveer P1000 Aeration Channel
- Two maturation ponds
- Two sludge ponds

Ongoing investigation into effluent discharge quality is also underway and may lead to further capital works.

An aerial image showing the existing STP layout along with the STP process flow diagram is shown in Figure 13-3 and Figure 13-4 respectively.

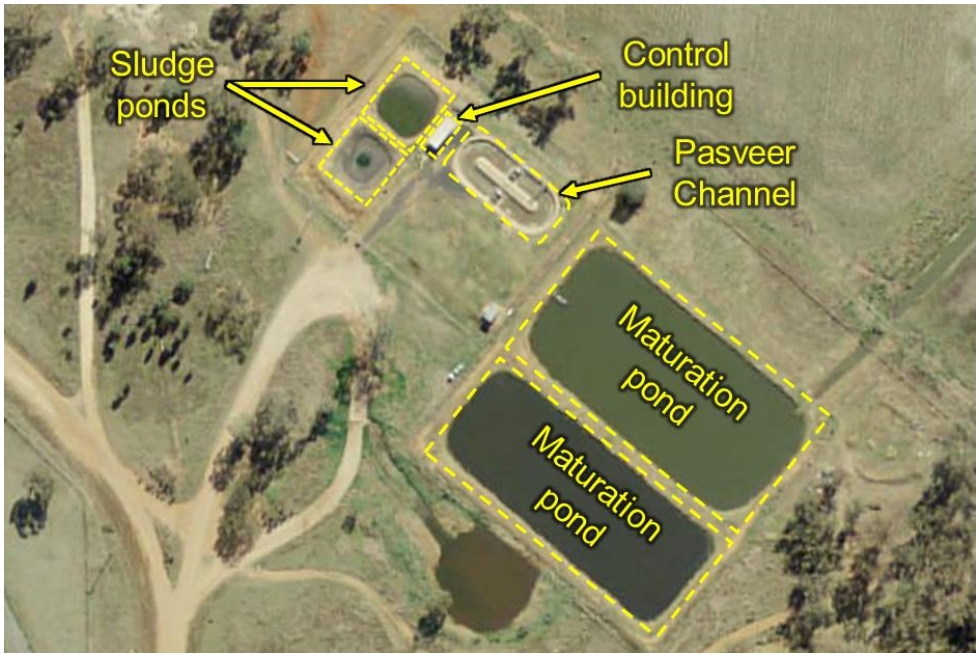

Figure 13-3: Trangie STP aerial photo

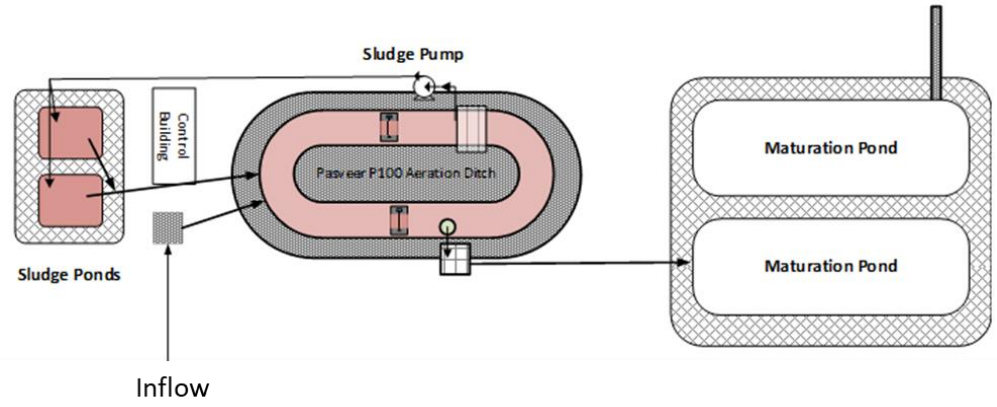

Figure 13-4: Trangie STP process flow diagram

A new main switchboard, control system and digital telemetry system was installed in early 2020 with plans in place to install online mixed liquor suspended solids, dissolved oxygen and discharge water quality monitoring systems during the 2021 financial year.

Further plans for 2021 are the design and construction of new inlet works to include a grit and screenings system. This is a much-needed WHS upgrade from the primitive bar screen that requires daily manual raking. Ongoing investigation into effluent discharge quality is also underway and may lead to further capital works.

Previous reports have been undertaken into the need for a replacement plant and this consideration may need to be made following on from the completion of this IWCM Strategy

13.2.2 Historical flows

STP inflow is recorded at the flowmeter of SPS1, there is no monitoring at the STP. Daily data was available from December 2016 to April 2021. Daily rainfall data is obtained from the Bureau of Meteorology (BOM weather station number 51049 – Trangie Research Station AWS).

The historical sewage inflow to the Trangie STP is shown in Figure 13-5 and Figure 13-6.

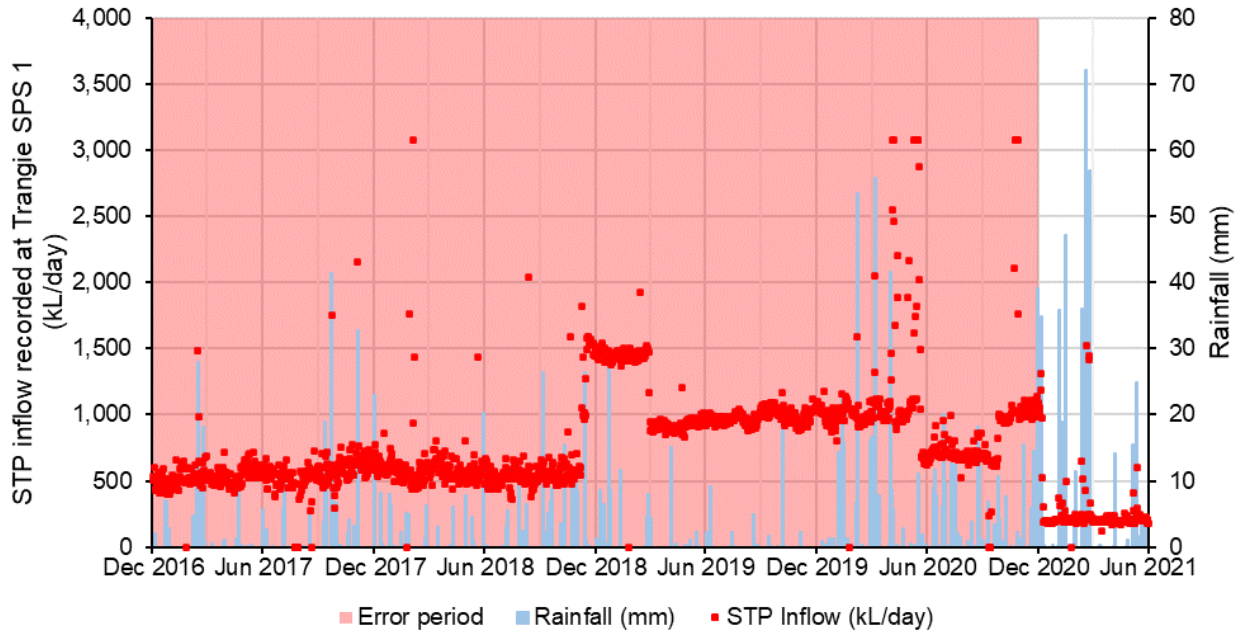

Figure 13-5: Historical daily sewage inflow to the Trangie STP and rainfall

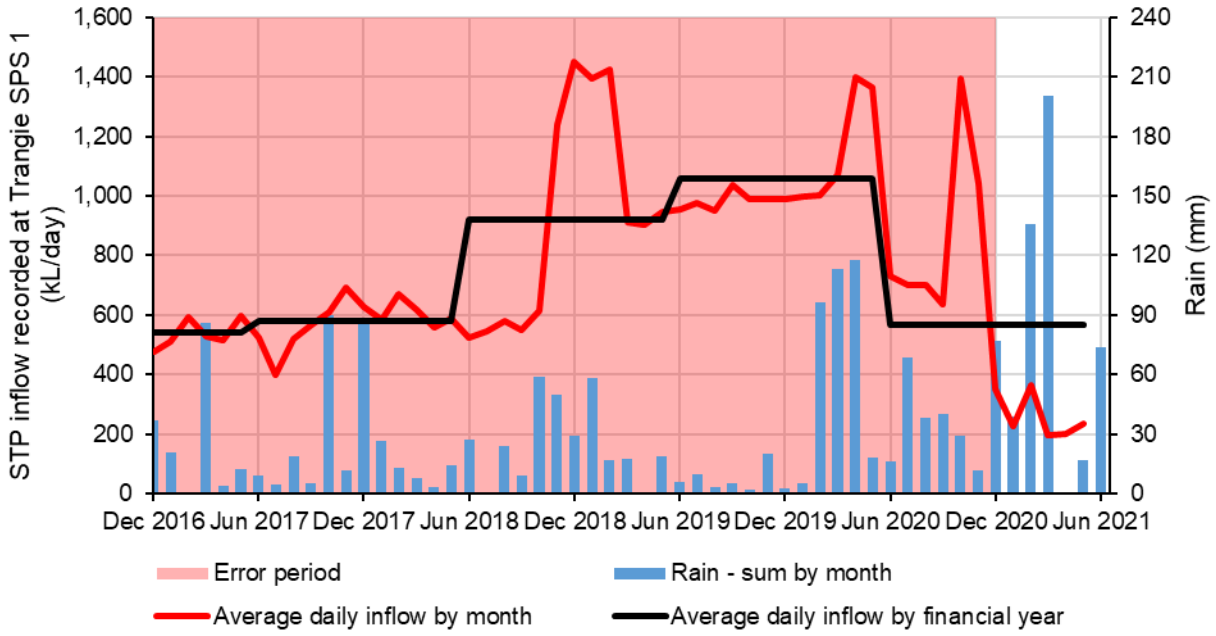

Figure 13-6: Historical monthly sewage inflow to the Trangie STP and rainfall

Council has advised that the STP inflow recorded after January 2021 are the correct readings. Errors in the historical STP inflow data were due to broken gate valves and non-return valves at the SPSs at around December 2018, with the replacement of the SPS gate valves done in December 2020.

13.3 STP inflow analysis

Average dry weather flow (ADWF) estimated from STP inflow data

STP daily inflow data was analysed to estimate the average dry weather flow (ADWF). To estimate historical ADWF, a dry day was taken as a day with less than 2 mm of rainfall on that day, any of the five preceding days and one day following. All historical rainfall data was obtained from the Bureau of Meteorology (BOM).

As Council has advised that the Trangie STP inflow data had correct readings after January 2021, all previous financial years from this date were disregarded due to inaccurate readings.

Based on the STP inflow data from January to June 2021, the ADWF for the Trangie STP is around 190 kL/day.

ADWF estimated from customer billing data

The ADWF was also estimated from the water billing data as a cross-check. For residential users, all internal water consumption is assumed to be discharged to the sewer. For non-residential users, the sewer load was estimated by taking the winter demand as the sewage output.

The 2020/21 ADWF estimated from the water billing data is:

- Residential sewage load = 75.5 kL/day
- Non-residential sewage load = 65.5 kL/day
- Total estimated ADWF = 140.9 kL/day

The ADWF estimated from the water billing data (141 kL/day) is lower than the ADWF estimated from STP inflow data (190 kL/day), by a difference of around 26%. This is expected as residents in Trangie are more conscious of the water quality regarding the taste and odour, which results in low internal water consumption (see Section 10.6.2). Instead, residents are consuming water from

rainwater tanks, which when combined with internal water demand means that the sewage unit loading is higher than compared to the unit internal water demand.

Nominated ADWF and unit hydraulic loading

The ADWF estimated from STP inflow data, **190 kL/day**, is the nominated ADWF for the Trangie SS, which will be used as the starting point for projections.

The total Equivalent Person (EP) for the Trangie SS has been estimated as **1,082 EP**, which is explained in more detail in Section 12.8. Using this EP, the unit sewage loading is calculated to be **176 L/EP/day**. This value is lower than compared to other NSW country town sewerage systems.

Peak dry weather flow (PDWF)

Calculated values for peak dry weather flow (PDWF) are based on the methodology in the Public Works sewer design manual.

The total Equivalent Tenement (ET) for the Trangie SS has been estimated as **492 ET**, which is explained in more detail in Section 13.7. The peaking factor ('r') was calculated to be 2.5 using the scheme total ET, and the PDWF was estimated to be 5.6 L/s.

Peak wet weather flow (PWWF)

Trangie SPS 1 is the only SPS that pumps directly to the Trangie STP. This SPS contains two pumps with flow rates of 35.6 and 63.0 L/s. During wet weather, the pump with the highest pump rate, 63.0 L/s, will be the peak wet weather flow (PWWF) at the STP.

The PWWF in each SPS catchment is calculated using the method in the Public Works sewer design manual. The results are provided in Section 13.9.3. The PWWF from all catchments in the Trangie SS is estimated to be 34.1 L/s.

Historical wet weather flows at the Trangie STP

Based on the historical STP inflow data that was deemed by Council to be accurate readings (from January 2021 to June 2021), the highest sewage inflow into the Trangie STP was 1,521 kL/day recorded on the 19 March 2021. The wet weather event was not a rare event (1 in 2 years), with 76.6 mm rainfall falling over two days.

13.3.1 Biological and nutrient loading

The normal range for BOD load in small communities is 55 to 65g BOD/EP/day. Where specific data is not available, a BOD loading of 60 g/EP/day is considered for Council's sewerage schemes.

72-hour flow monitoring would provide an accurate estimate of the actual biological and nutrient loading to the STP.

13.3.2 Section 61 inspections and recommendations

No Section 61 inspection report was available from DPE Water regarding Trangie STP.

13.4 STP capacity assessment

Pasveer Channel

The design capacity of the Pasveer Channel is 1,000 EP at the design BOD unit loading of 70 g/EP/day. From Section 13.3.1, the nominated BOD unit loading was taken to be 60 g/EP/day for Trangie STP. Using this, the assessed capacity of the Pasveer Channel at 60g BOD/EP/day was calculated to be about 1,167 EP, which is higher than both the current loading (1,082 EP) and the 30-year projected loading (1,106 EP).

Effluent ponds

Effluent from the Pasveer Channel is transferred to the maturation ponds, where it is disposed of by evaporation. Therefore, the maturation ponds were assessed as evaporation ponds.

For assessing the current capacity of the evaporation ponds at the STP, PWA used historical daily rainfall and evaporation data from 1956 to 2018 to develop a water balance model of a hypothetical evaporation pond at Trangie. The model considers the sewage load (including wet weather flows), mass balances over the STP ponds, and effluent loss by evaporation. The model calculated that for every kilolitre of ADWF going into the STP, around 504 m^2 of evaporation pond area is required to dispose of the effluent, while reducing overflows to occur not more frequently than in 50% of years, as required for low strength effluent by the DEC Guidelines [19].

The current capacity assessment for the effluent ponds at the STP is shown in Table 13-1.

Table 13-1: Capacity assessment of the effluent ponds in the Trangie STP

	Units	Value
Pond area at top water level	m^2	6,130
Hydraulic capacity @ 504 m^2 per kilolitre of ADWF	kL/day	12
Assessed capacity @ 176 L/EP/day	**EP**	**69**

The assessed capacity of the effluent ponds is lower than both the current loading (1,082 EP) and the 30-year projected loading (1,106 EP). Council has indicated that they are currently discussing this issue with DPE Water.

13.5 Effluent management

13.5.1 Discharge to the environment

Treated effluent from the Pasveer Channel gravitates to the maturation ponds, where it is disposed of by evaporation.

Overflows from the maturation pond is discharged via the effluent outlet structure where it flows along a 2 km effluent discharge channel and terminates at the Trangie Agricultural Research Station. Council advised that this could have potential WHS and environmental risks as the overflows are uncontrolled and discharged through an area where access by livestock and potentially human contact is possible. Issue

13.5.2 Environment Protection Licence requirements

Council does not hold an EPL for the Trangie STP, as the flow to the STP is less than 750 kL/day. Council advised that they are currently reviewing this.

13.6 Biosolids management

Mixed liquor is wasted from the Pasveer Channel by waste activated sludge (WAS) pumping into one of the two sludge lagoons during the aeration phase of the operation cycle. The sludge lagoons are used to store and stabilise the sludge. The supernatant liquor displaced from the top of the lagoon is drawn off at the lagoon surface and gravitates back to the Pasveer Channel for further treatment.

Council advised that the sludge beds are dried, then the dry waste is excavated and buried at the landfill. Based on the STP process, it is expected that the biosolids are classified as Stabilisation Grade C, and hence classified as Contaminant Grade E, which is not suitable for use, based on the NSW EPA Guidelines for Use and Disposal of Biosolids Products. [17]

13.7 EP and ET estimates

An Equivalent Person (EP) is defined as the quantity and/or quality of sewage discharge for a person resident in a detached house. For a non-residential establishment, the EP represents the number of persons who would contribute the same quantity and/or quality of domestic sewage as the non-residential establishment. An Equivalent Tenement (ET) is similar to EP, but instead of a person used in the definition, an occupied detached house is used.

The residential sewer ET in each sewer catchment is equal to the number of occupied private residential dwellings, estimated from customer billing data. The non-residential ET is calculated by dividing the non-residential winter sewer discharge by the unit residential sewage discharge. EP is then calculated by multiplying ET by the household size for that scheme, from Table 7-2.

The estimated 2021/22 ET and EP for each sewer catchment is given in Table 13-2.

Table 13-2: Trangie sewerage scheme - estimated ET and EP for each sewer catchment

Sewer catchment	ET			EP		
	Res	Non-Res	Total	Res	Non-Res	Total
Trangie SPS1	131	102	**233**	288	223	**512**
Trangie SPS2	52	33	**85**	115	73	**188**
Trangie SPS3	58	3	**61**	128	7	**135**
Trangie SPS4	81	32	**113**	178	70	**248**
Total to STP	**323**	**169**	**492**	**710**	**373**	**1,082**

13.8 EP and ET projections

The growth strategy for Trangie is discussed in Section 7.5.

Using the growth rates as discussed in Section, the ET projections for each SPS catchment are given in Table 13-3.

Table 13-3: Trangie sewerage scheme – projected ET by SPS catchment

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Residential							
SPS1	133	137	147	155	155	155	155
SPS2	52	52	52	52	52	52	52
SPS3	58	58	58	58	58	58	58
SPS4	81	81	81	81	81	81	81
Total residential	**325**	**329**	**339**	**347**	**347**	**347**	**347**
Non-residential							
SPS1	102	102	102	102	102	102	102
SPS2	33	33	33	33	33	33	33
SPS3	3	3	3	3	3	3	3
SPS4	32	32	32	32	32	32	32
Total non-residential	**169**	**169**	**169**	**169**	**169**	**169**	**169**
Total							
SPS1	235	239	249	257	257	257	257
SPS2	85	85	85	85	85	85	85
SPS3	61	61	61	61	61	61	61
SPS4	113	113	113	113	113	113	113
Total to Trangie STP	**494**	**498**	**508**	**516**	**516**	**516**	**516**

The 30-year residential and non-residential EP projections for the Trangie SS are presented in Table 13-4. The ET projections from the above table have been converted to EP by multiplying by the projected household size in Trangie. The full EP projections for each SPS catchment are given in Appendix E.2.

Table 13-4: Trangie sewerage scheme – projected EP by user class

User class	2022	2027	2032	2037	2042	2047	2052
Residential	714	723	745	762	762	762	762
Non-residential	373	373	373	373	373	373	373
Total	**1,087**	**1,096**	**1,118**	**1,135**	**1,135**	**1,135**	**1,135**

13.9 Sewer system flow projections

13.9.1 System ADWF projections

The estimated ADWF projections for the Trangie SS are shown in Table 13-5. The ADWF has been projected using the unit hydraulic load of 176 L/EP/day, calculated from Section 13.3.

Table 13-5: Trangie sewerage scheme – projected ADWF by SPS catchment (kL/day)

SPS catchment	2022	2027	2032	2037	2042	2047	2052
SPS1	91	92	96	99	99	99	99
SPS2	33	33	33	33	33	33	33
SPS3	24	24	24	24	24	24	24
SPS4	44	44	44	44	44	44	44
Total to Trangie STP	**191**	**192**	**196**	**199**	**199**	**199**	**199**

See Appendix E.3 for more detailed ADWF projections.

13.9.2 System PDWF projections

The projected PDWF for the Trangie SS is shown in Table 13-6. The projected PDWF was calculated using the Public Works Sewer Design Manual where the total ETs were taken from Table 13-3.

Table 13-6: Trangie sewerage scheme – projected PDWF (kL/hr)

STP	2022	2027	2032	2037	2042	2047	2052
Trangie	24.6	24.7	25.1	25.4	25.4	25.4	25.4

13.9.3 System PWWF projections

The projected PWWF for the Trangie SS is shown in Table 13-7. The projected PWWF was calculated using the Public Works Sewer Design Manual where the total ETs were taken from Table 13-3. It should be noted that the PWWF reported here is the combined PWWF from all sewer catchments in Trangie and does not take into account the SPS pump rates. The PWWF to each SPS catchment is assessed later in Section 13.10.3.

Table 13-7: Trangie sewerage scheme – projected PWWF (L/s)

STP	2022	2027	2032	2037	2042	2047	2052
Trangie	35	36	36	37	37	37	37

13.10 SPS current performance and projections

13.10.1 SPS specifications

The specifications for the SPS in Trangie are shown in Appendix E.1. The current SPS performance is assessed with respect to the following factors:

- the pump run time in dry weather and weather – to assess the capacity
- the emergency storage volume – to assess if the response time is adequate
- the odour/septicity potential in the rising main.

13.10.2 Pump run time in dry weather

As a rule of thumb PWWF is around seven times ADWF for a gravity system, therefore if a pump is running more than three hours at ADWF it may indicate that the SPS may not have the capacity to pump out the excess flow during wet weather, and sewage overflow may occur.

The results are given in Table 13-8. Instances where the average daily pump run time exceeds three hours is highlighted in red.

Table 13-8: Trangie sewerage scheme – SPS projections – pump run time (hours)

SPS catchment	Pump rate (L/s)	2022	2027	2032	2037	2042	2047	2052
SPS1	**49.3**	1.1	1.1	1.1	1.1	1.1	1.1	1.1
SPS2	**7.6**	2.1	2.1	2.1	2.1	2.1	2.1	2.1
SPS3	**2.9**	2.3	2.3	2.3	2.3	2.3	2.3	2.3
SPS4	**12.8**	0.9	0.9	0.9	0.9	0.9	0.9	0.9

All SPSs have an estimated pump run time below three hours daily.

13.10.3 Pump rate compared to PWWF

The PWWF in each SPS catchment is calculated using the method in the Public Works Sewer Design Manual. A PDWF and storm allowance is calculated for each catchment based on the estimate ET, which combined give the PWWF.

The PWWF to each SPS is shown in Figure 13-7. The PWWF in each catchment is shown in red text.

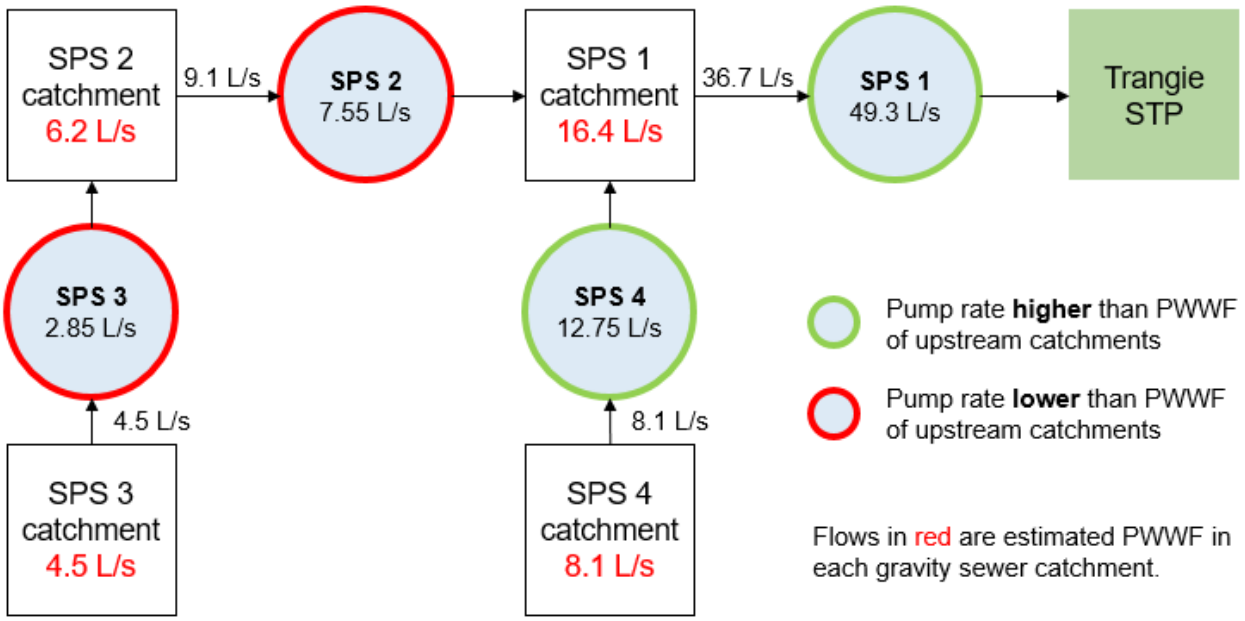

Figure 13-7: Estimated PWWF to each SPS in Trangie SS

From the PWWF assessment, the following SPS may be undersized to pump wet weather flows:

- SPS 2 (7.55 L/s) – the PWWF from the SPS 2 catchment is estimated to be 6.2 L/s. However, with the pump flow rate from the SPS 3 going into the SPS 2 catchment, this will be 9.1 L/s (6.2 L/s + 2.85 L/s). Issue
- SPS 3 (2.85 L/s) – the PWWF from the SPS 3 catchment is estimated to be 4.5 L/s. Issue

The PWWF to an SPS was projected using the method in the Public Works sewer design manual and the projected ET in each SPS catchment. The pump rate of any SPS that are directly upstream of the catchment also contribute to the estimated PWWF. The projected PWWF to the SPS is shown in Table 13-9, with instances where the PWWF exceeds the pump rate highlighted in red.

Table 13-9: Trangie sewerage scheme – SPS projections for PWWF to the SPS (L/s)

SPS catchment	Pump rate (L/s)	2022	2027	2032	2037	2042	2047	2052
SPS1	**49.3**	31.0	31.2	31.9	32.5	32.5	32.5	32.5
SPS2	**7.6**	10.8	10.8	10.8	10.8	10.8	10.8	10.8
SPS3	**2.9**	4.5	4.5	4.5	4.5	4.5	4.5	4.5
SPS4	**12.8**	8.1	8.1	8.1	8.1	8.1	8.1	8.1

The pumps at SPS 2 and 3 are estimated to have exceeded their pump duties during PWWF. Issue

13.10.4 Emergency storage time

If a technical issue causes a pump to stop working, the emergency storage volume in the pump well should be able to store the incoming volume of sewage without overflow until Council can restore the operation of the pump. This is an issue when the time before overflow is less than Council's LOS response time target for sewerage incidents.

For 'Priority 1' incidents (failure to contain sewage within the sewer system or any problem affecting a critical user at a critical time), Council has indicated an emergency response time target of 60

minutes during working hours, and 120 minutes after hours (see Section 6.1). The emergency storage time is compared to Council's emergency response time target (1 hour) in Table 13-10. Emergency storage time of less than 1 hour during ADWF conditions are highlighted in red.

Table 13-10: Trangie sewerage scheme – SPS projections for emergency storage time at ADWF (hours)

SPS catchment	Emergency storage volume (m^3)	2022	2027	2032	2037	2042	2047	2052
SPS1	**38.0**	10.1	9.9	9.5	9.2	9.2	9.2	9.2
SPS2	**15.0**	10.9	10.9	10.9	10.9	10.9	10.9	10.9
SPS3	**18.0**	18.3	18.3	18.3	18.3	18.3	18.3	18.3
SPS4	**15.0**	8.3	8.3	8.3	8.3	8.3	8.3	8.3

*This sewer catchment has recently been developed, therefore there is currently no flows from this catchment. Growth in this catchment will start from 2024.

All SPSs have an emergency storage time greater than Council's LOS response time for sewerage incidents.

13.10.5 Odour/septicity potential

Septicity potential is generally assessed by reviewing sewage detention times in SPS rising mains. According to WSA Guidelines, sewage with a detention time between four and eight hours has a medium risk of septicity, and above eight hours has a high risk of septicity.

The projected rising main detention time are shown in Table 13-11. Detention time greater than four hours, but less than eight hours are highlighted in yellow, and detention time greater than eight hours are highlighted in red.

Table 13-11: Trangie sewerage scheme – SPS projections for rising main detention time (hours)

SPS catchment	Rising main volume (m^3)	2022	2027	2032	2037	2042	2047	2052
SPS1	**42.1**	5.3	5.3	5.2	5.1	5.1	5.1	5.1
SPS2	**4.4**	1.9	1.9	1.9	1.9	1.9	1.9	1.9
SPS3	**4.1**	4.2	4.2	4.2	4.2	4.2	4.2	4.2
SPS4	**4.5**	2.5	2.5	2.5	2.5	2.5	2.5	2.5

The estimated detention time in the rising main for SPS 1 and 3 are currently over four hours, which indicates a medium risk of odour and septicity issues. Potential issue

13.11 STP current performance and projections

The Trangie STP has a design capacity of 1,000 EP. The design hydraulic loading is 240 kL/day (at 240 L/EP/day) and the design biological loading is 70kg BOD/day (at 70g BOD/EP/day).

The projected hydraulic and biological loading to the STP is shown in Figure 13-8.

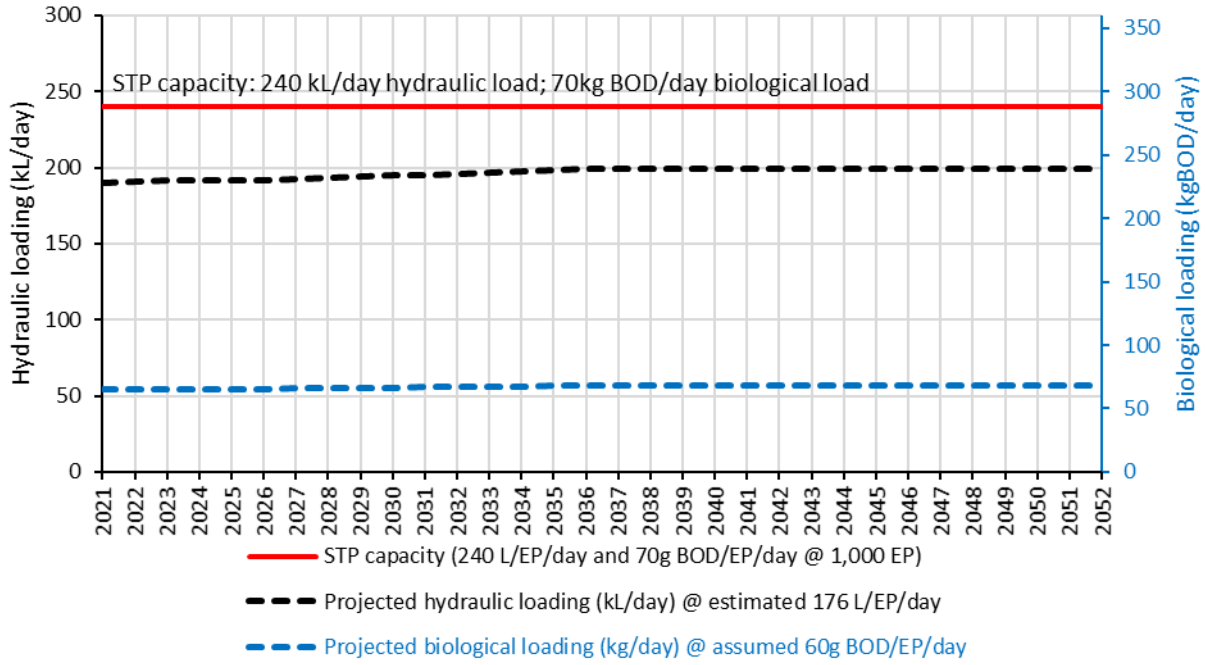

Figure 13-8: Trangie STP - projected loadings against STP design capacity

From the figure above, the STP has sufficient capacity to treat current and the 30-year projected sewage loads.

13.12 Work Health and Safety

To be completed once APV condition assessment is completed and provided

14. Unserviced communities

There are numerous remote small villages and rural localities throughout the LGA without a potable water supply. Residents in these areas predominantly rely on roof rainwater and/or groundwater bores for water supply and during periods of extended drought have water tanked to their homes. These residents treat wastewater using on-site management systems (for example septic tanks). In some areas with reticulated water supply, residents and businesses also use on-site management systems as they may not receive a sewer service.

Council advised that there is no OSSMS Policy. Issue

OSSMS assessment

On-site sewage management systems (OSSMS) were assessed for the unserviced area of Tomingley. A preliminary assessment of the operating environment at Tomingley was undertaken in accordance with the Department of Local Government document "On-site sewage management for single households", Jan 1998. The issues are identified in Table 14-1.

There were no nearby soil profiles that could be found for the unserviced communities. As such, the site drainage was assessed using state-wide land and soil mapping from eSPADE. [20]

Table 14-1: OSSM assessment

Parameter	Site drainage	Lot size	Buffer distance to permanent surface water
OSSMS requirements			
Requirement	Well drained	Well drained soil: minimum 2,000 m^2 Poorly/imperfectly drained soil: 2,000 to 4,000 m^2 Practically impervious soil: minimum 4,000 m^2	Minimum 100 metres
Risk if requirement is not met	Resurfacing hazard (leading to potential human contact)	Public health risk: insufficient area for effluent disposal leading to potential human contact	Contamination of surface water
Village assessment			
Tomingley	Clayey sand in first 60 cm of soil, followed by 70 cm of clay soils, followed by shale and claystone. This is generally poorly drained soil. Potential issue	Clayey sand and clay soils are generally poorly drained soils. Most lots average 1,020 m^2 in the RU5 village zone. Potential issue	Two properties within 100 metres from Gundong Creek. These properties treat sewage via septic tanks and dispose of effluent via surface irrigation and soil absorption. Potential issue

From the assessment above, the soil profile in Tomingley is clayey sand and clay, which are generally poorly drained soils due to their fine particle sizes. Poorly drained soils require a minimum of 2,000 m^2 for effective effluent disposal. This combined with most lots within the RU5 Village zone having an average lot size of 1,020 m^2 means that there is a potential public health risk of insufficient area for effluent disposal, which may come into contact with the public. In addition, there are two properties that are within 100 m from the Gundong Creek. This is an issue if the OSSMS were to fail, where the effluent disposed from the absorption trenches would flow to the creek,

thereby creating a potential risk of contamination of the surface water. Council advised that the Gundong Creek is generally dry and is heavily polluted with high levels of atrazine, therefore the creek is no longer used as a water source for Tomingley.

Council provided their septic register, which contains details of properties that are on OSSMS. In Tomingley, there are 34 properties that are on OSSMS, of which:

- 30 properties are septic tanks, of which 2 properties dispose of their effluent by rubble drains, 20 properties via soil absorption, 7 properties via surface irrigation, and one property via sub-surface irrigation.
- Three properties are pump-out tanks with effluent disposal by soil absorption.
- One property is AWTS (aerated wastewater treatment system) with effluent disposal by surface irrigation.

An aerial image of Tomingley is shown in Figure 14-1.

Figure 14-1: Unserviced community – Tomingley

15. IWCM Issues

15.1 General IWCM system issues

The general IWCM issues are listed in Table 15-1.

Table 15-1: General IWCM issues

Issue type	Target for compliance	Issue
Best practice management	Best practice pricing – tariff structure	Council advised that the access charge for bulk users should be increased.
	Best practice pricing – inclining block tariff	Council does not have step increases in water usage charge.
Levels of service	LOS targets	Council needs to nominate performance indicators and targets for water supply and sewerage services.

15.2 Water supply issues

The water supply IWCM issues are listed in Table 15-2.

Table 15-2: Water supply IWCM issues

Issue type	Target for compliance	Issue
General		
Reliability of supply infrastructure	Capacity / entitlement	Climate change data for the region predicts above 35ºC days will increase by 10-20 days in the near future (2020-2039) and 30-40 days in the far future (2060-2079). This will put additional stress on the water supply system and its ability to meet the target level of service for system reliability during prolonged dry periods.
Narromine Potable WSS		
Reliability of supply infrastructure	Water losses	The infrastructure leakage index (ILI) for the Narromine Potable WSS is 6.7, indicating a high water loss. The water loss is around 264 L/assessment/day, which is approximately three times the state median.
Water quality	Water quality risk assessment	Based on PWA's water quality risk assessment tool, the inherent risk of the Narromine source water catchment is 'Very High, indicating a very high risk to chlorine-sensitive and chlorine-resistant pathogens. This is due to disused uncapped bores close to all of the town water supply bores, along with a large number of failed stock and domestic bores. The residual risk of chlorine-resistant pathogens in the Narromine Potable WSS is very high due to no treatment barriers that control these pathogens in Narromine.
Trangie WSS		
Regulatory	Exceedance of Water Access Licence entitlement	The unrestricted future extraction for the Trangie WSS is expected to already exceeded the WAL entitlement for Trangie (350 ML/year).

Issue type	Target for compliance	Issue
Reliability of supply infrastructure	Water losses	The infrastructure leakage index (ILI) for the Trangie WSS is 12.6, indicating a very high water loss. The water loss is around 455 L/assessment/day, which is about five times the state median.
Tomingley WSS		
No IWCM issues identified in the Tomingley WSS		

15.3 Sewerage system issues

The sewerage IWCM issues are listed in Table 15-3.

Table 15-3: Sewerage system IWCM issues

Issue type	Target for compliance	Issue
General		
Regulatory	On-site sewage management system (OSSMS) policy	Council does not currently have an OSSMS policy.
Narromine SS		
Regulatory	Log reduction value (LRV) assessment based on Narromine STP treatment processes	Based on PWA's preliminary LRV assessment for the Narromine effluent reuse scheme, the current treatment and non-treatment barriers at the Narromine STP do not achieve the target LRV for the removal of protozoa, viruses and bacteria for the irrigation of agricultural non-food crops.
Reliability of infrastructure	STP performance – raw sewage not screened	Council has identified that raw sewage is not screened, and it is unknown what build-up of solids (screenings) and grit has occurred over time.
	STP performance – possible leakage from effluent pond in Narromine STP	Based on PWA's water balance model of Narromine STP for conducting an overflow assessment from the effluent pond, the model calculated effluent pond overflows in every year. Council indicated that the STP ponds have never overflowed, along with no effluent reuse at Narromine since 2015-16. From these considerations, it may potentially be possible that the effluent stored in the ponds are leaking through the clay liner base and into the ground.
	SPS performance – pump run time	Narromine SPS 1 and 2 are estimated to have exceeded three hours of pump run time daily.
	SPS performance – PWWF	Narromine SPS 1 (pump rate 46.0 L/s) – the PWWF from all upstream catchments is estimated to be 117.0 L/s. Narromine SPS 2 (pump rate 14.2 L/s) – the PWWF from the Narromine SPS 2 catchment is estimated to be 39.0 L/s. The pumps at Narromine SPS 1 and 2 are estimated to have exceeded their pump duties during PWWF.

Issue type	Target for compliance	Issue
	SPS performance – septicity analysis	The estimated detention time in the rising mains for Narromine SPS 4, 5, 8 and 9 are currently over eight hours, indicating a high risk of odour and septicity. The estimated detention time in the rising mains for Narromine SPS 1 and 6 are currently over four hours, indicating a medium risk of odour and septicity.
Capacity	Projected load against STP capacity	Due to growth in the Narromine SS, the assessed capacity of the maturation pond in the Narromine STP will be lower than the 30-year projected loading.
Trangie SS		
Performance / Regulatory	Effluent management – discharge to the environment	Effluent overflows from the maturation pond in the Trangie STP flows along a 2 km effluent discharge channel and terminates at the Trangie Agricultural Research Station. Council indicated that this could have potential WHS and environmental risks as the overflows are uncontrolled and discharged through an area where access by livestock and potentially human contact is possible.
Reliability of infrastructure	SPS performance – PWWF	Trangie SPS 2 (pump rate 7.55 L/s) – the PWWF from the Trangie SPS 2 catchment is estimated to be 6.2 L/s. However, with the pump flow rate from the Trangie SPS 3 going into the Trangie SPS 2 catchment, this will be 9.1 L/s. Trangie SPS 3 (pump rate 2.85 L/s) – the PWWF from the Trangie SPS 3 catchment is estimated to be 4.5 L/s. The pumps at Trangie SPS 2 and 3 are estimated to have exceeded their pump duties during PWWF.
	SPS performance – septicity analysis	The estimated detention time in the rising mains for Trangie SPS 1 and 3 are currently over four hours, indicating a medium risk of odour and septicity.
On-site sewage management systems		
Performance / Regulatory	Effluent management	The soil profile in Tomingley is poorly drained due to the presence of clay soils. This combined with most lots within the Tomingley village averaging 1,020 m2 means that there is a potential public health risk due to insufficient area for effluent disposal. There are two properties that are within 100 m from the Gundong Creek. If these OSSMS were to fail, effluent disposed from the absorption trenches would flow to the Gundong Creek, creating a potential contamination risk of surface water.

16. References

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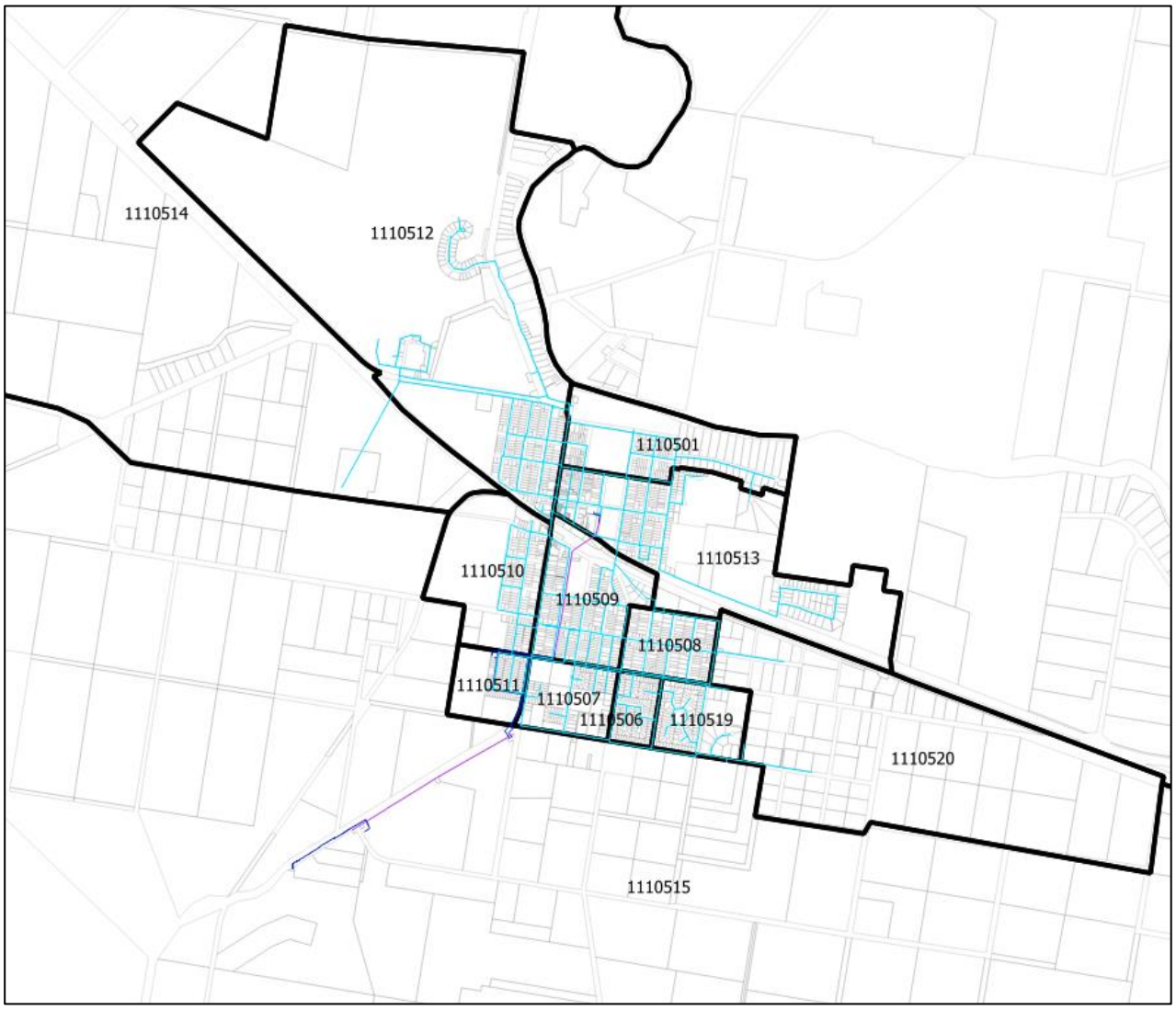
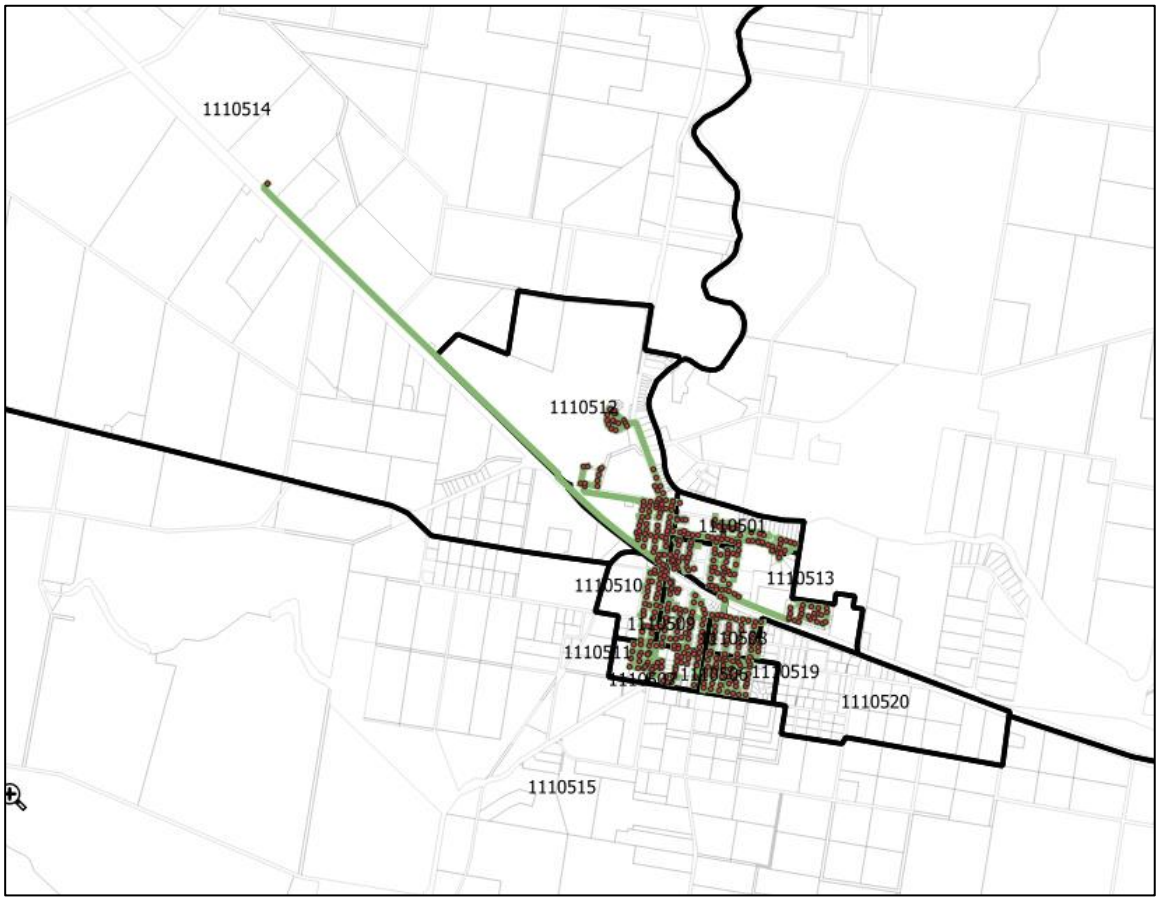
Appendix A ABS SA1 and MB boundaries

A.1 ABS data – Narromine UCL

Appendix Figure A-1 and Appendix Figure A-2 below shows the SA1 boundary from the 2016 ABS Census data, which the boundaries were selected to roughly match the water supply and sewerage service zones respectively for Narromine. It is used to calculate the household size and occupancy ratio shown in Table 7-2 on page 29.



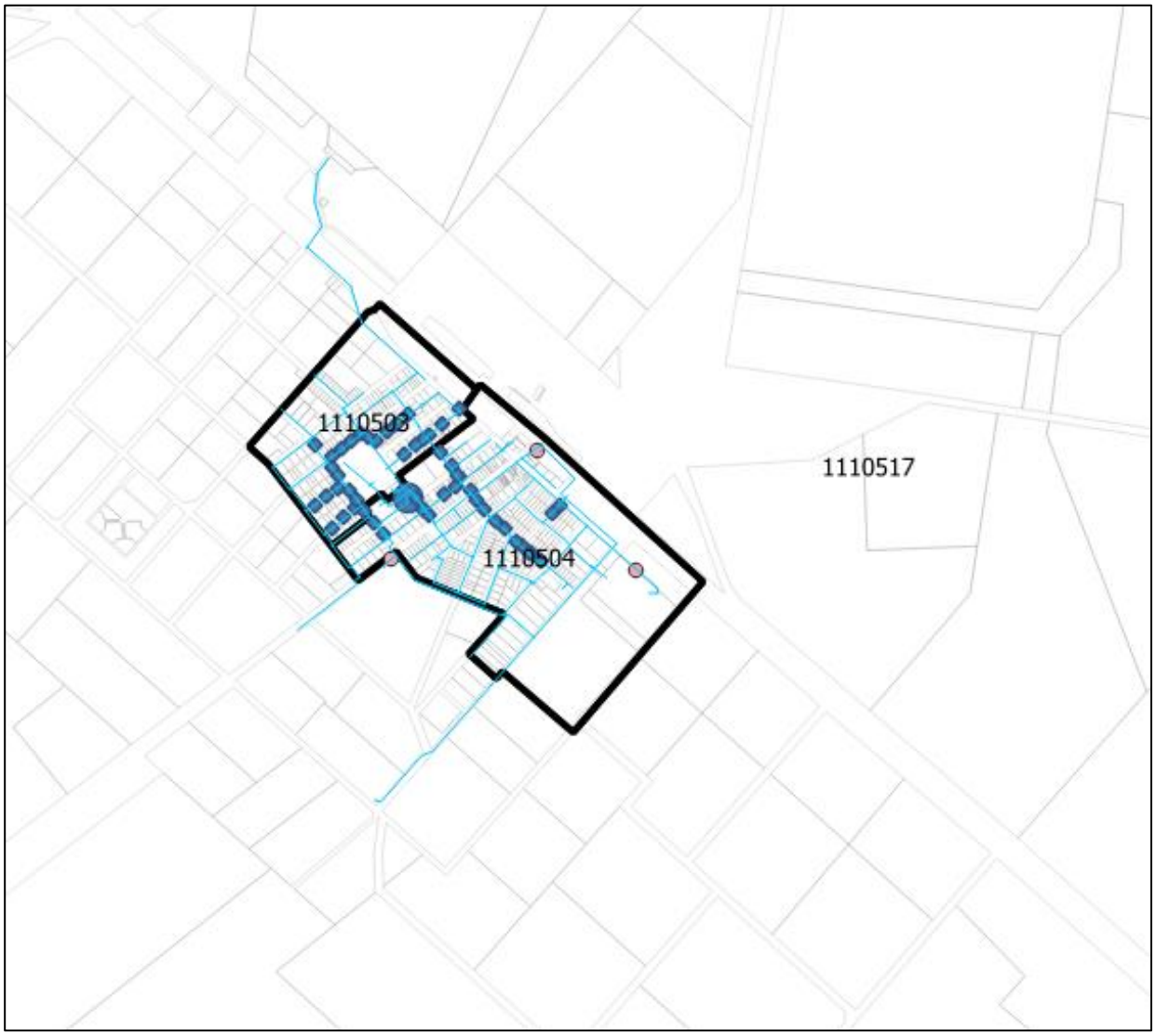
Appendix Figure A-1: Narromine town SA1 boundary for water supply zone



Appendix Figure A-2: Narromine town SA1 boundary for sewer zone

A.2 ABS data – Trangie UCL

Appendix Figure A-3 and Appendix Figure A-4 below shows the SA1 boundary from the 2016 ABS Census data, which the boundaries were selected to roughly match the water supply and sewerage service zones respectively for Trangie. It is used to calculate the household size and occupancy ratio shown in Table 7-2 on page 29.



Appendix Figure A-3: Trangie town SA1 boundary for water supply zone

Appendix Figure A-4: Trangie town SA1 boundary for sewer zone

A.3 ABS data - Tomingley

As the SA1 zones were too large to cover the Tomingley serviced area, the smaller meshblocks were used to estimate the population within the Tomingley township, which is shown in Appendix Figure A-5. It should be noted that the meshblock data does not provide the same level of detail as SA1 data, such as whether dwellings are occupied or not. To determine the household size in Tomingley, it was assumed that 90% of dwellings were occupied.

Appendix Figure A-5: Tomingley meshblock

The meshblock of 10538510000 contains the existing water serviced boundary of the Tomingley township within the Tomingley WSS.

Appendix B Nominated growth strategy

Council provided development areas within Narromine and Trangie. Growth assumptions used in the water supply and sewer load projections are detailed in Appendix Table B-1.

Appendix Table B-1: Growth assumptions for Narromine and Trangie

No.	Development area	ET	Development priority	Notes
Narromine				
0	Skypark	27	Now	To develop within next 2 years from 2022. Assume growth is evenly distributed within 2 years (i.e. 13.5 ET per year for 2 years).
1	Simmons Global			
	▪ Work camp	25	Industrial	Use Public Works Sewer Design Manual (PW SDM) to estimate ET. Assume Non-Residential – Military Camp, 1/6 ET per soldier. 150 people x 1/6 ET = 25 ET. Assume growth is evenly distributed across 5 years (i.e. 5 ET/year for 5 years). Assume this will occur at same time as Simmons Global Advanced manufacturing development.
	▪ Advanced manufacturing	10	Industrial	Expected 250 people in 5 years. Use PW SDM to estimate ET. Assume Dry Industrial – Clean Trade, 1/25 ET per employee. 250 people x 1/25 ET = 10 ET. Assume growth is evenly distributed across 5 years (i.e. 2 ET/year for 5 years).
2	Industrial estate Aerodrome	0.6	Industrial	22 industrial lots. Council anticipates low water usage and sewage discharge. 10 years to develop fully. Located in SP1 Aviation zoning. Lot sizes average 2,770 m^2 (0.277 ha). Use PW SDM to estimate ET. Assume Industrial – Clean Dry Trades (since low water usage and sewer load), 2 ET/ha. 0.277 ha x 2 ET/ha = 0.6 ET. Assume growth is evenly distributed across 10 years (i.e. 0.06 ET/year for 10 years).
3	McCutcheon Residential	50	Second	Assume 5 years construction from 2022; start growth at 2027. Allocate growth based on development priority.
4	Residential development	40	Fourth	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
5	Tucks – mill development	15	Fifth	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
6	Residential development	15	First	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.

No.	Development area	ET	Development priority	Notes
7	Keens shops	1.6	Second	Assume 5 years construction from 2022; start growth at 2027. Allocate growth based on development priority.
8	Residential development	7	First	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
9	Monadelphous site re-development	16	First	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
10	Dappo Road housing subdivision	15	First	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
11	Timbrebongie Stage 2 – Dappo Road	6	Second	Assume Stage 2 construction takes 15 years from 2022; start growth at 2037. Allocate growth based on development priority.
12	Timbrebongie Dappo Road ▪ Aged care villas ▪ Residential subdivision	 20.7 16	 First First	 Assume 5 years construction from 2022; start growth at 2027. Allocate growth based on development priority. Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
13	Timbrebongie Stage 2 – Dappo Road	20.7	Second	Assume Stage 2 construction takes 15 years from 2022; start growth at 2037. Allocate growth based on development priority.
14	Waterford residential	50	First	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
15	Infill development	50	First	Allocate growth based on development priority.
16	Tucks industrial land Dubbo Road	14	Industrial	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority. Based on historical water billing data in Narromine, the existing industrial area in Narromine SPS 5 has 32 assessments, with a non-residential ET of 23. Council proposes 20 new industrial blocks. Assume pro-rata basis, 20 new industrial blocks = 20 assessments x (23 ET / 32 assessments) = 14 ET (assuming 1 industrial block is 1 assessment). Also based on historical billing data, growth was 1 non-residential assessment every 2 years, where 1 non-residential assessment is 1.5

No.	Development area	ET	Development priority	Notes
				ET. Therefore, assume growth of 1 non-residential assessment (1.5 ET per non-residential assessment) per 2 years.
17	Large lot residential development	12	Third	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
18	Large lot residential development	15	Third	Assume 2 years construction from 2022; start growth at 2024. Allocate growth based on development priority.
Trangie				
	Residential development due to Trangie feedlot development	20		Assume 5 years construction from 2022; start growth at 2027. From Narromine Shire Residential & Large Lot Residential Strategy (2018) document, growth rate in Trangie township is 1-2 new dwellings per year. Assume growth rate of 2 new dwellings per year in Trangie.
	Weemabah Street Aboriginal Elder Housing Development	4		6 single bedroom dwellings, strata title. Use PW SDM to estimate ET. Assume each single bedroom dwelling is a townhouse unit, 2/3 ET per townhouse unit. 6 units x 2/3 ET = 4 ET. From Narromine Shire Residential & Large Lot Residential Strategy (2018) document, growth rate in Trangie township is 1-2 new dwellings per year. Assume growth rate of 2 new dwellings per year in Trangie.

See Appendix Table B-2 and Appendix Table B-3 below for the growth distribution assumption in Narromine and Trangie townships respectively.

Appendix Table B-2: Narromine development areas growth distribution assumption

No.	Development areas	User class	Priority	ET	2022	2023	2024	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	Expected water zone	Expected sewer zone
0	Skypark	Res	Now	27	14	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS10
1	Simmons Global - work camp	Non Res	Industrial	25	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS4
1	Simmons advanced manufacturing precinct	Non Res	Industrial	10	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS4
2	Industrial estate aerodrome	Non Res	Industrial	0.55	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS4
3	McCutcheon residential	Res	2nd	50	0	0	0	0	0	0	0	0	0	11	21	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS1
4	Residential development	Res	4th	40	0	0	0	0	0	0	0	0	0	0	0	0	0	17	21	1.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS1
5	Tucks Mill - Residential development	Res	5th	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1.9	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS1
6	Residential development	Res	1st	15	0	0	3	3	6.8	2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS3
7	Keens shops	Res	2nd	1.6	0	0	0	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS1
8	Residential development	Res	1st	7	0	0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS7
9	Monadelphous site redevelopment	Res	1st	16	0	0	3	3	6.8	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS1
10	Dappo Rd housing subdivision	Res	1st	15	0	0	3	3	6.8	2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS11
11	Timbrebongie Stage 2 - Dappo Rd	Res	2nd	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS11
12	Timbrebongie aged care villas Dappo Rd	Res	1st	20.7	0	0	0	0	0	3.3	6.9	6.9	3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS11
12	Timbrebongie residential subdivision Dappo Rd	Res	1st	16	0	0	3	3	6.8	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS11
13	Timbrebongie Stage 2 - Dappo Rd - aged care villas	Res	2nd	20.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	7.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS11
14	Waterford residential	Res	1st	50	0	0	3	3	6.8	3.3	6.9	6.9	12	8.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS1
15	Infill development	Res	1st	50	7.3	7.3	3	3	6.8	3.3	6.9	6.9	5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	North	SPS1
16	Tucks Industrial land Dubbo Rd	Non Res	Industrial	14	0	0	1.5	0	1.5	0	1.5	0	1.5	0	1.5	0	1.5	0	1.5	0	1.5	0	1.5	0	0.5	0	0	0	0	0	0	0	0	0	0	North	SPS5
17	Large lot residential development	Res	3rd	12	0	0	0	0	0	0	0	0	0	0	0	1.3	10	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS2
18	Large lot residential development	Res	3rd	15	0	0	0	0	0	0	0	0	0	0	0	1.3	10	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	South	SPS2
	Total residential ET in Narromine				**20.8**	**20.8**	**20.8**	**20.8**	**41.7**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**1.9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
	New dwelling growth expected in Narromine (ET)				**20.8**	**20.8**	**20.8**	**20.8**	**41.7**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**20.8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		

Note that in the new dwelling growth expected in Narromine, Council provided anticipated growth up to 2029. This was based on the permanent population increase expected in Narromine that was provided by Council. For the purposes of projections, the growth rate of 20.8 new ET per year from 2029 was extrapolated to 2039 (shown in blue text) to cater for growth expected from the development areas in Narromine.

Also note that in the "Expected water zone", "North" refers to Nymagee Street reservoir zone, and "South" refers to Duffy Street reservoir zone in Narromine.

Appendix Table B-3: Trangie development areas growth distribution assumption

Development areas	User class	Priority	ET	2022	2023	2024	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	Expected water zone	Expected sewer zone
Residential development due to Trangie feedlot development	Res	-	20	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Only one zon	SPS1
Weemabah St Aboriginal Elder Housing Development	Res	-	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Only one zon	SPS1

Note that there is only one water supply reservoir zone in the Trangie township, and also there is no non-residential growth expected in Trangie.

Appendix C Water demand analysis and projections

C.1 Background

The following report sections below describe the two water supply schemes, and provide results, and issues identified as a result of PWA's water demand analysis. The water demand analysis is described below.

Outcomes of water demand analysis

A water demand analysis is undertaken to calculate the unit demands, estimate the non-revenue water and forecast the following demands:

- Average (rainfall) year demands – for revenue planning
- Unrestricted future year demands – to assess drought security
- Peak day demands – to assess system reliability.

The 30-year forecasts based on the nominated growth, are used to identify the issues in meeting the adopted water supply security, and reliability objectives of the urban water supply system.

The analysis uses the water production data (that is the water delivered into the system), and the customer billing data (metered consumption by users in the system).

The billing data was provided by assessment with every assessment taken as a connected property. Therefore, analysis has been undertaken on an assessment basis.

Peak usage analysis

Weather patterns in summer that result in prolonged periods of high demand can stress systems more than a large but isolated peak day demand. Historical daily production data is analysed to understand water usage patterns during these periods of peak usage.

The first aim of the analysis is to obtain a ratio of the peak day to the average day in the peak week, which is used to estimate peak day demands from the production model hindcast. The second aim is to obtain a demand "persistence pattern" during the peak period, which can be used to estimate whether the existing reservoirs and WTP capacity can supply demand during the peak period. The persistence pattern can also be used in simulating a peak demand period in a hydraulic model simulation.

Water production and customer usage modelling

Modelling of water production data (that is the water delivered into the system), and the customer billing data (metered consumption by users in the system) is undertaken to understand the impact of various factors/trends (demographic, climatic, economic etc.) on the variability of town water demand.

The aim is to develop a model which, when input with historical factors/trends, will output a production that co-relates well with the actual historic production or customer usage.

The model is then hindcast over a period of available climatic data of temperature and rainfall to estimate the annual demands if the current conditions of lot size, household size, number of connections, pricing and usage patterns were to prevail. The average year and dry year demand over the 130-year period are then determined and these demands are used as the starting point for the forecasts.

Modelling the effect of climate change

Not all user classes are expected to have increased demands due to climate change. The increase in production due to climate change was calculated by keeping the demands of climate independent user-classes and the water loss the same, while calculating the increased demand of climate dependent user classes.

The historical water requirements for grass irrigation were calculated using PWA's simulated water use model for each of the global climate models (GCMs) as well as the historical data set. The results were then input to the water demand model developed for the climate dependent user-classes within all water supply schemes in Narromine Shire.

C.2 Water balance

C.2.1 Methodology

The historical water production data and customer usage data was used to calculate a water balance over the system. The water losses represent the difference between the volume of water delivered into a network and the metered customer usage. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force.

The system losses can be estimated through finding the differences of water produced and water consumed. Assumptions were made to further categorise water losses into apparent losses (such as unauthorised consumption – theft/illegal use and customer meter under-registration) and real losses (such as leakages).

Unbilled authorised consumption was estimated as 0.5% of water supplied. Apparent losses are estimated as customer meter under-registration (2% of metered consumption) plus theft (0.1% of water supplied). These assumptions are from the Australian Government National Performance Framework [21]. Unavoidable real loses are calculated using the average pressure, length of main and number connections using equations from the IWA paper titled 'A Review of Performance Indicators for Real Losses from Water Supply Systems' [22]. As these losses are calculated using assumptions, actual volumes may differ, however they are a useful indicator of where losses are occurring.

C.2.2 Historical water losses

Narromine WSS

Note: Historical data from 2017/18 was not shown as the production data was incomplete for this financial year.

	2018/19	2019/20	2020/21
Production (ML/year)	986	856	789
Demand (ML/year)	795	703	616
Standpipe usage (ML/year)	6	11	6
Losses (ML/year)	185	141	167
Losses (% of production)	19%	16%	21%
Average connections	1,709	1,710	1,722
Average unit losses (L/assessment/year)	296	227	264

Trangie WSS

Note: Historical data from 2017/18 was not shown as the production data was incomplete for this financial year. Data from 2020/21 was also not shown as the standpipe usage

	2018/19	2019/20
Production (ML/year)	345	312
Demand (ML/year)	258	227
Standpipe usage (ML/year)	2	5

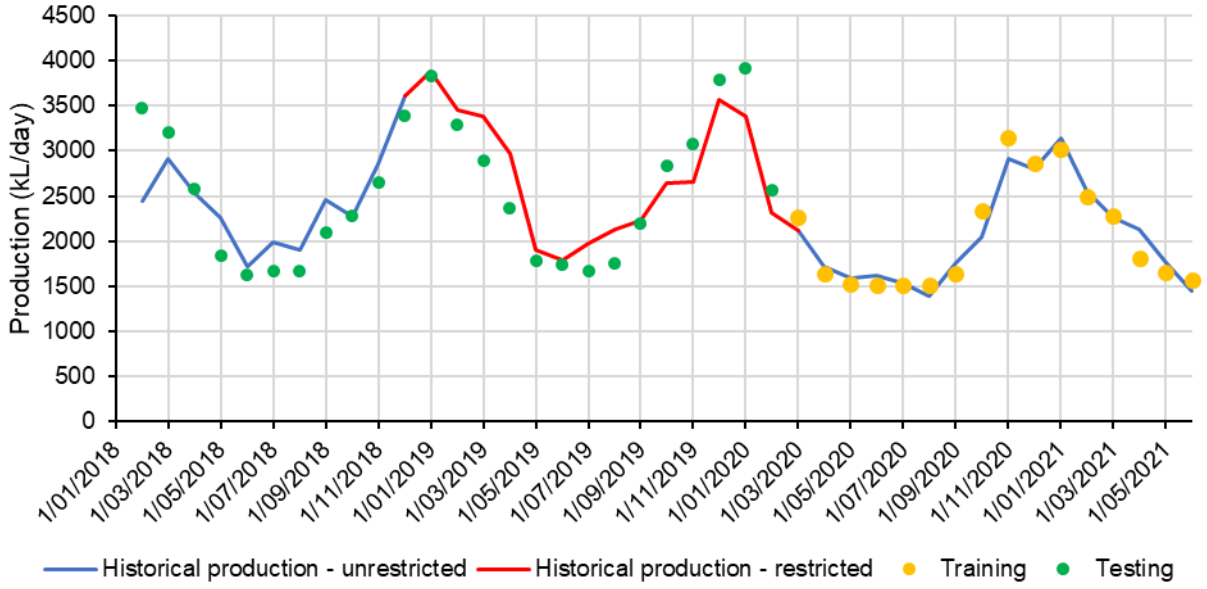
	2018/19	2019/20
Losses (ML/year)	86	80
Losses (% of production)	25%	26%
Average connections	487	485
Average unit losses (L/assessment/year)	489	455

C.3 Water modelling and analysis

C.3.1 Production modelling

C.3.1.1 Narromine Potable WSS

The models are highly correlated to the historical production patterns. Models combining irrigation and evaporative cooler usage resulted in the best fits.



For Narromine, the model was trained during the period after the restrictions (i.e. after March 2020) due to a step change in water usage behaviours between pre- and post-restrictions. The training data has an R^2 of 0.93 compared to the R^2 of 0.78 in the tested period.

Restriction period for Narromine Potable WSS

Council has imposed water restrictions for Narromine for the majority of the available production data. Council enforced the following restrictions mentioned below:

- Level 2 restrictions from January 2018 to January 2019.
- Level 3 restrictions from January 2019 to March 2019, and Level 4 restrictions from March 2019 to January 2020. This was due to drought impacting Narromine in the summer of 2018/19. Restrictions eased to Level 3 from January 2020 to March 2020.
- Restrictions eased to Level 2 from March 2020 to October 2020
- Restrictions eased to Level 1 from October 2020 to February 2021.
- Restrictions were lifted from Narromine since February 2021.

More details on the restriction periods in Narromine are included in Appendix C.4.

There was insufficient production data during unrestricted periods that was available for Narromine, thus a "true" unrestricted demand could not be estimated. However, upon reviewing Council's water restrictions breakdown table, the Level 3 and 4 restrictions were not drastic compared to Level 1 and 2 restrictions as:

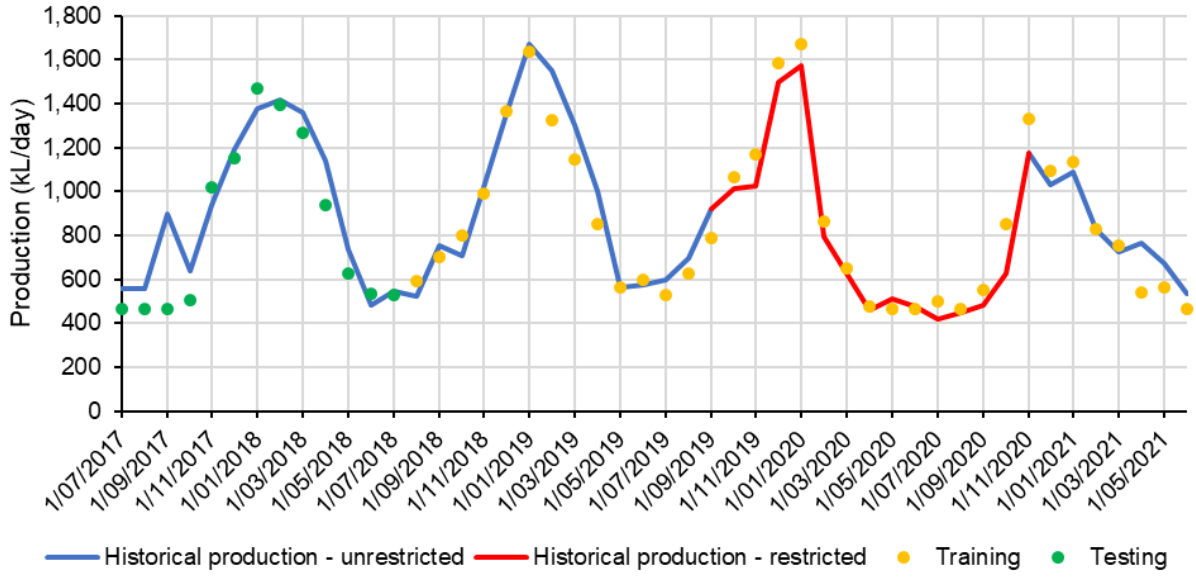
- Topping up, filling garden water features and ponds were permitted up to Level 4 restrictions
- Washing cars at home were permitted with bucket only on the lawn between 9 am to 12 pm at any day of the week
- Unlimited duration of baths and showers were permitted up to Level 3 restrictions, with Level 4 restriction limited to five-minute showers and one bath per person per day
- Unlimited duration of use of evaporative air conditioners were permitted up to Level 3 restrictions, with Level 4 restriction limited to between 7 am to 12 am daily.

Council has also advised that residents living in Narromine have a "green oasis" water behaviour usage pattern, where a large amount of water is used to irrigate their lawns and gardens. As such, it is highly likely that the Levels 3 and 4 restrictions did not have any significant effect on reducing water usage, and that Levels 3 and 4 restrictions realistically had the same effect as Levels 1 and 2 restrictions.

Therefore, for the purposes of modelling, Levels 3 and 4 restrictions will have the most impact on the water use in Narromine. PWA have assumed that the Levels 1 and 2 restrictions does not have a large effect on the water demand pattern in Narromine, thus PWA has modelled the production (and water demand) by only disregarding production data during Levels 3 and 4 restriction periods.

C.3.1.2 Trangie WSS

The models are highly correlated to the historical production patterns. Models combining irrigation and evaporative cooler usage resulted in the best fits.



For Trangie, the model included the historical peak which occurred in January 2019. The training data has an R^2 of 0.92 compared to the R^2 of 0.88 in the tested period.

C.4 Water restrictions

Water restriction that has been applied in Narromine Shire are shown below in Appendix Table C-1 and Appendix Table C-2. Some information is provided by Council, with further details obtained

from alternative sources such as Council's media releases, articles, or archiving websites (called Wayback Machine). Furthermore, Council's water restriction messages are often relayed through social media posts (Facebook), as well as news outlets such as Narromine News Online. The dates and level of water restriction that are reported on Council's social media channel and news outlet are consistent with Council's own website.

Appendix Table C-1: Water restriction enforcement – Narromine township

Town	Level of water restrictions	Start date	End date	Source
Narromine	Level 1	1/12/2017	22/01/2018	Council
	Level 2	22/01/2018	2/01/2019	Council website & social media post
	Level 3	2/01/2019	18/03/2019	Council website
	Level 4	18/03/2019	16/01/2020	Council media release
	Level 3	16/01/2020	9/03/2020	Council website & Narromine news
	Level 2	9/03/2020	16/10/2020	Council website
	Level 1	16/10/2020	15/02/2021	Council website
	Restrictions lifted	15/02/2021	Now	Council

Social media post refers to Council's Facebook page, with links to Council website regarding Council's media release of water restrictions.

Appendix Table C-2: Water restriction enforcement – Trangie and Tomingley townships

Town	Level of water restrictions	Start date	End date	Source
Trangie and Tomingley	Level 1	1/12/2017	21/01/2018	Council
	No restriction	22/01/2018		Council website & social media post
	No restriction	2/01/2019		Council website
	No restriction	19/03/2019	7/10/2019	Council website
	Level 2	7/10/2019	16/01/2020	Council website & Social media post
	Level 2	16/01/2020	9/03/2020	Council media release
	Level 2	9/03/2020	16/10/2020	Council website & Narromine news
	Level 1	16/10/2020	15/02/2021	Council website & Narromine news
	Restrictions lifted	15/02/2021	Now	Council, (Website indicates L1)

Social media post refers to Council's Facebook page, with links to Council website regarding Council's media release of water restrictions.

C.5 Water demand projections

Narromine

Appendix Table C-3 below shows the breakdown of unrestricted future year extraction (or dry year extraction)

Appendix Table C-3: Narromine Potable WSS – Breakdown of unrestricted future year extraction (ML/year)

	2022	2027	2032	2037	2042	2047	2052
North reservoir zone (Nymagee Street Reservoir)							
Residential	172	199	241	250	250	250	250
Non-residential	194	209	212	213	215	215	215
Subtotal	**366**	**408**	**453**	**463**	**465**	**465**	**465**
South reservoir zone (Duffy Street Reservoir)							
Residential	320	356	366	409	420	420	420
Non-residential	70	70	70	70	70	70	70
Subtotal	**390**	**426**	**436**	**478**	**490**	**490**	**490**
Total dry year demand	**756**	**834**	**888**	**942**	**955**	**955**	**955**
+ Water losses	187	206	220	233	236	236	236
Dry year production	**943**	**1,040**	**1,108**	**1,175**	**1,191**	**1,191**	**1,191**
Unrestricted future year extraction*	**1,014**	**1,119**	**1,191**	**1,263**	**1,280**	**1,280**	**1,280**

*This includes water losses at the WTP (e.g. backwashing). 7% losses were assumed for the purposes of projections.

Trangie

Appendix Table C-4 below shows the breakdown of unrestricted future year extraction (or dry year extraction)

Appendix Table C-4: Trangie WSS – Breakdown of unrestricted future year extraction (ML/year)

	2022	2027	2032	2037	2042	2047	2052
Residential	224	226	231	235	235	235	235
Non-residential	81	81	81	81	81	81	81
Total dry year demand	**305**	**307**	**312**	**316**	**316**	**316**	**316**
+ Water losses	47	47	48	48	48	48	48
Unrestricted future year extraction	**352**	**354**	**360**	**364**	**364**	**364**	**364**

Appendix D Water quality risk assessment

D.1 Narromine health-based targets risk rating

Bore 3

Question	Answer	REDRILLED in 2018 - Narromine Scoping study (draft 3) 090419.docx		
Catchment Assessment			Catchment characteristics	
Name of water supply	Narromine Bore 3	1.5	Average slope	0.7%
Name of water source	ower Macquarie Zone 1 Groundwater Source	1.6	Average annual rainfall (mm)	569.6
Is this a primary or secondary source	Primary Source	1.7	Area NSW	Central West
Is the water source groundwater or suface water	Groundwater	1.8	Soil drainage	Poorly drained
		1.9	Land use grazing (%)	5%
Groundwater Assessment				
Are there disused uncapped bores allowing ingress of surface water into aquifer?	No			
Can surface water ingress into aquifer through bore casing?	No			
Type of aquifer water is being extracted (where the screens are located)?	Alluvial			
Is there an aquitard (impervious) layer between surface and water-bearing aquifer (where screens are)?	No			
Is Aquifer level directly influenced by surface water?	Yes			
What is the depth of the water-bearing aquifer (m)?	30			
Any change in turbidity? e.g. linked to rain events	Yes			
Vulnerability Assessment Required?	Yes			

Upper/Lower quaternary aquifer (20-30-40m below ground)
Eight TWS bores have been screened across this aquifer, with four of these TWS bores still operational. This aquifer has variable groundwater yields ranging from 10l/s to 20l/s. Groundwater within this aquifer has also been subject to some surface-derived contamination and can also be prone to drought and effect form other groundwater users.

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Council notes that this bore has high CaCO3

Vulnerability Assessment

Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
Definition:	1km radius from bore in direction of recharge	5km radius from bore in direction of recharge		
Urban Areas				
No of properties with OSSMS in catchment	0	0	Low	Low
Threats				
Are there STPs in catchment	No	No	Low	Low
Are there possibililties of sewer overflows in catchment	No	No	Low	Low
Are there biosolids reuse in catchment	No	No	Low	Low
Are there industrial WWTS in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	Yes	Low	High
Are there urban stormwater discharges in catchment	No	No	Low	Low
Is there aquifer recharge with stormwater or effluent	No	No	Low	Low
Effluent Reuse				
Any effluent reuse in catchment	No	No		
Stock animals				
Are dairies, feedlots or other intensive farming operations in catchment	No	Yes	Low	High
Are there free-roaming livestock within catchment	Yes	Yes		
Is number of calves and lambs in catchment known?	No	No	Average oocysts/Ha for Central West will be used	Average oocysts/Ha for Central West will be used
% of perennial waterways fenced off	>90%	>90%		
% of perennial waterways with riparian vegetation	%65 to 90%	%65 to 90%		
Weighted risk from livestock			Low	Low
Highest catchment rating	High			
Inherent Risk				
	High			

Note: There is not an aquitard (impervious) layer between surface and water-bearing aquifer, the aquifer level is directly influenced by surface water, and although the aquifer is deep (>20m below ground) there has been changes in turbidity linked to rain events - requires catchment vulnerability assessment

Appendix Figure D-1: Catchment inherent risk rating for Bore 3 - Narromine Potable WSS

Treatment Process Assessment	
What is the filtration system?	No Filtration
No Filtration requirements	
Is raw water and treated water turbidity measured at least twice per day?	
Does high turbidity automatically shut-down the supply and/or WTP?	
What is highest monthly maximum treated water turbidity recorded?	
What is the highest monthly 95%ile treated water turbidity recorded?	
Disinfection	
Is there UV or Ozone disinfection?	Neither UV nor Ozone

Disinfection note: Neither UV nor Ozone disinfection used in treatment

Assessment Summary	
Inherent risk (prior to treatment)	High
Residual risk	High

Print Results Summary

Residual LRV	Residual Risk
<0	Very Low
>=0 but <1	Low
>=1 but <1.5	Medium
>=1.5 but < 2	High
>=2	Very High

Appendix Figure D-2: Catchment residual risk rating for Bore 3 - Narromine Potable WSS

Bore 6

Question	Answer		Bore 6 construction Jan 2016 - screens at 47m at minimum. Furthest screen at 80m deep.
Catchment Assessment			Catchment characteristics
Name of water supply	Narromine Bore 6D		1.5 Average slope: 0.7%
Name of water source	ower Macquarie Zone 1 Groundwater Source		1.6 Average annual rainfall (mm): 569.6
Is this a primary or secondary source	Primary Source		1.7 Area NSW: Central West
Is the water source groundwater or suface water	Groundwater		1.8 Soil drainage: Poorly drained
			1.9 Land use grazing (%): 5%
Groundwater Assessment			
Are there disused uncapped bores allowing ingress of surface water into aquifer?	No		
Can surface water ingress into aquifer through bore casing?	No		
Type of aquifer water is being extracted (where the screens are located)?	Alluvial		
Is there an aquitard (impervious) layer between surface and water-bearing aquifer (where screens are)?	No		
Is Aquifer level directly influenced by surface water?	Yes		
What is the depth of the water-bearing aquifer (m)?	50	or 55-60 based on GW0429	
Any change in turbidity? e.g. linked to rain events	Yes		
Vulnerability Assessment Required?	Yes		

Lower Quaternary aquifer (30-40m below ground)
Eight TWS bores have been screened across this aquifer, with four of these TWS bores still operational. This aquifer has variable groundwater yields ranging from 10l/s to 20l/s. Groundwater within this aquifer has also been subject to some surface-derived contamination and can also be prone to drought and effect form other groundwater users.

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New bore 6 is deep - around 47m and deeper - Upper tertiary alluvium

Vulnerability Assessment

Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
Definition:	1km radius from bore in direction of recharge	5km radius from bore in direction of recharge		
Urban Areas				
No of properties with OSSMS in catchment	0	0	Low	Low
Threats				
Are there STPs in catchment	No	No	Low	Low
Are there possibililties of sewer overflows in catchment	No	No	Low	Low
Are there biosolids reuse in catchment	No	No	Low	Low
Are there industrial WWTS in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	Yes	Low	High
Are there urban stormwater discharges in catchment	No	No	Low	Low
Is there aquifer recharge with stormwater or effluent	No	No	Low	Low
Effluent Reuse				
Any effluent reuse in catchment	No	No		
Stock animals				
Are dairies, feedlots or other intensive farming operations in catchment	No	Yes	Low	High
Are there free-roaming livestock within catchment	Yes	Yes		
Is number of calves and lambs in catchment known?	No	No	Average oocysts/Ha for Central West will be used	Average oocysts/Ha for Central West will be used
% of perennial waterways fenced off	>90%	>90%		
% of perennial waterways with riparian vegetation	%65 to 90%	%65 to 90%		
Weighted risk from livestock			Low	Low
Highest catchment rating	High			

Inherent Risk

High

Note: There is not an aquitard (impervious) layer between surface and water-bearing aquifer, the aquifer level is directly influenced by surface water, and although the aquifer is deep (>20m below ground) there has been changes in turbidity linked to rain events - requires catchment vulnerability assessment

Appendix Figure D-3: Catchment inherent risk rating for Bore 6 - Narromine Potable WSS

Treatment Process Assessment	
What is the filtration system?	Conventional Filtration
Filtration requirements	
Is combined filtered water turbidity measured online?	No
Is combined filtered water tested at least twice per shift?	Yes
What is highest monthly maximum combined filtered water turbidity recorded? (in NTU)	0.1
What is the highest monthly 95%ile combined filtered water turbidity recorded? (in NTU)	0.1
Is filtration preceded by clarification that treats all flow, and has a coagulant continuously added while in operation?	No
Is individual filtered water turbidity measured online with a reading every 15 minutes (or more frequently) ?	No
Is there GAC or BAC filtration that treats the entire flow?	No
Disinfection	
Is there UV or Ozone disinfection?	Neither UV nor Ozone

Disinfection note: Neither UV nor Ozone disinfection used in treatment

Assessment Summary	
Inherent risk (prior to treatment)	High
Residual risk	High

Residual LRV	Residual Risk
<0	Very Low
>=0 but <1	Low
>=1 but <1.5	Medium
>=1.5 but < 2	High
>=2	Very High

Print Results Summary

Appendix Figure D-4: Catchment residual risk rating for Bore 6 - Narromine Potable WSS

Bore 7

Question	Answer	Bore 7 is screened across the tertiary aquifer - bore yield and quality should be acceptable (good)		
Catchment Assessment			Catchment characteristics	
Name of water supply	Narromine Bore 7		1.5 Average slope	0.7%
Name of water source	ower Macquarie Zone 1 Groundwater Source		1.6 Average annual rainfall (mm)	569.6
Is this a primary or secondary source	Primary Source		1.7 Area NSW	Central West
Is the water source groundwater or suface water	Groundwater		1.8 Soil drainage	Poorly drained
			1.9 Land use grazing (%)	5%
Groundwater Assessment				
Are there disused uncapped bores allowing ingress of surface water into aquifer?	No			
Can surface water ingress into aquifer through bore casing?	No			
Type of aquifer water is being extracted (where the screens are located)?	Alluvial			
Is there an aquitard (impervious) layer between surface and water-bearing aquifer (where screens are)?	No			
Is Aquifer level directly influenced by surface water?	Yes			
What is the depth of the water-bearing aquifer (m)?	60			
Any change in turbidity? e.g. linked to rain events	Yes			
Vulnerability Assessment Required?	Yes			

Upper Tertiary aquifer (50-75m below ground)
The alluvial units of this aquifer are characterised by predominantly cleaner and more uniformed sand and gravel interbedded with clays at depths of 50 to 75m below ground level, with an aquifer thickness from 10m to 20m. The gravels are typically rounded to well-rounded and well sorted sand and gravels

There is only one TWS bore currently screened across this aquifer, being **TWS 7 (GW273272 - replaced 030742)** which was drilled in 2013 and pump tested in March 2015. Pump test results indicted this bore had a sustainable yield of 17L/sec

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Council's email says bore 7 has failed and been sealed - think that was for 7S 7D still operational?

Vulnerability Assessment

Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
Definition:	1km radius from bore in direction of recharge	5km radius from bore in direction of recharge		
Urban Areas				
No of properties with OSSMS in catchment	0	0	Low	Low
Threats				
Are there STPs in catchment	No	No	Low	Low
Are there possibililties of sewer overflows in catchment	No	No	Low	Low
Are there biosolids reuse in catchment	No	No	Low	Low
Are there industrial WWTS in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	Yes	Low	High
Are there urban stormwater discharges in catchment	No	No	Low	Low
Is there aquifer recharge with stormwater or effluent	No	No	Low	Low
Effluent Reuse				
Any effluent reuse in catchment	No	No		
Stock animals				
Are dairies, feedlots or other intensive farming operations in catchment	No	Yes	Low	High
Are there free-roaming livestock within catchment	Yes	Yes		
Is number of calves and lambs in catchment known?	No	No	Average oocysts/Ha for Central West will be used	Average oocysts/Ha for Central West will be used
% of perennial waterways fenced off	>90%	>90%		
% of perennial waterways with riparian vegetation	%65 to 90%	%65 to 90%		
Weighted risk from livestock			Low	Low
Highest catchment rating	High			

Inherent Risk

High

Note: There is not an aquitard (impervious) layer between surface and water-bearing aquifer, the aquifer level is directly influenced by surface water, and although the aquifer is deep (>20m below ground) there has been changes in turbidity linked to rain events - requires catchment vulnerability assessment

Appendix Figure D-5: Catchment inherent risk rating for Bore 7 - Narromine Potable WSS

Treatment Process Assessment	
What is the filtration system?	No Filtration
No Filtration requirements	
Is raw water and treated water turbidity measured at least twice per day?	
Does high turbidity automatically shut-down the supply and/or WTP?	
What is highest monthly maximum treated water turbidity recorded?	
What is the highest monthly 95%ile treated water turbidity recorded?	
Disinfection	
Is there UV or Ozone disinfection?	Neither UV nor Ozone

Disinfection note: Neither UV nor Ozone disinfection used in treatment

Assessment Summary	
Inherent risk (prior to treatment)	High
Residual risk	High

Print Results Summary

Residual LRV	Residual Risk
<0	Very Low
>=0 but <1	Low
>=1 but <1.5	Medium
>=1.5 but < 2	High
>=2	Very High

Appendix Figure D-6: Catchment residual risk rating for Bore 7 - Narromine Potable WSS

Bore 9

Question	Answer	Bore is screened across upper aquifers, affected by surface contamination		
Catchment Assessment			Catchment characteristics	
Name of water supply	Narromine Bore 9	1.5	Average slope	0.7%
Name of water source	Lower Macquarie Zone 1 Groundwater Source	1.6	Average annual rainfall (mm)	569.6
Is this a primary or secondary source	Primary Source	1.7	Area NSW	Central West
Is the water source groundwater or suface water	Groundwater	1.8	Soil drainage	Poorly drained
		1.9	Land use grazing (%)	5%
Groundwater Assessment				
Are there disused uncapped bores allowing ingress of surface water into aquifer?	No			
Can surface water ingress into aquifer through bore casing?	Yes			
Type of aquifer water is being extracted (where the screens are located)?	Alluvial			
Is there an aquitard (impervious) layer between surface and water-bearing aquifer (where screens are)?	No			
Is Aquifer level directly influenced by surface water?	Yes			
What is the depth of the water-bearing aquifer (m)?	90			
Any change in turbidity? e.g. linked to rain events	Yes			
Vulnerability Assessment Required?	No			

Lower Quaternary aquifer (30-40m below ground) from 2015 report
Eight TWS bores have been screened across this aquifer, with four of these TWS bores still operational. This aquifer has variable groundwater yields ranging from 10l/s to 20l/s. Groundwater within this aquifer has also been subject to some surface-derived contamination and can also be prone to drought and effect form other groundwater users.

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G:\Waterserv\Projects\Narromine SC\IWCM\4_RefDoc\Data From Council\3_ExistingSchemeInfo\Water\Bore testing

New bore constructed in 2015 - WBZ at 95-101m depth, pump at 55m depth
G:\Waterserv\Projects\Narromine SC\Hydraulic Modelling\4_Refdocs\OneDrive_1_5-3-2021\9 Pump Information\Bore 9

Vulnerability Assessment

Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
Definition:	1km radius from bore in direction of recharge	5km radius from bore in direction of recharge		
Urban Areas				
No of properties with OSSMS in catchment	0	0	Low	Low
Threats				
Are there STPs in catchment	No	No	Low	Low
Are there possibililties of sewer overflows in catchment	No	Yes	Low	High
Are there biosolids reuse in catchment	No	No	Low	Low
Are there industrial WWTS in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	Yes	Low	High
Are there urban stormwater discharges in catchment	No	No	Low	Low
Is there aquifer recharge with stormwater or effluent	No	No	Low	Low
Effluent Reuse				
Any effluent reuse in catchment	No	No		
Stock animals				
Are dairies, feedlots or other intensive farming operations in catchment	No	No	Low	Low
Are there free-roaming livestock within catchment	Yes	Yes		
Is number of calves and lambs in catchment known?	No	No	Average oocysts/Ha for Central West will	Average oocysts/Ha for Central West will b
% of perennial waterways fenced off	>90%	>90%		
% of perennial waterways with riparian vegetation	%65 to 90%	%65 to 90%		
Weighted risk from livestock			Low	Low
Highest catchment rating	High			
Inherent Risk	Very High			

Note: Surface water can ingress aquifer through bore casing - very high risk

Appendix Figure D-7: Catchment inherent risk rating for Bore 9 - Narromine Potable WSS

Treatment Process Assessment	
What is the filtration system?	Conventional Filtration
Filtration requirements	
Is combined filtered water turbidity measured online?	Yes
Is combined filtered water tested at least twice per shift?	Yes
What is highest monthly maximum combined filtered water turbidity recorded? (in NTU)	0.1
What is the highest monthly 95%ile combined filtered water turbidity recorded? (in NTU)	0.1
Is filtration preceded by clarification that treats all flow, and has a coagulant continuously added while in operation?	Yes
Is individual filtered water turbidity measured online with a reading every 15 minutes (or more frequently) ?	No
Is there GAC or BAC filtration that treats the entire flow?	No
Disinfection	
Is there UV or Ozone disinfection?	Neither UV nor Ozone

Disinfection note: Neither UV nor Ozone disinfection used in treatment

Assessment Summary	
Inherent risk (prior to treatment)	Very High
Residual risk	Very High

Residual LRV	Residual Risk
<0	Very Low
>=0 but <1	Low
>=1 but <1.5	Medium
>=1.5 but < 2	High
>=2	Very High

Print Results Summary

Appendix Figure D-8: Catchment residual risk rating for Bore 9 - Narromine Potable WSS

D.2 Trangie health-based targets risk rating

Question	Answer			
Catchment Assessment			Catchment characteristics	
Name of water supply	Trangie Water Supply Scheme Bore 1	1.5	Average slope	1%
Name of water source	Lower Macquarie Zone 3 Groundwater Source	1.6	Average annual rainfall (mm)	496
Is this a primary or secondary source	Primary Source	1.7	Area NSW	Central West
Is the water source groundwater or suface water	Groundwater	1.8	Soil drainage	Imperfectly drained
		1.9	Land use grazing (%)	28%
Groundwater Assessment				
Are there disused uncapped bores allowing ingress of surface water into aquifer?	No			
Can surface water ingress into aquifer through bore casing?	No			
Type of aquifer water is being extracted (where the screens are located)?	Great Artesian Basin			
Is there an aquitard (impervious) layer between surface and water-bearing aquifer (where screens are)?	No			
Is Aquifer level directly influenced by surface water?	No			
What is the depth of the water-bearing aquifer (m)?	100			
Any change in turbidity? e.g. linked to rain events	No			
Vulnerability Assessment Required?	No			

Vulnerability Assessment

Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
Definition:	1km radius from bore in direction of recharge	5km radius from bore in direction of recharge		
Urban Areas				
No of properties with OSSMS in catchment	5	10	Low	Low
Threats				
Are there STPs in catchment	No	No	Low	Low
Are there possibililties of sewer overflows in catchment	Yes	Yes	Very High	High
Are there biosolids reuse in catchment	No	No	Low	Low
Are there industrial WWTS in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	No	Low	Low
Are there urban stormwater discharges in catchment	No	No	Low	Low
Is there aquifer recharge with stormwater or effluent	No	No	Low	Low
Effluent Reuse				
Any effluent reuse in catchment	No	No		
Stock animals				
Are dairies, feedlots or other intensive farming operations in catchment	No	No	Low	Low
Are there free-roaming livestock within catchment	Yes	Yes		
Is number of calves and lambs in catchment known?	No	No	Average oocysts/Ha for Central West will be usec	Average oocysts/Ha for Central West will be used
% of perennial waterways fenced off	<65%	<65%		
% of perennial waterways with riparian vegetation	<65%	<65%		
Weighted risk from livestock			Medium	Medium
Highest catchment rating	Very High			
Inherent Risk				
	Low			

Note: Groundwater is extracted from Great Artesian basin which is deep below ground - low risk

Appendix Figure D-9: Catchment inherent risk rating - Trangie WSS

Treatment Process Assessment	
What is the filtration system?	No Filtration
No Filtration requirements	
Is raw water and treated water turbidity measured at least twice per day?	
Does high turbidity automatically shut-down the supply and/or WTP?	
What is highest monthly maximum treated water turbidity recorded?	
What is the highest monthly 95%ile treated water turbidity recorded?	
Disinfection	
Is there UV or Ozone disinfection?	Neither UV nor Ozone
Disinfection note: Neither UV nor Ozone disinfection used in treatment	

Assessment Summary	
Inherent risk (prior to treatment)	Low
Residual risk	Low

Print Results Summary

Residual LRV	Residual Risk
<0	Very Low
>=0 but <1	Low
>=1 but <1.5	Medium
>=1.5 but < 2	High
>=2	Very High

Appendix Figure D-10: Catchment residual risk rating - Trangie WSS

Appendix E Sewer loading projections

E.1 Sewage pumping station specifications

Rising main diameter details were obtained from Council's 2021 SPS Audit spreadsheet. Rising main length details were obtained from Council's GIS data.

SPS	SPS pumps to	Rising main diameter (mm)	Rising main length (m)	Pump rate (L/s)	Wet well diameter (m)	Wet well depth (m)	Maximum well capacity (kL)
Narromine sewerage scheme							
SPS1	Narromine STP	200	6,937	46.0	2.6	10.4	88.5
SPS2	SPS1	200	218	12.4 & 16.0	4.1	10.9	114.1
SPS3	SPS1	100	7	32.6 & 39.9	1.8	4.4	11.2
SPS4	SPS1	100	783	21.2	2.2	9.0	27.0
SPS5	SPS1	100	891	4.2 & 5.2	1.85	5.7	15.0
SPS6	SPS1	100	285	22.2	1.9	3.0	8.5
SPS7	SPS1	80	42	4.3 & 8.5	1.9	3.6	10.0
SPS8	SPS1	50	956	3.24	1.9	4.4	12.4
SPS9	SPS1	50	533	6.6 & 9.5	1.9	8.8	25.0
SPS10	SPS1	100	N/A	2.8	1.8	6.0	8.2
SPS11	SPS2	110	380	4.0 & 7.5	2.2	8.0	21.3
Trangie sewerage scheme							
SPS1	Trangie STP	200	1,340	35.6 & 63.0	3	5.5	38.0
SPS2	SPS1	100	557	3.8 & 11.3	1.9	5.5	15.0
SPS3	SPS2	100	528	1.9 & 3.8	1.9	6.4	18.0
SPS4	SPS1	100	573	9.9 & 15.6	1.9	5.6	15.0

E.2 EP projections – catchment level

Narromine SS

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Residential							
SPS1	1,614	1,747	1,955	2,095	2,131	2,131	2,131
SPS2	1,091	1,091	1,091	1,156	1,156	1,156	1,156
SPS3	148	184	184	184	184	184	184
SPS4	3	3	3	3	3	3	3
SPS5	0	0	0	0	0	0	0
SPS6	50	50	50	50	50	50	50
SPS7	32	49	49	49	49	49	49
SPS8	61	61	61	61	61	61	61

SPS catchment	2022	2027	2032	2037	2042	2047	2052
SPS9	69	69	69	69	69	69	69
SPS10	32	65	65	65	65	65	65
SPS11	0	82	124	169	188	188	188
Total residential	**3,101**	**3,401**	**3,651**	**3,901**	**3,956**	**3,956**	**3,956**
Non-residential							
SPS1	803	803	803	803	803	803	803
SPS2	44	44	44	44	44	44	44
SPS3	0	0	0	0	0	0	0
SPS4	17	85	85	85	85	85	85
SPS5	88	95	106	113	122	122	122
SPS6	0	0	0	0	0	0	0
SPS7	0	0	0	0	0	0	0
SPS8	0	0	0	0	0	0	0
SPS9	0	0	0	0	0	0	0
SPS10	0	0	0	0	0	0	0
SPS11	0	0	0	0	0	0	0
Total non-residential	**953**	**1,028**	**1,039**	**1,046**	**1,055**	**1,055**	**1,055**
Total							
SPS1	2,418	2,550	2,759	2,898	2,934	2,934	2,934
SPS2	1,135	1,135	1,135	1,199	1,199	1,199	1,199
SPS3	148	184	184	184	184	184	184
SPS4	20	88	88	88	88	88	88
SPS5	88	95	106	113	122	122	122
SPS6	50	50	50	50	50	50	50
SPS7	32	49	49	49	49	49	49
SPS8	61	61	61	61	61	61	61
SPS9	69	69	69	69	69	69	69
SPS10	32	65	65	65	65	65	65
SPS11	0	82	124	169	188	188	188
Total to Narromine STP	**4,054**	**4,429**	**4,690**	**4,947**	**5,010**	**5,010**	**5,010**

Trangie SS

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Residential							
SPS1	293	301	323	341	341	341	341
SPS2	115	115	115	115	115	115	115

SPS catchment	2022	2027	2032	2037	2042	2047	2052
SPS3	128	128	128	128	128	128	128
SPS4	178	178	178	178	178	178	178
Total residential	**714**	**723**	**745**	**762**	**762**	**762**	**762**
Non-residential							
SPS1	223	223	223	223	223	223	223
SPS2	73	73	73	73	73	73	73
SPS3	7	7	7	7	7	7	7
SPS4	70	70	70	70	70	70	70
Total non-residential	**373**	**373**	**373**	**373**	**373**	**373**	**373**
Total							
SPS1	516	525	547	564	564	564	564
SPS2	188	188	188	188	188	188	188
SPS3	135	135	135	135	135	135	135
SPS4	248	248	248	248	248	248	248
Total to Trangie STP	**1,087**	**1,096**	**1,118**	**1,135**	**1,135**	**1,135**	**1,135**

E.3 ADWF projections – catchment level

Narromine SS

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Residential							
SPS1	271	294	329	352	358	358	358
SPS2	183	183	183	194	194	194	194
SPS3	25	31	31	31	31	31	31
SPS4	1	1	1	1	1	1	1
SPS5	0	0	0	0	0	0	0
SPS6	8	8	8	8	8	8	8
SPS7	5	8	8	8	8	8	8
SPS8	10	10	10	10	10	10	10
SPS9	12	12	12	12	12	12	12
SPS10	5	11	11	11	11	11	11
SPS11	0	14	21	28	32	32	32
Total residential	**521**	**572**	**614**	**656**	**665**	**665**	**665**
Non-residential							
SPS1	135	135	135	135	135	135	135
SPS2	7	7	7	7	7	7	7
SPS3	0	0	0	0	0	0	0

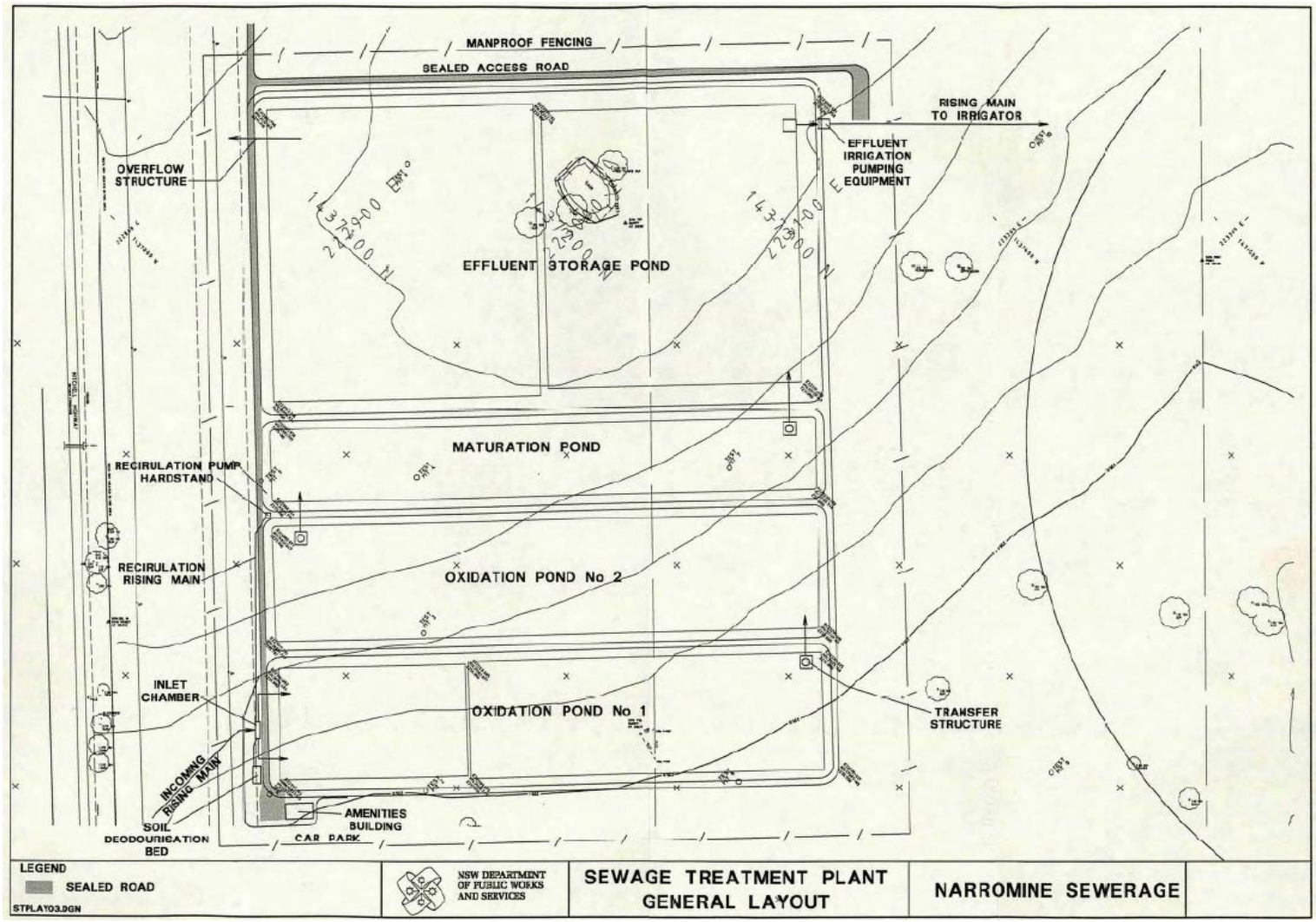
SPS catchment	2022	2027	2032	2037	2042	2047	2052
SPS4	3	14	14	14	14	14	14
SPS5	15	16	18	19	20	20	20
SPS6	0	0	0	0	0	0	0
SPS7	0	0	0	0	0	0	0
SPS8	0	0	0	0	0	0	0
SPS9	0	0	0	0	0	0	0
SPS10	0	0	0	0	0	0	0
SPS11	0	0	0	0	0	0	0
Total non-residential	**160**	**173**	**175**	**176**	**177**	**177**	**177**
Total							
SPS1	406	429	464	487	493	493	493
SPS2	191	191	191	202	202	202	202
SPS3	25	31	31	31	31	31	31
SPS4	3	15	15	15	15	15	15
SPS5	15	16	18	19	20	20	20
SPS6	8	8	8	8	8	8	8
SPS7	5	8	8	8	8	8	8
SPS8	10	10	10	10	10	10	10
SPS9	12	12	12	12	12	12	12
SPS10	5	11	11	11	11	11	11
SPS11	0	14	21	28	32	32	32
Total to Narromine STP	**681**	**744**	**788**	**831**	**842**	**842**	**842**

Trangie SS

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Residential							
SPS1	51	53	57	60	60	60	60
SPS2	20	20	20	20	20	20	20
SPS3	22	22	22	22	22	22	22
SPS4	31	31	31	31	31	31	31
Total residential	**125**	**127**	**131**	**134**	**134**	**134**	**134**
Non-residential							
SPS1	39	39	39	39	39	39	39
SPS2	13	13	13	13	13	13	13
SPS3	1	1	1	1	1	1	1
SPS4	12	12	12	12	12	12	12

SPS catchment	2022	2027	2032	2037	2042	2047	2052
Total non-residential	**65**	**65**	**65**	**65**	**65**	**65**	**65**
Total							
SPS1	91	92	96	99	99	99	99
SPS2	33	33	33	33	33	33	33
SPS3	24	24	24	24	24	24	24
SPS4	44	44	44	44	44	44	44
Total to Trangie STP	**191**	**192**	**196**	**199**	**199**	**199**	**199**

Appendix F General Layout of Narromine STP



Source: Narromine Sewerage Augmentation, Concept Development for Sewage Transport, Sewage Treatment Plant and Effluent Reuse System, prepared for Narromine Shire Council and Department of Land & Water Conservation, August 1999 (report number WE98140R1)

Appendix G Environment Protection Licence requirements for Narromine STP (EPL 11715)

Appendix Table G-1: EPA monitoring and discharge points for EPL 11715 (Narromine STP)

EPA ID point	Type of monitoring/discharge point	Location description
3	Total effluent volume monitoring	Pump station one
4	Discharge of effluent from the Effluent Storage Pond to Effluent Irrigation area	Effluent quality and discharge volume monitoring at the northern wall of the Effluent Storage Pond
5	Monitoring effluent quality	Effluent quality monitoring point at the discharge from the maturation pond to the effluent storage ponds
6	Discharge and monitoring	Emergency discharge point on the southern wall of the Effluent Storage Pond
7	Soil monitoring in effluent irrigation area	In Effluent Irrigation area

Appendix Table G-2: Concentration limits for EPL 11715 (Narromine STP)

EPA ID point	Pollutant	100th percentile concentration limit
6	BOD	30 mg/L
6	Nitrogen (ammonia)	20 mg/L
6	pH	6.5 to 8.5
6	Phosphorus (total)	9 mg/L
6	Total Kjeldahl Nitrogen	40 µg/L
6	Total suspended solids	50 mg/L

Appendix Table G-3: Requirement to monitor concentration of pollutants discharged for EPL 11715 (Narromine STP)

EPA ID point	Pollutant	Units of measure	Frequency	Sampling method
4, 5	BOD	mg/L	Quarterly	Grab sample
4, 5	Nitrogen (total)	mg/L	Quarterly	Grab sample
4, 5	Oil and Grease	mg/L	Quarterly	Grab sample
4, 5	pH	pH	Quarterly	Grab sample
4, 5	Phosphorus (total)	mg/L	Quarterly	Grab sample
4, 5	Total suspended solids	mg/L	Quarterly	Grab sample
6	BOD	mg/L	Daily during any discharge	Grab sample
6	Nitrogen (total)	mg/L	Daily during any discharge	Grab sample
6	Oil and Grease	mg/L	Daily during any discharge	Grab sample

EPA ID point	Pollutant	Units of measure	Frequency	Sampling method
6	pH	pH	Daily during any discharge	Grab sample
6	Phosphorus (total)	mg/L	Daily during any discharge	Grab sample
6	Total suspended solids	mg/L	Daily during any discharge	Grab sample
7	Exchangeable calcium	mg/kg	Yearly	Representative sample
7	Exchangeable magnesium	mg/kg	Yearly	Representative sample
7	Exchangeable sodium	mg/kg	Yearly	Representative sample
7	Nitrogen (total)	mg/kg	Yearly	Representative sample
7	pH	pH	Yearly	Representative sample
7	Phosphorus (total)	mg/kg	Yearly	Representative sample
7	Salinity	mg/kg	Yearly	Representative sample
7	Sodium Adsorption Ratio	mg/kg	Yearly	Representative sample

Appendix Table G-4: Requirement to monitor volume or mass for EPL 11715 (Narromine STP)

EPA ID point	Units of measure	Frequency	Sampling method
3	kL/day	Continuous	Magnetic flow meter
4	kL/day	Continuous	Magnetic flow meter
6	kL/day	Daily during any discharge	Estimate

Appendix Table G-5: Non-compliances with EPA licence conditions at Narromine STP for the last ten years

Date ending	Type of non-compliance	EPA actions	No. of times occurred	LBL fee
16 Dec 2020	No non-compliances			
16 Dec 2019	The STP exceeded the load limit for Total Suspended Solids (TSS) with a pollutant load of 18,431.70 kg. The STP did not discharge to the environment. The licensee is investigating the cause of the increased TSS.	Appropriate action taken by licensee	1	$0.00
	The STP exceeded load limit for BOD for 2019 reporting limit with pollutant load of 22,056.60 kg. The STP did not discharge to the	Appropriate action taken by licensee	1	

Date ending	Type of non-compliance	EPA actions	No. of times occurred	LBL fee
	environment. The licensee is investigating the cause of the increased BOD.			
16 Dec 2018	The Licensee did not collect annual sample for EPA point 7	EPA to monitor future compliance with this condition	1	$0.00
16 Dec 2017	No non-compliances			
16 Dec 2016	The Flow meter at monitoring point 3 was shut down for three days during maintenance work	Appropriate action taken by licensee	1	$0.00
	Exceeded volumetric discharge limit of 1,000 kL/day during reporting period	EPA to monitor future compliance with this condition	1	
16 Dec 2015	No non-compliances			
16 Dec 2014	No non-compliances			
16 Dec 2013	No non-compliances			
16 Dec 2012	No non-compliances			
16 Dec 2011	No non-compliances			

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