

Mount Morgan

regional water supply security assessment



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Mines and Energy

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Introduction

Mount Morgan is an historical mining town on the Dee River that has become a popular town for retirees and commuters to Rockhampton, many attracted by affordable house prices and the country town lifestyle.

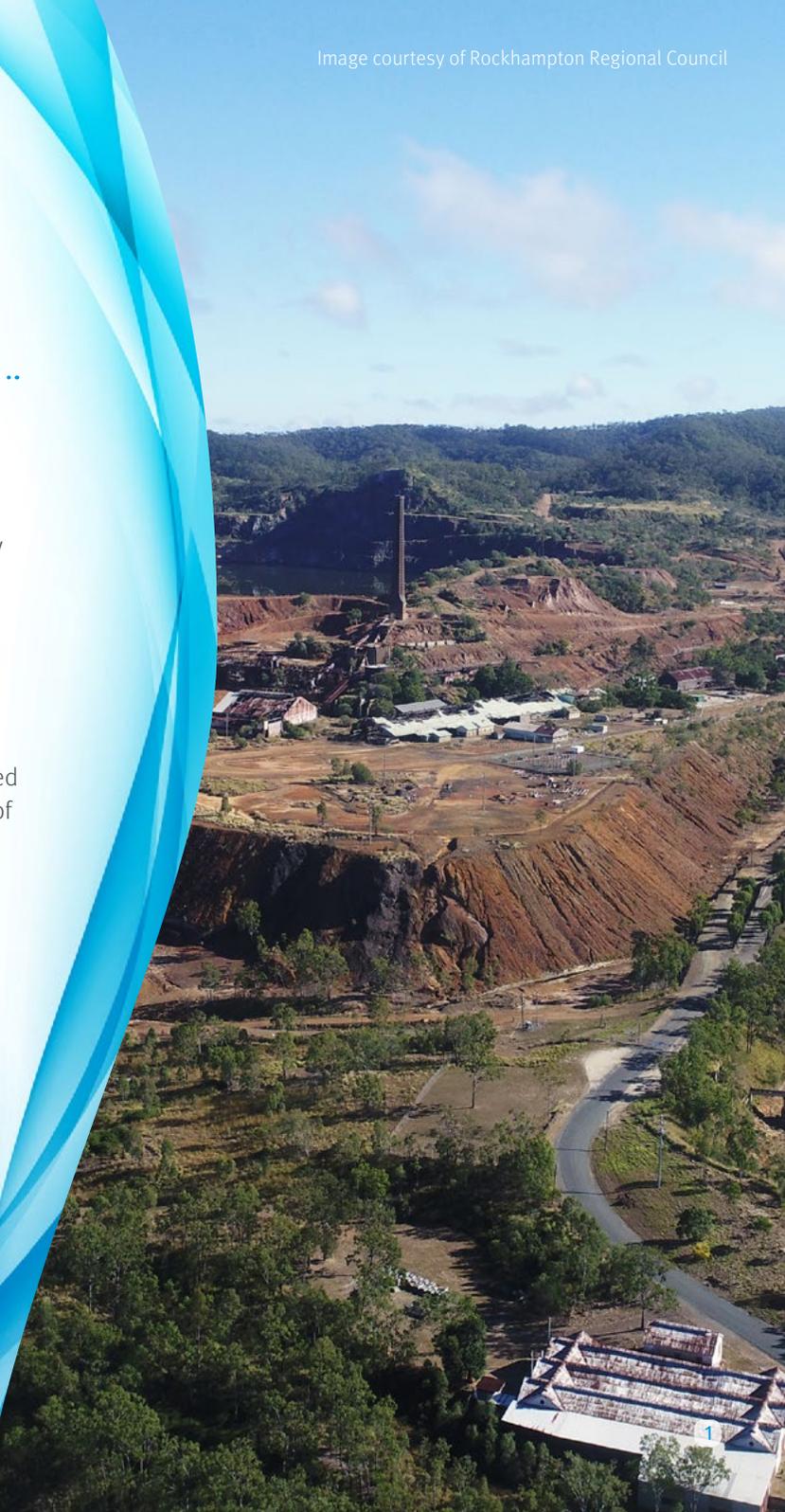
Mount Morgan is a small urban community located approximately 38 km southwest of Rockhampton. Its population peaked at 30 000 in the early 1900s with the productivity of the Mount Morgan gold mining operation. In 2017 Mount Morgan's population was approximately 2900 people with its economy mostly relying on tourism, agriculture, forestry and small business.

Safe, secure and reliable water supplies are an essential resource for Mount Morgan, supporting the health and wellbeing of the community. Water for Mount Morgan is sourced from Number 7 Dam (No. 7 Dam) on the Dee River. Fitzroy River Water, which is a business unit of the Rockhampton Regional Council (Council), is the registered water service provider for Mount Morgan's urban water supply, providing water and sewerage services to the community.

The Queensland Government, through the Department of Natural Resources, Mines and Energy, and Council partnered to investigate and establish a shared understanding of the existing security of the Mount Morgan urban water supply and its capacity to support future growth. Arising from this partnership is this regional water supply security assessment (RWSSA), which provides valuable information about Mount

Morgan's urban water supply security and a foundation for future water supply planning for the community.

This assessment shows how the current low water use by the community contributes to maintaining a relatively secure urban water supply. It is important to note that the information presented in this assessment does not consider any changes to the capacity of the existing water supply system and associated infrastructure or the impacts of possible water quality issues. Changes to demand, that may be driven by climate variability, population growth or other factors, have been considered in this assessment by taking into account a wide range of water demand levels.





Water supply source

No. 7 Dam is the sole source of water supplying Mount Morgan's reticulation network.

Water for the Mount Morgan community is sourced from No. 7 Dam, which is on the Dee River immediately downstream of the river's junction with Limestone Creek. The catchment area of the Dee River above the dam is approximately 39 km². Urban water supply for Mount Morgan is unsupplemented and authorised under the Water Plan (Fitzroy Basin) 2011. Council holds the only water licence authorising the take of water from No. 7 Dam, which allows the extraction of 584 megalitres per annum (ML/a).

No. 7 Dam is a mass concrete dam with an earth levee, which was built by the Mount Morgan Gold Mine Company in the early 1900s to supply water to the mine and the town. At that time, Mount Morgan was primarily supplied with water from the Fletcher Creek Weir via an adjacent groundwater bore. In 1993, Council assumed ownership of the dam and the delivery main from the Mount Morgan mine, and the dam became the town's main water supply source. In 1999, No. 7 Dam became the sole water supply for the community when it was raised by 4.5 m to provide the current storage capacity of 2830 ML. The Fletcher Creek bore has since been decommissioned and the supply of water from this source has been discontinued.

Figure 1 shows the location of Mount Morgan and the surrounding area.

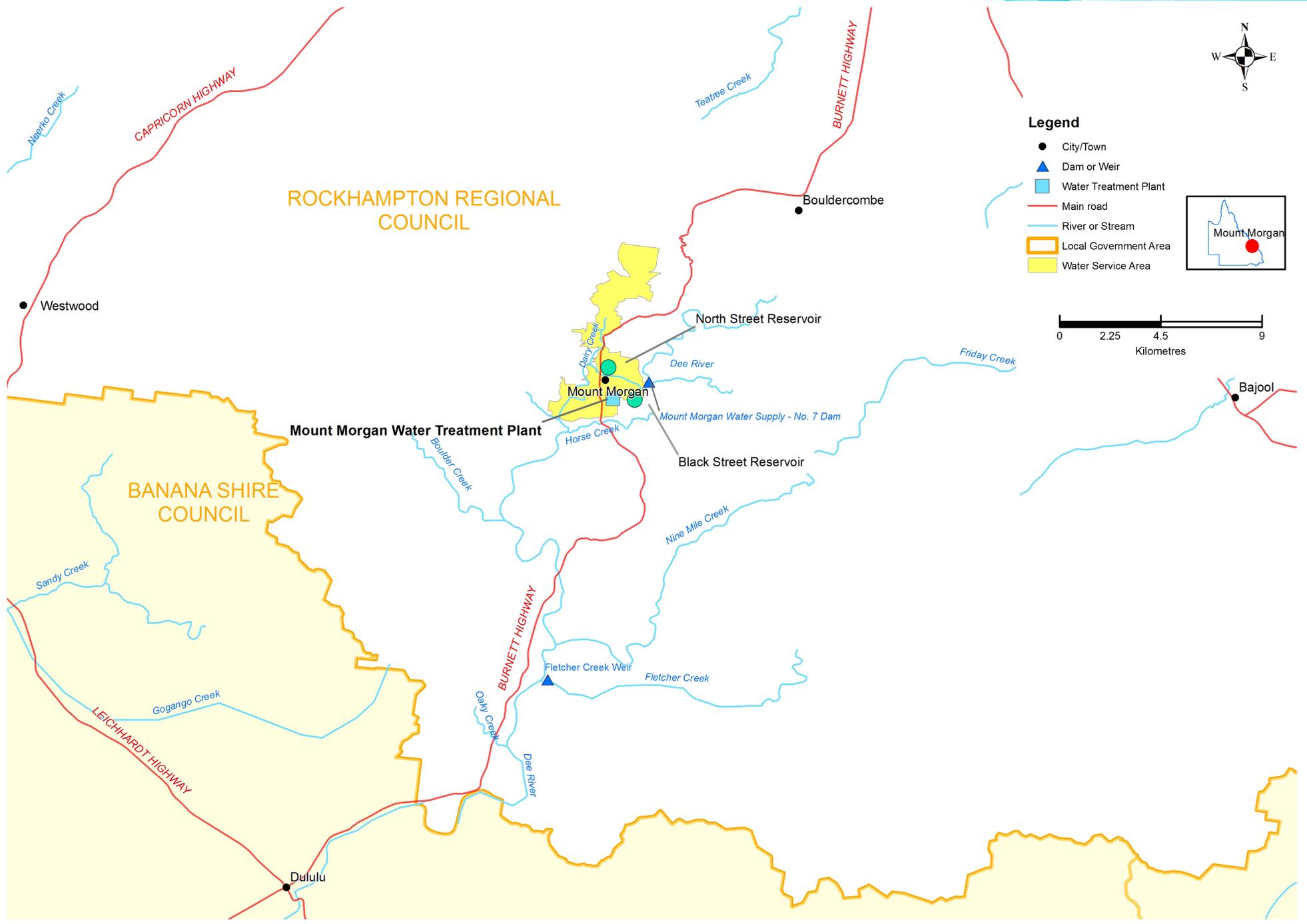


Figure 1: Mount Morgan and the surrounding area

Water users and water use

The Mount Morgan reticulation network supplies water for urban purposes, servicing approximately 2900 people in 2016–17.

Mount Morgan’s reticulation network

The total volume of water sourced from No.7 Dam for the Mount Morgan’s reticulation network between 2003–04 and 2016–17 averaged approximately 367 ML/a¹. To better understand the community’s water use, the average daily total water use and average daily residential water use were investigated.

The average daily total water use is expressed as litres per capita per day (L/c/d)². This water includes all urban uses such as residential, commercial, municipal and industrial water use as well as water losses associated with treatment and distribution. It also includes water use associated with Mount Morgan’s non-resident population within the community (e.g. tourists). Between 2003–04 and 2016–17, the average daily water use for Mount Morgan was approximately 367 L/c/d.

The average daily residential water use relates only to the water used by residents within the Mount Morgan community². Between 2003–04 and 2016–17, the average daily residential water use was approximately 230 litres per person per day (L/p/d).

1 Data sourced from the Statewide Water Information Management (SWIM) database and Council water treatment plant records from 2003-04 to 2016-17.

2 The average daily total and residential water use is calculated by dividing the total and residential water use respectively by the serviced population. The serviced population includes only permanent residents connected to the Council’s reticulation network. It does not include the transient population, such as tourists and temporary workforces.

Recycled water

A small proportion (less than 20%) of the water supplied through Mount Morgan’s reticulation network is subsequently recycled through the Mount Morgan sewage treatment plant. Effluent from Council’s sewage treatment plant is reused to irrigate school ovals and sporting fields. This recycled water does offset some urban water demand; however, as it is a reliable on-going source, this offset demand is considered separate to the urban demand on No. 7 Dam for the purposes of this assessment.

Water use is impacted by variations in climate

Urban water use varies between years and within each year, depending on various factors including climatic conditions such as rainfall, with higher use usually occurring during drier periods. Figure 2 illustrates the relationship between the annual rainfall recorded in Mount Morgan and Mount Morgan’s annual water use from 2003-04 to 2016-17. During this period, water use varied considerably from year to year, ranging from 276 ML in 2008-09 to 482 ML in 2004-05.

It is important to note that the average rainfall for the period for which detailed urban water use records were available (i.e. from 2003–04 to 2016–17) is similar to the average rainfall over the longer term record (i.e. from 1901–02).

Climate change

The Queensland Government provides scientific advice on climate change projections for 13 Queensland regions³, including the Central Queensland region in which Mount Morgan is located. Similarly to the rest of Queensland, the projections for the next 50 years indicate that the Central Queensland region will be warmer and drier with increased evaporation.

The projected climatic changes may potentially result in reductions in water supply availability and increases in water demands within the region. Such potential changes to demand, that may be driven by climate change, were captured in this assessment by taking into account a wide range of potential future climatic scenarios, which included extreme weather events.

3 The projections are based on data from the CSIRO and the Bureau of Meteorology, and are referenced against the historical period 1986–2005 for temperature, evaporation and rainfall.

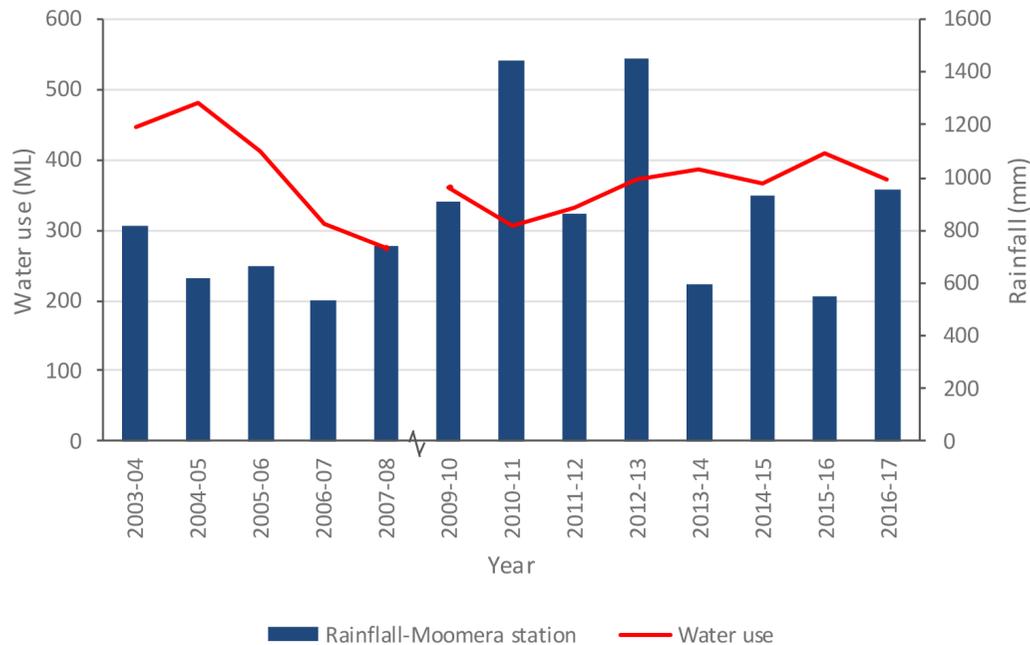


Figure 2: Annual rainfall and annual water use

Other users of the bulk water supply source

Agriculture

Agriculture is an important part of Mount Morgan's economy. Land use around the Dee River and Fletcher Creek is predominately cattle grazing and undisturbed bushland. The remainder is forestry and irrigated cropping. Agriculture and forestry accounted for 30% of all businesses within Mount Morgan's region in 2016–17⁴.

⁴ Queensland Government Statistician's Office— Resident Profile, viewed 11 April 2017, <http://www.qgso.qld.gov.au/>

Licences that authorise the take for agriculture from within the Dee River catchment are only located downstream of the dam. Therefore, these water entitlements do not impact the water supply security for Mount Morgan.

Mining

The Mount Morgan Gold Mining Company operated from 1882 until 1991. No mining or processing activity has occurred on site, and consequently there has been no water use for mining activities since the shutdown of operations.



Industry and tourist sector

The tourism industry is relatively important to the Mount Morgan economy due to the presence of the old Mount Morgan mine site, its location on the Burnett Highway and its vicinity to Queensland's populated central coast. Other industries in Mount Morgan include agricultural support industries, health care, social assistance, retail and real estate services. These businesses are generally of a small scale, consistent with most urban areas, and there are no major industrial users of water in Mount Morgan.

Water for industry and the tourist sector in Mount Morgan is supplied through the reticulation network. As such, water use by industry is accounted for within the urban water use for Mount Morgan. Over the period 2003–04 to 2016–17, the combined industrial, commercial and municipal water use in Mount Morgan constituted, on average, about 10% of Mount Morgan's urban water use.⁵

Historical performance of No. 7 Dam

No. 7 Dam is a small storage, which relies on the summer rainfalls in the relatively small catchment area of the Dee River to fill. Due to its small capacity, No. 7 Dam can fill quickly and, because the majority of river flows occur during a relatively short timeframe, at times there can be significant flow over the spillway. At current water use levels and without further inflows to the dam, the storage capacity of No. 7 Dam is sufficient to meet Mount Morgan's water demands for approximately 24 months, or longer if water restrictions were to be imposed. The relatively short drawdown period of the dam makes it susceptible to short, extreme dry events.

⁵ Queensland Government Statistician's Office— Resident Profile, viewed 11 April 2017, <http://www.qgso.qld.gov.au/>

From 2002–03 to 2015–16⁶, water levels in No.7 Dam declined to critical levels on a number of occasions. However, Mount Morgan did not experience a water supply shortfall in this period despite five years (from 2003–04 to 2007–08) of below average inflows, during which time the dam reached 3% (87 ML) of its full supply volume. A water supply shortfall is defined as an event where water supply is unable to meet urban water demand.

While the historical performance of a water supply system offers an indication of supply security, its application to future performance is limited. The historical performance does not take into account trends in demand patterns, climate variability or variation in historical inflows. Historical performance is dependent on the water use at the time, with water use typically increasing proportionately with population growth. A period of low inflows that did not result in a failure to meet water demands in the past may have failed under a higher water demand. More sophisticated tools, such as demand forecasting and stochastic modelling, are needed to account for a wider range of potential scenarios.

In response to drought or other temporary water shortage events, Council may impose water restrictions for Mount Morgan⁷. The water level in No. 7 Dam is used as a guide for managing the implementation of restrictions by Council's Drought Management Response Team, with restrictions being lifted when the dam storage volume returns to higher levels. The restrictions focus on outdoor water use, both residential and non-residential (where the water is not required for core business needs). Council are currently reviewing their drought management strategy, including the restrictions schedule.

⁶ This reflects the period for which there are detailed water level records available from the Department of Natural Resources, Mines and Energy—Water Monitoring Information Portal service (<https://water-monitoring.information.qld.gov.au/>)

⁷ Under Council's Fitzroy River Water Drought Management Plan (2009)

Future water use

Effective water supply planning must be evidence-based and consider likely and possible changes in future water demand.

A forecast of Mount Morgan's future urban water demand was collaboratively developed between the Queensland Government, and Council. It is based on current water use rates and population projections. These water demand projections will, of course, remain subject to ongoing monitoring of actual population growth and variations in urban water use trends (e.g. education and provision of more timely personal water consumption data may reduce consumption).

Mount Morgan's reticulation network

In this assessment, two population projections were used: one based on the Queensland Government Statisticians' Office (QGSO) population projections and a more conservative population projection by Council. For both projections, it was assumed that the proportion of the Mount Morgan population connected to the reticulation network would slightly increase over the projection period (from 91% in 2015 to 92% in 2032). Based on the QGSO projection, the population connected to the Mount Morgan reticulation network is expected to increase approximately 29% to reach 3750 persons in 2035–36. In comparison, Council anticipates that the population connected to the Mount Morgan reticulation network will increase approximately 5% to reach 3050 persons in 2035–36. The Council population projection is considered most likely to be achieved.

The average daily water use over the past fourteen years (i.e. 2003–04 to 2016–17) of 367 L/c/d was assumed to represent the average daily water demands into the future for the Mount Morgan community. This average daily urban water demand level will sometimes be exceeded as it is based on an average demand on the system over a number of years, rather than the demand that might occur for example in drier years. The use of average demand provides an indication of when demand is likely to exceed available supply. For planning purposes, this means an appropriate balance can be reached between the cost of water supply and the demand for available water.

Figure 3 shows the likely projected annual water demand on No. 7 Dam is estimated to increase to 410 ML/a by 2036. The likely projected water demand is based on the average daily water use of 367 L/c/d and the Council derived connected population projection. Figure 3 also presents the moderate water demand projection, which is also based on the average daily water use of 367 L/c/d but on QGSO's higher rate of population growth. The moderate average annual water demand is estimated to reach approximately 500 ML/a by 2036. This demand may be achieved during extended dry periods or from a higher population growth (e.g. population growth rate that is closer to the QGSO projection rather than Council's).



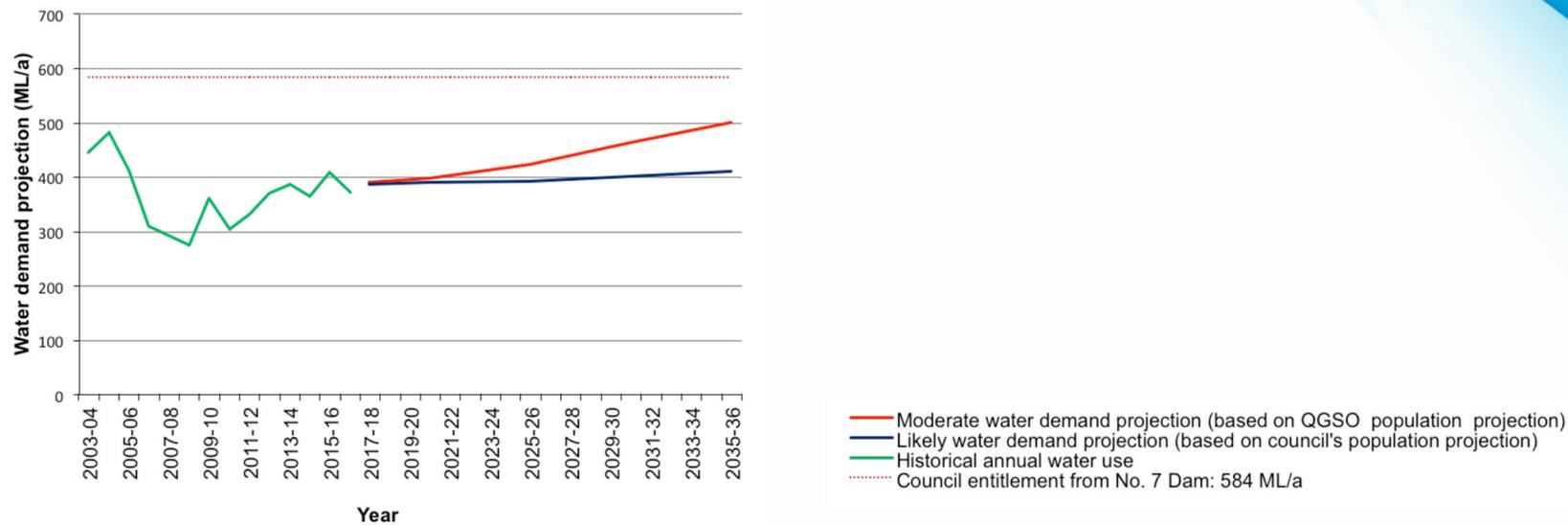


Figure 3: Mount Morgan's annual water demand projections

Other users of the bulk water supply source

Agriculture

There are no known agricultural projects planned for the region that would impact on water supply security for the Mount Morgan community.

Mining

Mining and processing activities ceased at Mount Morgan mine in 1991. In March 2018, Carbine Resources announced the decision of not proceeding with the re-opening the mine⁸. However, any potential re-opening of the Mount Morgan mine in the future should not significantly impact the community's water demands or water supply. This is because Council considers it unlikely that re-opening of the mine would result in a significant increase in the resident population of Mount Morgan and because the mine would have its own water supply source for its activities.

⁸ Carbine Resources at <http://carbineresources.com.au/wp-content/uploads/2018/03/180323-1-Mount-Morgan-Project-Update-and-Carbine-Board-Changes.pdf>, viewed 28 March 2018

Industry and tourist sector

While it is difficult to predict, recent trends suggest that moderate growth in tourist numbers may continue. Industrial activity centred in Mount Morgan is not likely to increase and is expected to remain at a small scale.

The non-residential water demand, to which industrial and tourist sector demands contribute, is met through the Mount Morgan reticulation network and is assumed to grow approximately proportionate to population growth. There is no industrial development expected within the region that would significantly impact on the water demands or water supply security of Mount Morgan.



Water supply system capability

Hydrologic assessment of Mount Morgan’s water supply system

Hydrologic assessments have been undertaken to determine the capability of Mount Morgan’s existing urban water supply (including existing operational arrangements and water licences) to meet current and projected future water demands.

Both historical and stochastic modelling techniques were used to simulate the performance of Mount Morgan’s water supply from No. 7 Dam. Historical modelling was used to demonstrate how the water supply would have performed under historical climatic conditions for a range of demand levels. The stochastic modelling involved generating 100 replicates of 10 000 years of stochastic data, which incorporated key statistical indicators from the historical records. The stochastic modelling accounts for a wider variation of potential climatic scenarios than the historical records.

In the hydrological modelling, Mount Morgan’s water demands were represented at four different water demand levels to reflect the impact of population growth, and are summarised in Table 1. The 2035–36 likely water demand projection is considered the most likely representation of the Mount Morgan community’s future water demand.

Table 1: Water demand levels modelled

Water demands (ML/a)	Description of demand level
380 ML/a	Annual water demand in 2016–17 (i.e. current water use)
410 ML/a	2035–36 likely water demand projection based on the average daily water use of 367 L/c/d and Council’s derived connected population projection
500 ML/a	2035–36 moderate water demand projection based on the average daily water use of 367 L/c/d and the QGSO’s derived connected population projection
584 ML/a	Full entitlement use of Council’s water licence for Mount Morgan from No. 7 Dam

Frequency of water supply shortfalls and low water levels

Stochastic modelling results show that the frequency of events reaching low water levels in No. 7 Dam increases with increasing water demand by the Mount Morgan community. Figure 4 shows that, assuming no water restrictions are applied, the likelihood of No. 7 Dam reaching 15% of its full supply volume nearly doubles as water demand increases from the current water use of 380 ML/a (i.e. 2016–17 water use) to 500 ML/a (i.e. 2035–36 moderate water demand projection). Figure 4 also shows that it is nearly two times more likely for No. 7 Dam to reach its minimum operating volume when demand is 500 ML/a compared to 410 ML/a (i.e. 2035–36 likely water demand projection).

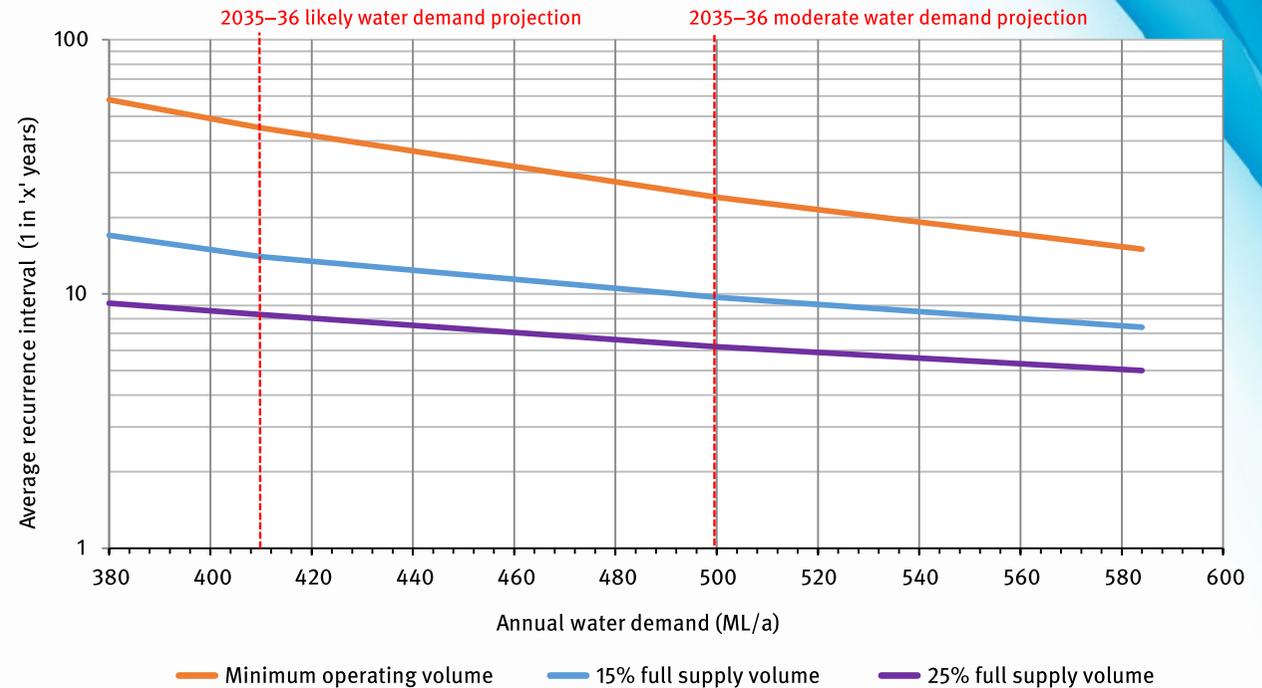


Figure 4: The average recurrence interval of reaching low volumes in No. 7 Dam at various water demands (assuming no water restrictions)

Image courtesy of Rockhampton Regional Council



Duration and severity of water supply shortfalls and low water levels

Figure 5 shows, for a range of water demand levels, the predicted frequency of No. 7 Dam being below specified low storage volumes for longer than 1 month, 3 months and 6 months, assuming no water restrictions are applied. The frequency and duration of No. 7 Dam falling to low storage volumes is a key indicator of the long-term reliability of the water supply system.

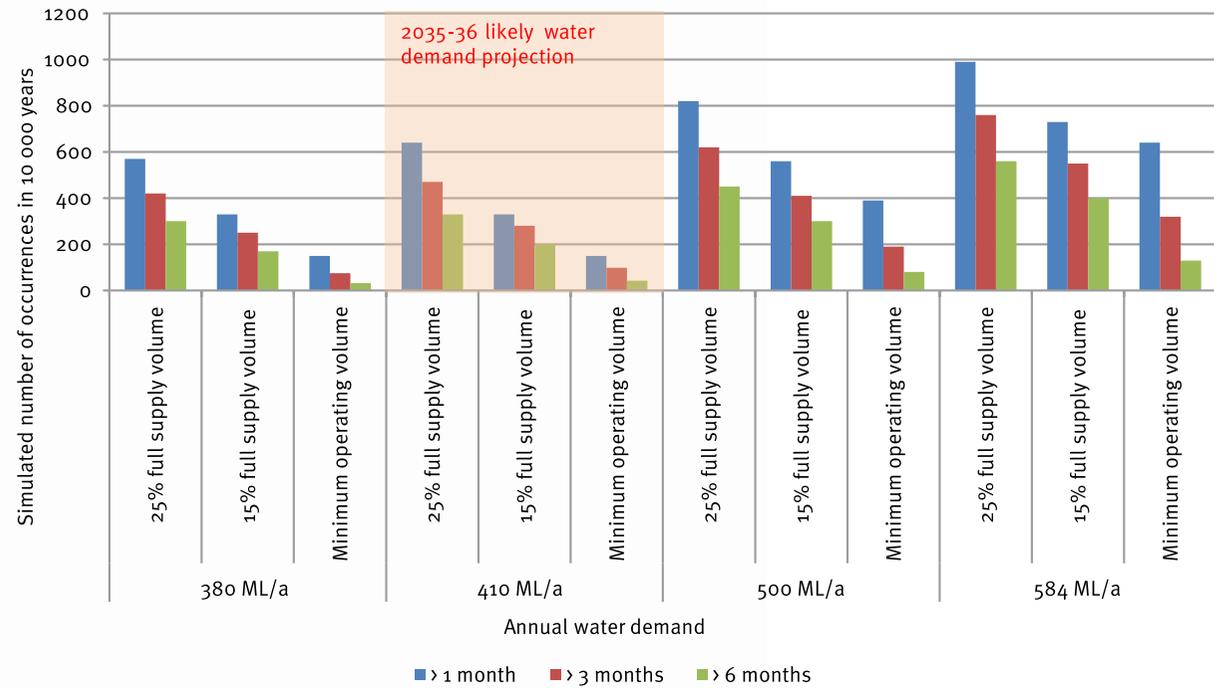


Figure 5: Frequency and duration of reaching low storage volumes in No. 7 Dam at various demands (assuming no water restrictions)



As water demand increases, so does both the predicted number of occurrences of the dam falling to low volumes and the relative proportion of occurrences that last for longer than 3 and 6 months. Stochastic modelling results indicate that at full entitlement use (584 ML/a) there are four times more instances of No. 7 Dam being below minimum operating volume longer than 6 months than at current demands of 380 ML/a (i.e. 2016–17 current water use). The stochastic modelling results also show that nearly half of the events of No. 7 Dam being at or below 25% of full supply volume for 1 month extend for longer than 6 months. This indicates that the storage is likely to stay at low levels for an extended period, potentially leading to prolonged periods of demand management measures, such as water restrictions.

Water restrictions

Council is currently evaluating its demand management measures, including the triggers for imposing water restrictions. Generally, water restrictions are imposed in an effort to reduce water consumption and extend the duration of available water supply during prolonged dry periods. Council's water restrictions primarily target outdoor water uses, including watering gardens, irrigating sports fields, and swimming pools.

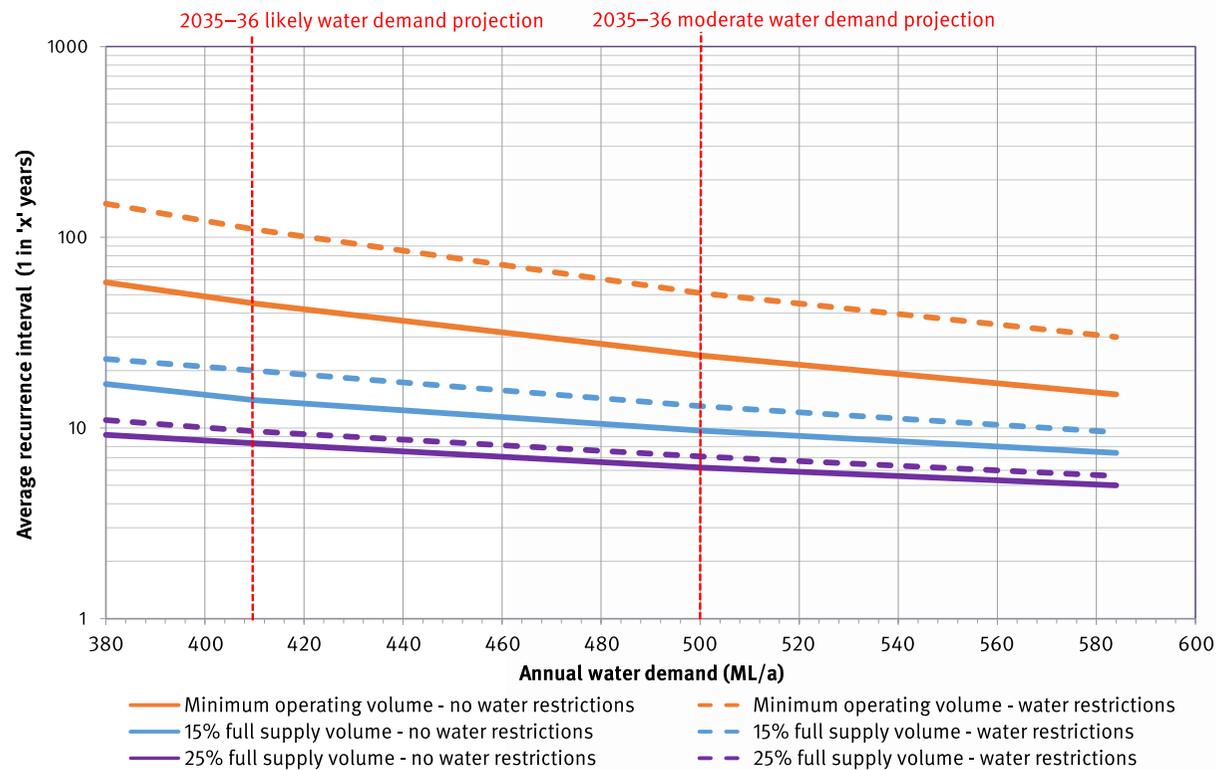
In the hydrological modelling, a water restriction regime based on the storage volume of No. 7 Dam and targeted water use reductions was tested (refer to Table 2).

Table 2: Mount Morgan's water restriction levels⁹

Restriction levels	Supply trigger levels (% of full supply volume)	Targeted reduction in urban water use (%)
0 (no restrictions)	>60%	-
1	50% <capacity <60%	5%
2	40% <capacity <50%	10%
3	30% <capacity <40%	15%
4	25% <capacity <30%	20%
5	15% <capacity <25%	25%
6	Capacity <15%	30%

The hydrologic assessment assumed that modelled savings from the water restrictions will actually be achieved. Figure 6 shows the improvement of the Mount Morgan water supply system performance when these water restrictions are imposed.

⁹ Trigger levels and reduction targets are based on the water restriction regime developed for Council's 2009 drought management plan and are currently under review.



The stochastic results indicate that No. 7 Dam is less likely to reach low levels if these water restrictions are in place. Figure 6 shows that the likelihood of No. 7 Dam being unable to meet Mount Morgan’s water demand (i.e. No. 7 Dam reaching minimum operating volume) halves with the water restriction regime in place.

Considerations such as the acceptable frequency of reaching low water levels in No. 7 Dam, the associated frequency of imposing water restrictions and the underlying likelihood of not being able to meet demand are fundamental parts of the water supply planning currently being undertaken by Council.

The assessment results demonstrate that Mount Morgan’s urban water supply is expected to have the capacity to support community growth over the next 20 years. Council is committed to improving water security for this community.

Figure 6: Average recurrence interval for No. 7 Dam reaching low levels under various water demands with and without water restrictions

Moving forward

This regional water supply security assessment represents a collaborative approach between the Queensland Government, through the Department of Natural Resources, Mines and Energy, and Rockhampton Regional Council to establish a shared understanding of the existing security of Mount Morgan's urban water supply and its capacity to support future growth.

Council is committed to developing a strategy to ensure the long-term security of the Mount Morgan water supply. In the development of this strategy, a number of initiatives are being considered. Initially, plans are being developed to undertake further analysis of Mount Morgan No. 7 Dam to better understand its performance as a raw water storage. This work will include performing an accurate bathymetric survey of the storage to ensure that the storage characteristics are fully understood, and also investigating the extent to which any losses are occurring from the storage through the riverbed and associated dam structure.

The Mount Morgan community has a relatively low per capita water use, indicating that this community understands the importance of being waterwise to improve water security.

Council will continue to encourage this community attitude and look to enhance this through further promotion of water efficiency and water conservation initiatives. Council will also look to expand the use of recycled water in Mount Morgan to offset the use of potable water where possible.

Longer term, Council is continuing to pursue options of eventually connecting the Mount Morgan community to the Rockhampton Water Supply Scheme via a bulk water supply pipeline. This project opportunity, if realised, would increase Mount Morgan's water supply security through use of the abundant Fitzroy River water resource to augment supply to this important community.





For more information on the Regional Water
Supply Security Assessment program please visit

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