Department of Natural Resources, Mines and Energy

Cloncurry

regional water supply security assessment

Queensland Government

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Introduction

The town of Cloncurry is located approximately 770 km west of the city of Townsville and 120 km east of Mount Isa. Cloncurry lies adjacent to the Cloncurry River, at the centre of the North West Queensland Mineral Province—one of the world's most highly mineralised areas.

The town of Cloncurry is the administrative centre for the Shire of Cloncurry, supporting strong pastoral and minerals sectors, as well as being an important regional centre for services for the smaller surrounding shires.

Based on the Queensland Government Statistician's Office estimates[1], the population of Cloncurry will increase from approximately 2320 (June 2017) to around 2440 by 2041. However, there is potential for mining activity to increase in the area, which in turn could increase the rate of Cloncurry's population growth.

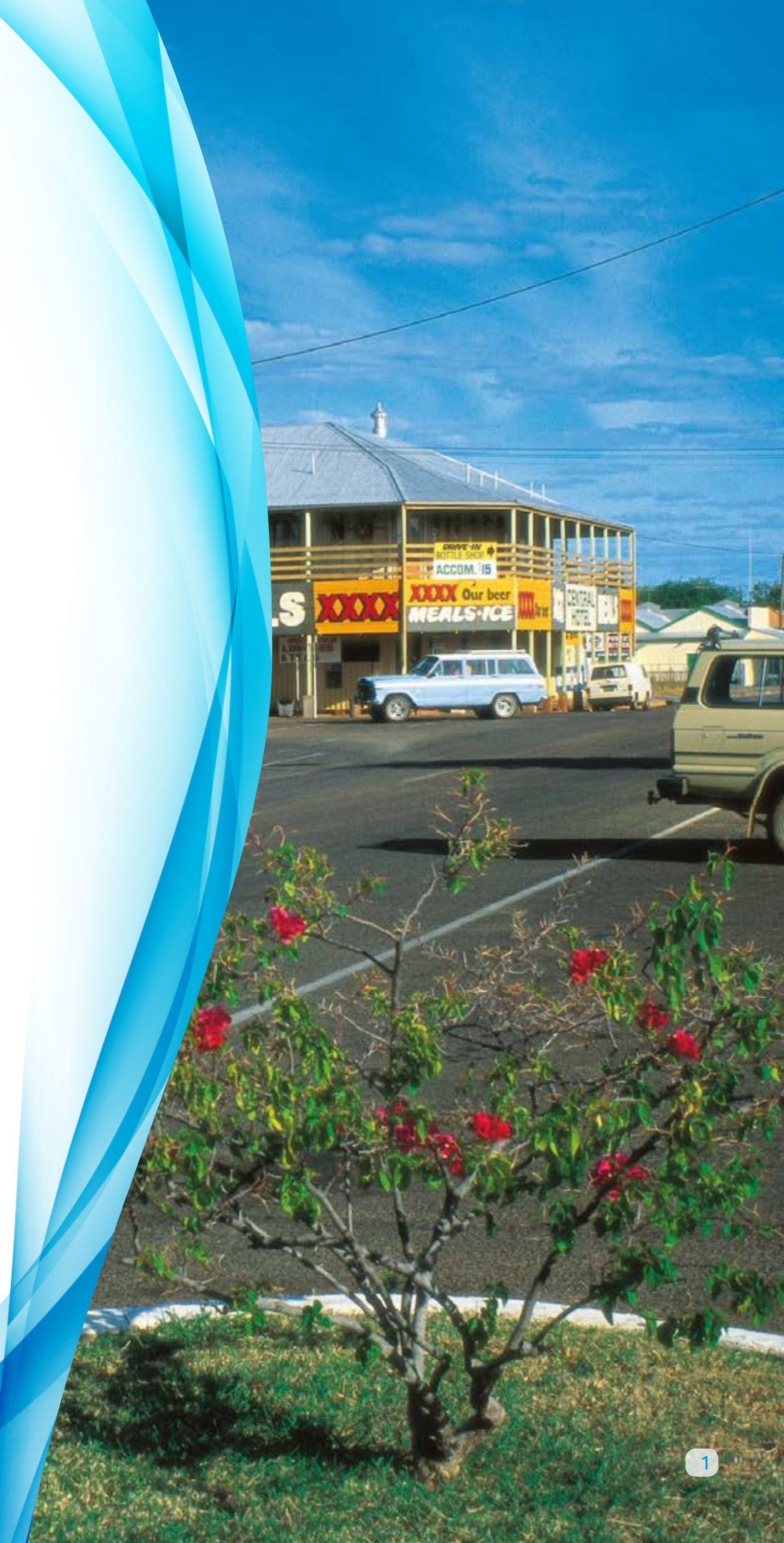
Safe, secure and reliable water supplies are an essential resource for Cloncurry, not only providing for the health and wellbeing of the community, but also providing opportunities for economic and community development. Cloncurry Shire Council is the registered water service provider for Cloncurry's urban water supply and provides both water supply and waste water services to Cloncurry.

The Queensland Government, through the Department of Natural Resources, Mines and Energy (DNRME), and council committed to a partnership to investigate and establish a shared understanding of the existing security of Cloncurry's urban water supply system and its capacity to support current demands and future growth. Arising from this partnership, this regional water supply security assessment (RWSSA) provides valuable information to the community and water supply planners about Cloncurry's urban water supply security, thereby providing a foundation for future water supply management by council.

This assessment has considered a number of water demand scenarios for the population of Cloncurry to identify the timing and magnitude of potential water supply risks. It is assumed that all of Cloncurry's urban population is serviced by Cloncurry's reticulation network, and that this will continue to be the case into the future. The assessment shows that, assuming that Cloncurry's historical patterns of water use and climatic conditions continue, Cloncurry's water supply is reasonably reliable for current and projected water demands until at least 2041. However, demands may need to be managed to ensure supply continuity, particularly when Julius Dam is the only available supply source. The assessment found that supplies from Julius Dam are an important element of Cloncurry's overall supply security—this includes providing an alternative supply during times of high turbidity in local supply sources.

It is important to note that information presented in the assessment is based on the capacity of the existing water supply system and associated infrastructure.

1 Based on QGSO data as at 20 September 2017. Note that QGSO population projections are revised from time to time.



Water supply sources

Cloncurry obtains its water supplies from a number of sources, these being Chinaman Creek Dam, Cloncurry Weir, river wells in the Cloncurry River, water harvested from the Cloncurry River, and the Julius Dam Water Supply Scheme.

Council holds a number of water licences which it uses to meet Cloncurry's urban water demand. Cloncurry's primary local water source is Chinaman Creek Dam, from which Council has a licence for extracting up to 2000 megalitres per annum (ML/a). Council also holds a licence for extracting up to 1460 ML/a from the river wells, and a licence to take up to 700 ML/a from the ponded area of Cloncurry Weir, which may be either taken directly for urban supply or may instead be harvested (pumped) into Chinaman Creek Dam. Council also holds a water harvesting licence that permits up to 2000 ML/a to be extracted from Chinaman Creek downstream of the dam (i.e. Cloncurry River flow that has backed up into Chinaman Creek) and pumped into Chinaman Creek Dam to top up storage levels (noting that the maximum total volume that can be taken from Chinaman Creek Dam is 2000 ML/a, and water harvesting from other sources into the dam does not increase this volume). Chinaman Creek Dam, Cloncurry Weir and the river wells are owned and operated by council.

Water from Julius Dam is delivered to Cloncurry's water treatment plant via the Cloncurry Pipeline, which branches off the North West Queensland Water Pipeline. Cloncurry's water supplies from Julius Dam are currently provided through agreements between the Queensland Government, Cloncurry Shire Council and North West Queensland Water Pipeline Pty Ltd (a wholly owned subsidiary of SunWater). Under these agreements, the volume of water that Cloncurry can take from the pipeline is limited to 3.12 ML/day, 237.5 ML/quarter and 950 ML/a. Julius Dam is owned and operated by SunWater.

The location of Cloncurry and its various water supply sources are shown in Figure 1. Water for Cloncurry is treated at Cloncurry's water treatment plant before being transferred to the town's reservoir system and distributed to customers via the town's reticulation network.

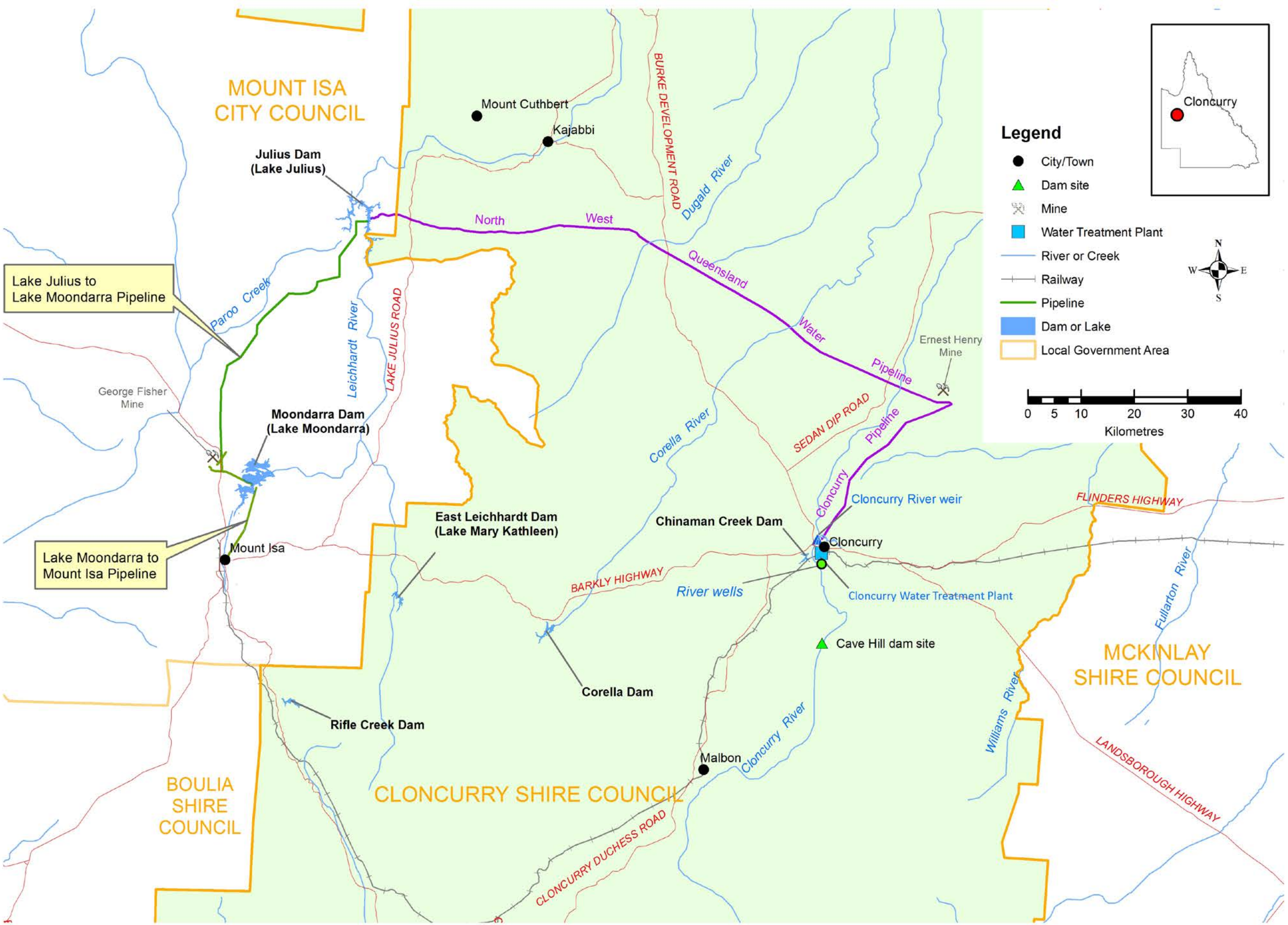


Figure 1: Location of Cloncurry and its water supply sources

Water users and water demand

Cloncurry's reticulation network provides water for urban purposes to about 2320 people (as at June 2017).

Cloncurry's reticulation network

Information from the Statewide Water Information Management database shows that the total volume of water sourced for Cloncurry's reticulation network over the period 2012–13 to 2017–18 averaged approximately 1300 ML/a (ranging from around 1060 ML/a to 1717 ML/a).

Based on the total volume of water sourced and the serviced population, Cloncurry's average water demand during this period (2012–13 to 2017–18) was approximately 1520 litres per capita per day (L/c/d). This figure accounts for residential, commercial, municipal, and industrial water supplied from the reticulation network, plus any system losses. It also includes water use by the transient population, such as tourists and temporary workforces. Water use by the transient population is mostly accounted for under the category of commercial use; however, the transient population is not included in the serviced population figures.

The average residential water use for this period was approximately 1230 litres per person per day (about 80% of total urban water use).

Recycled water

Although water from Cloncurry's waste-water treatment plant is not currently recycled, council is in the process of upgrading its water treatment plant to meet environmental protection requirements and is investigating re-use alternatives for the treated effluent. The use of recycled water could potentially reduce demand on the reticulation system, for example where recycled water replaces the use of reticulated water for watering parks and gardens.

Water demand is impacted by variations in climate

Urban water demand varies between years and within each year, depending on various factors including climatic conditions such as rainfall, with higher demand usually occurring during hotter, drier periods. However, at times during extended dry periods dam levels may become very low and, as a result of water restrictions being applied, water use may be lower than it would otherwise have been.

Average rainfall for Cloncurry (based on water years—July to June) is about 482 millimetres per annum (mm/a). The long-term historical rainfall data for Cloncurry (1884–85 to 2017–18) is summarised in Table 1. Also shown in Table 1 is the average rainfall over the recent 2012–13 to 2017–18 period, which is lower than the average over the longer term. The implications of this lower average rainfall on the average water demand figure are discussed in more detail later.

Table 1: Summary rainfall statistics for Cloncurry

Rainfall station No. 29008 McIllwraith St.	Annual average (mm)	Median (mm)	Historic low (mm)	Historic high (mm)
1884–85 to 2017–18	482.2	452	124	1498
2012–13 to 2017–18	360.7	379.4	150.6	478.3

*(*Note: Missing data was substituted with data from Station No. 29141 Cloncurry Airport)*

Figure 2 shows the total annual (July to June) rainfall recorded in Cloncurry (gauging station 29008 McIllwraith St) and the extent that the average daily water demand on Cloncurry's reticulation network varies from year to year for the period 2012–13 to 2017–18, and the total annual volumes of water sourced for Cloncurry's reticulation network over the same period.

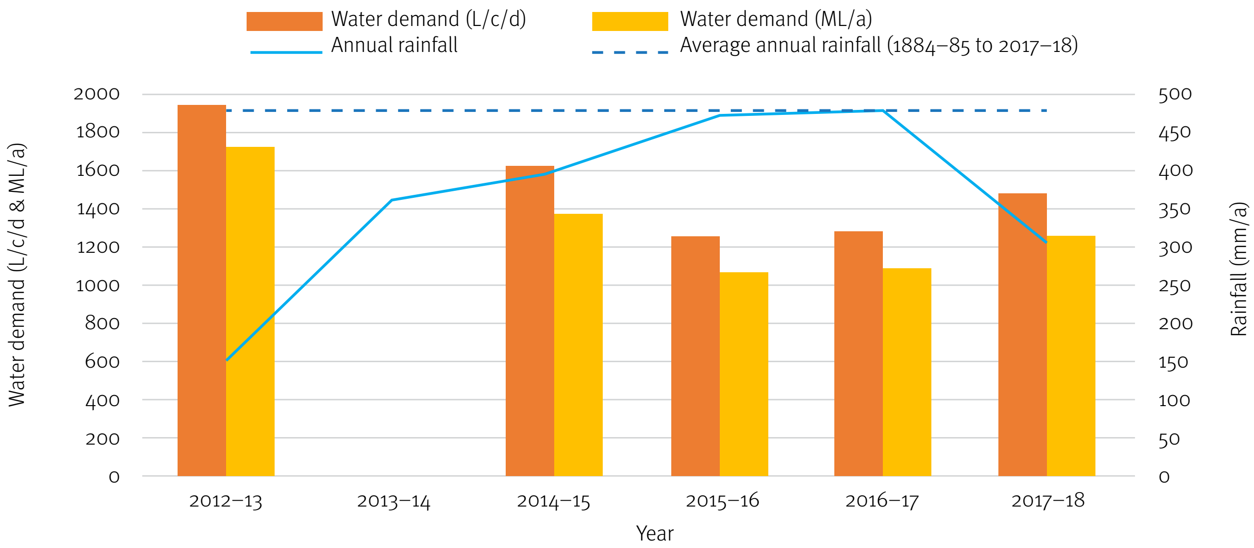


Figure 2: Water demand and annual rainfall for Cloncurry

Figure 2 shows the extent that the water demand varies from year to year, ranging from approximately 1253 L/c/d in 2015–16 to 1948 L/c/d in 2012–13. Over the period shown, Cloncurry's highest annual water demand occurred in 2012–13, which coincided with the lowest annual rainfall for the period (only 150.6 mm) and was significantly below the long-term annual average (~482 mm). Figure 2 also shows that rainfall for every year in this period was below the long-term annual average and, as a result, water demand during this period may have been higher than average.

Climate change

The Queensland Government provides scientific advice on climate change projections for 13 Queensland regions, including the North West Queensland region in which Cloncurry is located. Similar to most areas of Queensland, the projections indicate that the North West Queensland region will be warmer and drier with increased evaporation.

The projected climate changes may potentially result in reductions in water supply availability and increases in water demands within the region. The impact of changes to demand, which may be driven by climate change, were captured in this assessment through considering a range of water demand levels and a wide range of potential future climatic scenarios which include events more extreme than have been observed historically.

Other users of the bulk water supply sources

Agriculture

The Cloncurry Shire has a strong pastoral industry, dominated by beef production. Water resources in the Cloncurry region are managed under the Water Plan (Gulf) 2007, which generally permits the taking of water within the plan area for stock and/or domestic purposes. However, due to the short duration of flows in Chinaman Creek and the Cloncurry River, it is considered that take for stock and domestic purposes would have no significant impact on the supplies for Cloncurry.

Other than council's entitlements, there are currently (as at March, 2019) no water entitlements within the catchment area of Chinaman Creek and no water licences used for agricultural purposes in the catchment area of the Cloncurry River upstream of Cloncurry.

Mining and industry

Cloncurry is situated in the centre of the North West Queensland Mineral Province, which contains an estimated 75% of Queensland's total metalliferous resources such as copper, silver, lead and zinc. Mining activity in the Cloncurry Shire has a significant impact on Cloncurry's population, with population increases and decreases generally linked to mine expansion and contraction activities. Most of the mines in the Cloncurry region source water for their operations from local groundwater bores and their operations do not directly impact the main water supply sources for the town of Cloncurry.

Within the local Cloncurry area there are only two licences to take water for mining —a licence to take up to 18 ML/a from the Cloncurry River about 40 km upstream from Cloncurry, and a licence to take up to 200 ML/a from Coppermine Creek in Cloncurry (Coppermine Creek joins the Cloncurry River downstream of Cloncurry Weir). The use of water under these entitlements does not have any adverse impacts on water availability for Cloncurry.

There are flow-on economic benefits from mining activities in the Cloncurry Shire for associated and supporting industries within Cloncurry town. In addition to providing a base for supporting the surrounding mining operations, such industries and businesses in Cloncurry help to support the local population and provide local employment. However, there are no large scale industries in Cloncurry itself, and industrial water demand for Cloncurry is considered to be broadly correlated with Cloncurry's population.

Future water demand

To enable well-founded water supply planning, it is essential to have a sound understanding of the possible changes to water demand that may occur in the future due to Cloncurry's population growth, as well as future mining and other water uses.

In developing a projection of Cloncurry's future water demand, it is essential that all key assumptions, such as rates of water use and population growth, are identified and agreed upon. The projections will remain subject to ongoing monitoring of actual population growth and variations in water use trends (e.g. changes in water use practices may increase or decrease consumption).

Cloncurry's reticulation network

As discussed earlier, the resident population of Cloncurry is projected to increase from about 2320 in 2017 to about 2440 by 2041, which equates to an average annual growth rate of approximately 0.2%. However, it is noted that new mining activity could occur in the Cloncurry region and consequently Cloncurry's residential population could increase more significantly at some point in the next 20 years. Any significant population increase due to new mining activity is more likely to occur in relatively sudden spurts of growth rather than being a gradual annual growth. Cloncurry's urban population has increased or decreased by as much as about 11% from one Census period to the next over the period 1991 to 2016 (although total net growth over this entire period has been less than 1%). Under a higher average annual population growth rate of, for example, 1% per annum, Cloncurry's population could increase by about a further 500 people by the year 2041, to around 2970 people (around 20% higher than currently projected).

The average daily water demand for Cloncurry over the period 2012–13 to 2017–18 was approximately 1520 L/c/d. It is important to note that this figure represents average demand during a relatively dry, hot period compared to the long-term historical averages—in each year from 2012–13 to 2017–18 the annual rainfall was below the historical long-term average annual rainfall (for the period 1884-85 to 2017-18), and for more than two-thirds of all months the mean maximum daily temperature was above the long-term average. Therefore, the average water demand during this period may have been higher than an average derived from a wetter, cooler period. Offsetting this to some extent, average temperatures and evaporation in the Cloncurry region are projected to increase over the next 30 years, and these factors are generally associated with higher water demands.

The use of an average demand figure provides a means of directly comparing future demand projections to determine 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.

The projected water demand for Cloncurry, based on a 0.2% annual population growth rate and an average water demand of about 1520 L/c/d, is shown below in Figure 3. Average annual urban water demand for Cloncurry is projected to increase from the recent average of about 1300 ML/a (2012–13 to 2017–18) to about 1350 ML/a by 2041. This represents an increase in water demand of about 3.7% over this period—actual water demand in any particular year may be higher or lower for a variety of reasons, including variations in climatic conditions.

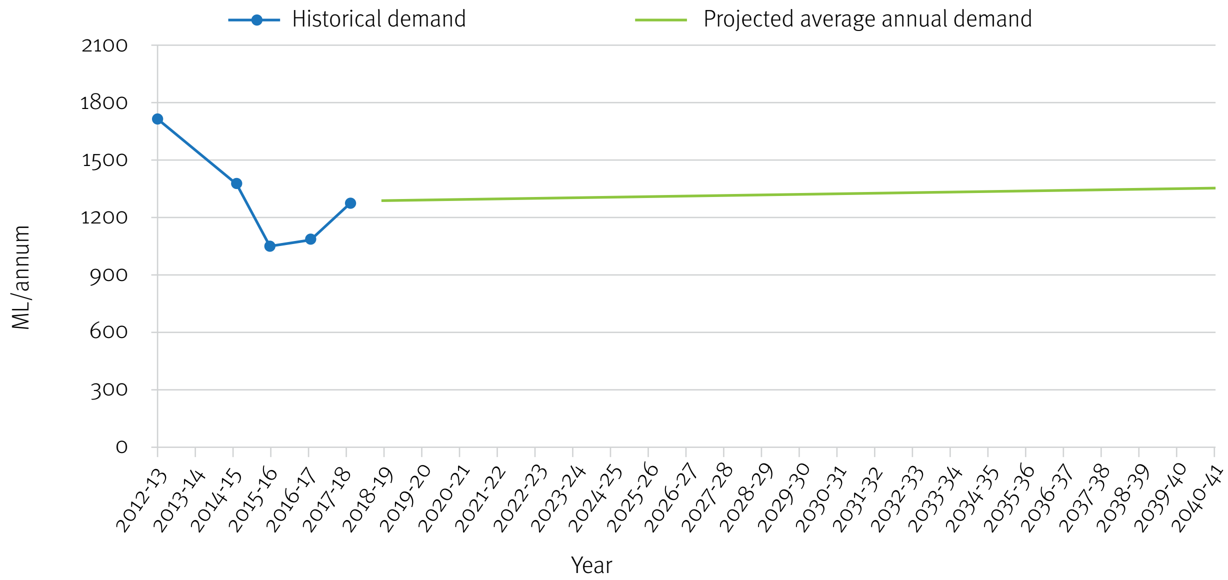


Figure 3: Cloncurry's projected average annual water demand

As previously mentioned, Cloncurry's residential population could increase more significantly if new mining activity occurs in the Cloncurry region. While the potential timing of any such growth is currently unknown, under a scenario of (on average) 1% per annum population growth, Cloncurry's population could increase to around 2970 people by the year 2041 (around 20% higher than currently projected, or approximately double the largest population changes that have previously occurred between Census periods). The effect of such a population increase would be a commensurate increase in water demand of about 300 ML/a, to reach a total average demand of around 1650 ML/a by 2041.

Recycled water

The availability of recycled water in the future could potentially reduce demand on Cloncurry's reticulation system; for example, where it is used for watering parks and gardens. Recycled water use may also provide an opportunity to continue the greening of Cloncurry's municipal areas even during very dry periods when the urban water supply sources (e.g. Chinaman Creek Dam) are at low levels.

Other users of the bulk water supply source

Agriculture

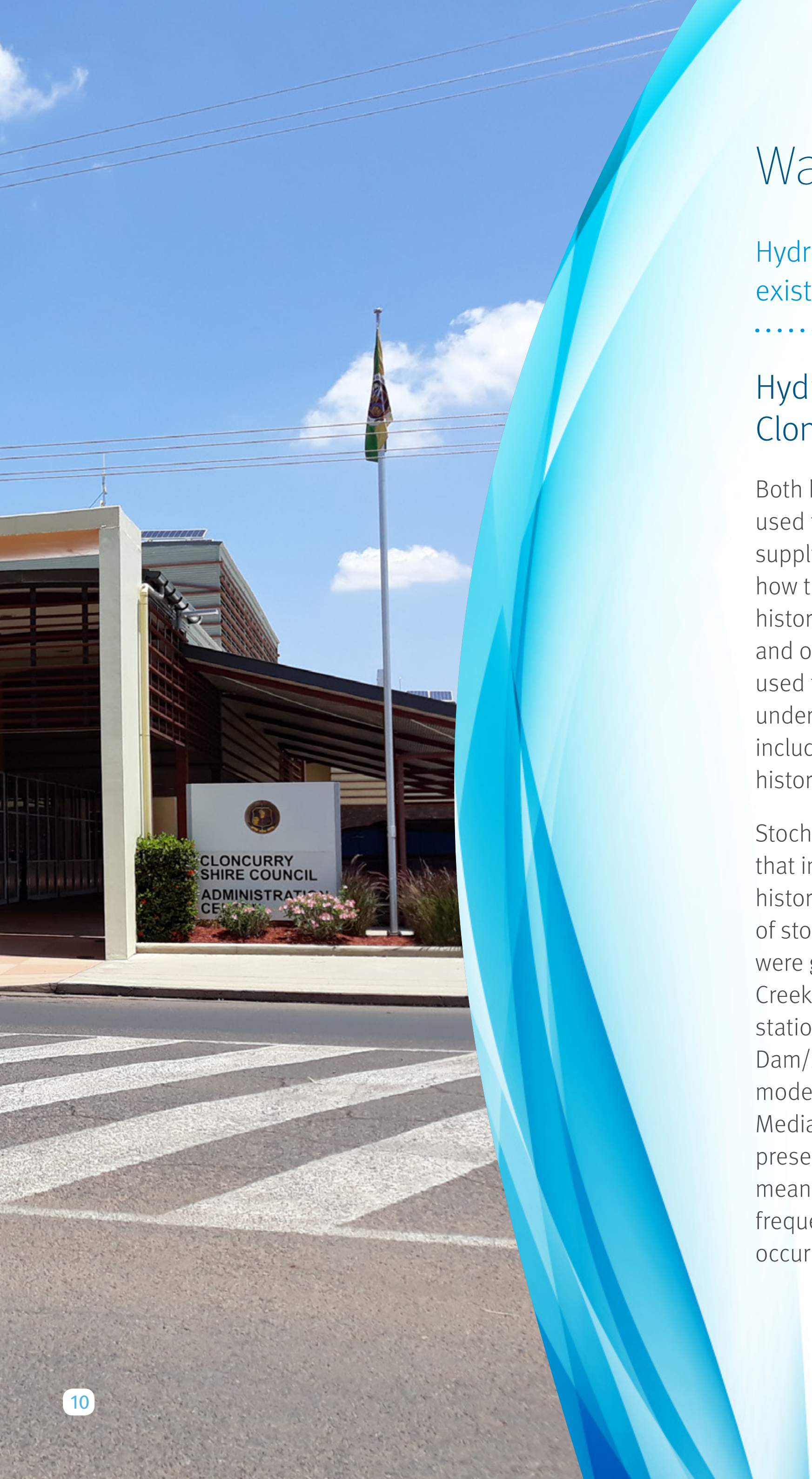
Soils, both north and south of Cloncurry, that are potentially suitable for the development of agriculture and which can be irrigated from Cloncurry River flows have been identified in a number of studies, including new water infrastructure proposals. There is therefore some potential for a future increase in water demand from the agricultural sector on the water sources that service Cloncurry (specifically, the Cloncurry River).

The Water Plan (Gulf) 2007 outlines general reserves of unallocated water within the Flinders River catchment area (which includes the Cloncurry River), which could potentially be used for irrigation (or any other) purposes. However, any water entitlements granted from these reserves would need to comply with the Water Plan and require a pass-flow condition, which reduces their potential impacts on Cloncurry's water supply sources.

Future water demands from the agricultural industry are considered unlikely to have a significant impact on the water supplies for Cloncurry, largely due to the short duration of flows in Chinaman Creek and the Cloncurry River, and the requirement for pass-flow conditions on any future water entitlements issued.

Mining and Industry

Mining activity plays a significant role in Cloncurry's economy and its population. There continues to be significant interest from the mining industry in the Cloncurry region and, although individual mining operations will commence and conclude over time, global demand for mineral resources is likely to sustain mining activity in the Cloncurry area for a considerable time to come. While these mining activities are not projected to have a significant direct impact on Cloncurry's water supplies, their effect on Cloncurry's population is expected to continue. As previously discussed, an increase in overall mining activity would be likely to increase both Cloncurry's population and related urban water demand.



Water supply system capability

Hydrologic assessments have been undertaken to determine the capability of Cloncurry's existing bulk water supply system to meet current and projected future water demands.

Hydrologic assessment of Cloncurry's water supply system

Both historical and stochastic modelling techniques were used to simulate the performance of Cloncurry's water supply. Historical modelling was used to demonstrate how the water supply would have performed under historical climatic conditions for a range of demand levels and operating arrangements. Stochastic modelling was used to demonstrate how the water supply may perform under a wider variation of potential climatic scenarios, including during more severe droughts than those in the historical period of record.

Stochastic modelling involves generating data sequences that incorporate key statistical indicators from the historical record. One hundred replicates of 10 000 years of stochastic rainfall, evaporation and streamflow data were generated for the catchment areas of Chinaman Creek and the Cloncurry River (to the stream gauging station downstream of Cloncurry), as well as the Julius Dam/Moondarra Dam catchment areas, and hydrologic modelling of each of the 100 replicates undertaken. Median outputs from the stochastic modelling have been presented in this assessment. Using the median outputs means that half of the replicate sequences had a lower frequency and half had a higher frequency of an event occurring.

The hydrologic modelling undertaken simulates council's current operational procedures for Cloncurry's water supply sources, including for water supplied from Julius Dam via the North West Queensland Water Pipeline (NWQWP).

It is noted that council's current operational procedures differ from the arrangements agreed to when Cloncurry's supply from Julius Dam was first established. The original operating arrangements were designed, among other things, to maximise the volume of water that could be taken from the local supplies first. Council's current operating procedures also take into account the water-quality impacts from high turbidity levels, which occur when there are significant inflows following prolonged dry periods (during which times water is accessed from the NWQWP). Additionally, Cloncurry's water supply system has changed since the original agreement, with the construction of the Cloncurry Weir in 2014.

The original agreement and operating arrangements are being reviewed as part of the periodic review process outlined in the initial agreement. As the modelling outcomes below are based on a particular set of operational procedures, it is important to note that modelled outcomes may be different under alternative operational arrangements.

The hydrologic assessments assume that all existing water entitlements in the Flinders Rivers catchment from the dams or watercourses that support Cloncurry's water supply system are fully developed and operational, with the exception of the entitlements associated with Cloncurry's reticulation network. Cloncurry's water demands were represented at five different total annual demand levels: three demands ranging from 1350 ML/a to 1800 ML/a to span the range of Cloncurry's projected future demands, plus two higher demands to assess the performance of the system under increased demand pressure. All of the hydrologic assessments undertaken assumed a demand of 31 550 ML/a on the Moondarra and Julius Dam water supply schemes (excluding Cloncurry's use)—this level of demand represents the highest average annual total water demands projected for this system to at least 2041).

In an effort to reduce water consumption and extend the duration of the available water supply during extended dry periods, council has established a water restriction regime for Cloncurry based on the storage volume of Chinaman Creek Dam. The water restrictions primarily target outdoor water uses including watering of lawns and gardens, washing vehicles, cleaning paved or concreted areas, and swimming pool use. Further details on water restriction rules are available on council's website.

Council's various water restriction levels reflect a targeted maximum daily water consumption level for the community. For modelling purposes, a proportionate percentage reduction was applied to the L/c/d demand at each restriction level, as shown in column 4 of Table 2 (these percentages were calculated based on council's consumption targets).

Table 2 shows the storage volumes in Chinaman Creek Dam that trigger the various water restrictions, and the corresponding urban water consumption targets. The hydrologic assessment assumes that anticipated savings from the water restrictions will actually be achieved.

Restriction level	Supply trigger levels (Remaining % of the fully supply capacity in Chinaman Creek Dam)	Council's targeted maximum urban consumption target	% reduction applied to L/c/d demand in model
1	60 % and above	Permanent conservation measures	0
2	At or above 50% and below 60%	<3.5 ML/day	14
3	At or above 40% and below 50%	<3.2 ML/day	21
4	At or above 30% and below 40%	<3.0 ML/day	26
5	At or above 20% and below 30%	<2.8 ML/day	31
6	Below 20%	<2.5 ML/day	38

Note: Trigger levels and reduction targets are subject to review and amendment as determined by Cloncurry Shire Council from time to time

Frequency of water supply shortfalls and water restrictions

For this assessment, Cloncurry is considered to have experienced a water supply shortfall when its water supply sources are unable to meet the water demands placed on the system by Cloncurry's community. This could, for example, occur as a result of the overall available supplies becoming depleted due to, for example, severe or extended drought, or the community's demand exceeding the volume of water it is entitled to take.

Historical modelling assessment

The historical modelling undertaken (for the period 1890 to 2003) indicates that Cloncurry's water supply system would have been capable of meeting demands up to about 1800 ML/a during that period without experiencing any water supply shortfalls, assuming water restrictions are applied when triggered. This level of demand exceeds Cloncurry's projected average 2041 demand of around 1350 ML/a. However, it should be noted that this projected water demand is an average demand and Cloncurry's annual demand has been higher in the past—demand will vary from day to day and between years and generally be higher during hotter, drier periods.

Simulated storage levels for Chinaman Creek Dam, produced from the hydrological modelling, illustrate that rapid water-level fluctuations occur on a regular basis and water levels in the dam have fallen to low levels on several occasions. This is primarily a result of the small storage capacity of the dam, which is significantly drawn down each year by water demand and storage losses, and relies on seasonal inflows to refill. Figure 4 shows the simulated storage behaviour of Chinaman Creek Dam for the period 1890 to 2003 at a demand of 1350 ML/a, under council's current operating arrangements (which includes the supply of water from Julius Dam via the North West Queensland Water Pipeline (NWQWP)). Also shown in Figure 4 is the simulated occurrences of water levels being below the triggers for Level 4 restrictions and Level 6 restrictions (at a demand of 1350 ML/a).

The operating rules generally focus on using Cloncurry's local water supply sources first, while providing an alternate supply via the NWQWP during times that local supply sources have very high turbidity or are at very low water levels. Under the operating rules, there may be times when supply is from local sources, the NWQWP, or a combination of both. However, in all cases, water restrictions are based on the volume of water remaining in Chinaman Creek Dam.

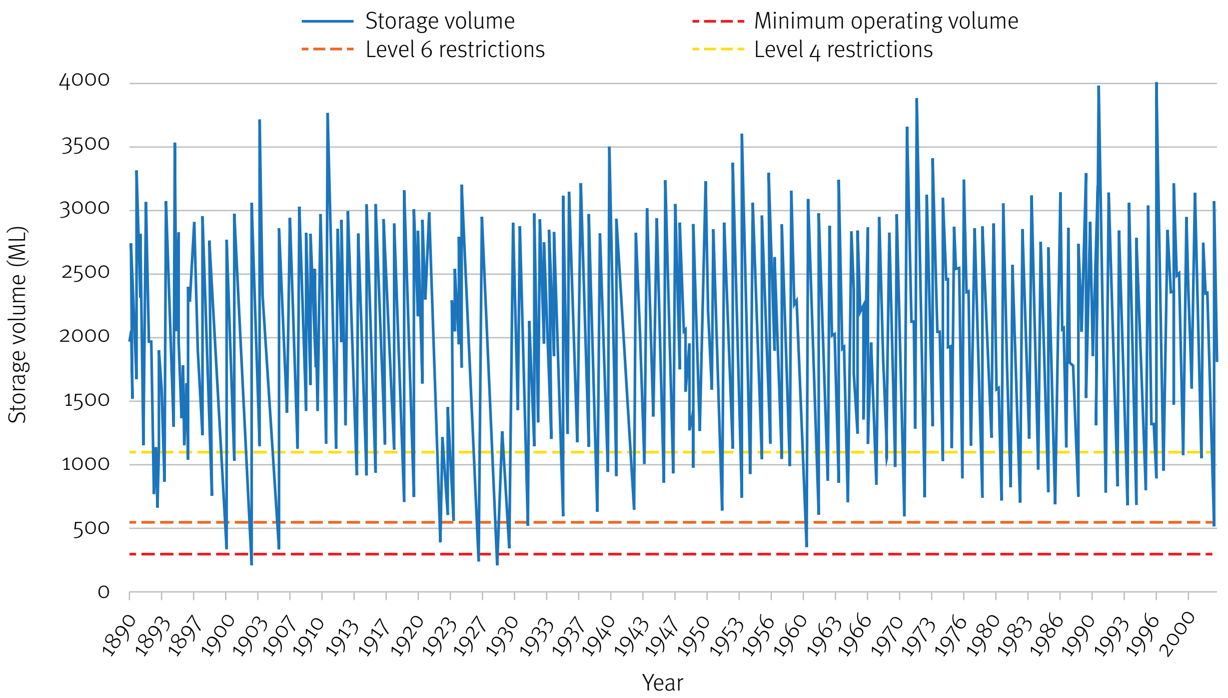


Figure 4: Simulated performance of Chinaman Creek Dam at a demand of 1350 ML/a under council's current operating arrangements and with water restrictions

Image courtesy of Cloncurry Shire Council

The modelling also showed that at a demand of 1800 ML/a Cloncurry's local supplies would have fallen to low levels on numerous occasions, and at times the ability to meet demand would have been entirely dependent on supplies from Julius Dam (i.e. via the NWQWP). As previously mentioned, daily, quarterly and annual caps apply to the volume of water that can be taken from the NWQWP, limiting take from the pipeline to 3.12 ML/day, 237.5 ML/quarter and 950 ML/a. For demands around and above 1800 ML/a, the existing operating rules and restriction regime may become limiting factors and, accordingly, an alternative operating arrangement and or restriction regime may be needed.

For example, historical modelling showed that for the higher demands modelled (i.e. above 1800 ML/a) the reliability of supply was significantly reduced, largely because of the extraction limits applied to the NWQWP.

The modelling showed that, at a demand of 2100 ML/a (assuming a constant daily demand pattern), in about 2.7% of years (or on average about once in 37 years) the NWQWP would be the only supply source for some period of the year, during which time the restricted daily demand would exceed the pipeline daily extraction limits. Therefore, during times when Julius Dam is the only available supply source, demands may need to be managed or alternative operating arrangements may be required to ensure supply continuity.

While the historical performance of a water supply system provides 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 to historical inflows. Historical performance is dependent on the water use at the time, with urban water use typically increasing proportionately to population growth. A period of low inflows that did not result in a failure to meet urban water demands in the past may have failed under a higher urban water demand. More sophisticated tools, such as demand forecasting and stochastic modelling, are needed to account for a wider range of potential scenarios.

Stochastic modelling assessment

As outlined earlier, stochastic modelling accounts for a wider variation of potential climatic scenarios than the historical modelling. This makes it a useful tool for improving our understanding of the water supply system's capacity, including the likelihood of events that have not occurred during the historical period but may be possible in the future.

Stochastic modelling results indicate that at a water demand of 1350 ML/a (around Cloncurry's projected 2041 demand), a water supply shortfall may occur on average about once in 900 years (Figure 5, Point A). For a water demand of 1800 ML/a (the maximum demand with no failures under the historical modelling), the stochastic modelling indicates Cloncurry may experience a water supply shortfall about once in 230 years on average (Figure 5, Point B)—however, it is anticipated that many of the modelled shortfalls at this demand level are a result of the operating rules rather than there being no water, and under alternative rules better performance might be achieved. At this demand level (1800 ML/a), occurrence of a water supply shortfall lasting for a duration greater than 1 month is less than once in 10 000 years.

Figure 5 illustrates, for a range of demands up to 1800 ML/a, the average recurrence interval of demand not being met, water levels in Chinaman Creek Dam being below the dam's minimum operating level, and water levels being below the Level 4 and Level 6 water restriction triggers (key statistics related to Figure 5 are also provided in Table 3). Figure 5 shows the extent to which, as demand increases, there is a shorter average recurrence interval between these events occurring.

At the projected 2041 water demand of about 1350 ML/a, water levels in Chinaman Creek Dam may be below the trigger level for Level 4 water restrictions on average about every second year (once in 1.7 years) (Figure 5, Point C), and below the trigger level for Level 6 water restrictions approximately once in 8 years on average (Point D), increasing to about once in 6.3 years at a demand of 1800 ML/a (Point E).

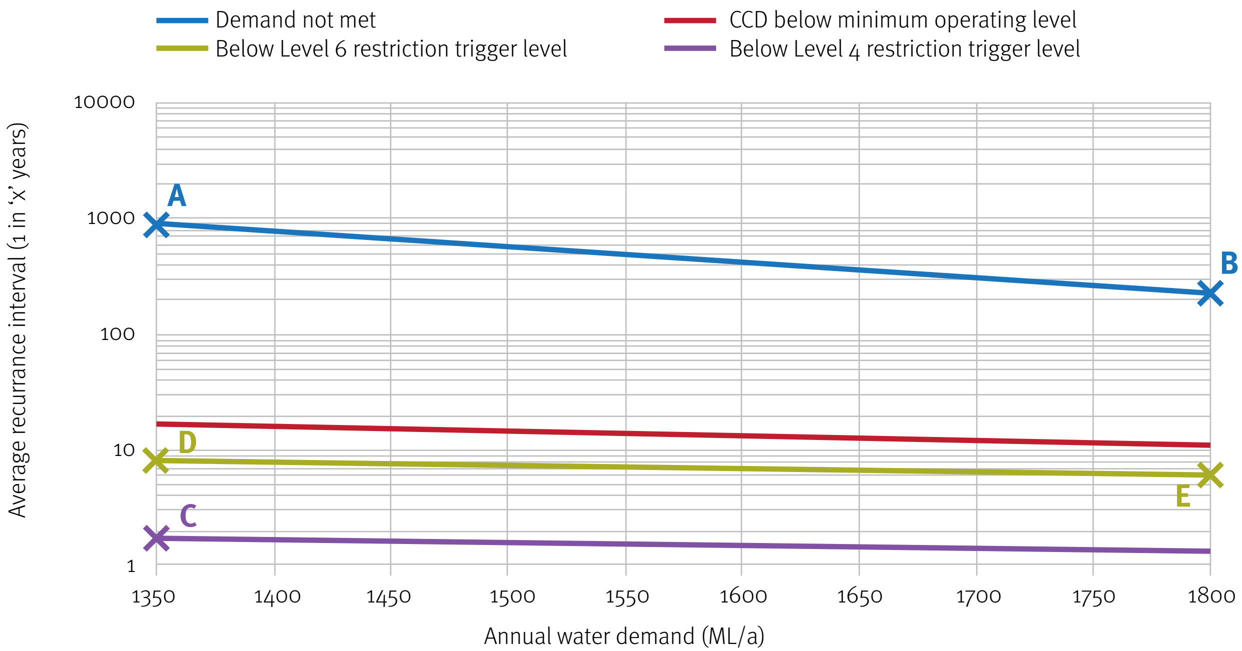


Figure 5: Frequency of demand not being met, and water levels in Chinaman Creek Dam (CCD) being below various water restriction trigger levels and below minimum operating level

Table 3: Average recurrence interval of key triggers being met and events occurring

Demand (ML/a)	Average recurrence interval (1 in 'x' years)			
	Water supply shortfall	Below trigger level for Level 4 water restrictions	Below trigger level for Level 6 water restrictions	Chinaman Creek Dam below minimum operating level
1350	909	1.7	8	17
1550	476	1.6	7.1	14
1800	233	1.4	6.3	11

Stochastic modelling shows that, under the assumptions used, the system's performance significantly drops for the modelled demands above 1800 ML/a (note, however, that average water demands are not projected to exceed 1800 ML/a by 2041, including under the scenario previously discussed regarding increased mining activity). For example, modelling showed that for a water demand of 2100 ML/a, demand will be met in most years, but about 1 in 40 years demand will either not be met or be only partially met during some periods of that year. Occurrence of these water supply shortfalls being for a duration greater than 1 month is about once in 67 years and, of these, durations greater than 3 months occur about once in 135 years.

As discussed for the historical modelling results, the reduced performance for demands above 1800 ML/a is primarily a result of the daily, quarterly and annual limits that apply to taking water from the NWQWP, which result in demand not being able to be fully met from the pipeline when it is the community's sole supply source (even when the current maximum water restrictions are applied). Therefore, during such times, alternative operating arrangements may be required to ensure supply continuity.

Considerations such as an acceptable frequency of the various restriction levels being applied, and the underlying likelihood of demand not being met, are critical and fundamental parts of the water supply planning currently being undertaken by Cloncurry Shire Council and generally by councils across Queensland.

Duration and severity of water restrictions

Although the frequency of water restrictions is an important consideration, the duration and severity of each restriction period may be more important for many water users. For example, it may be more acceptable to experience less severe and shorter periods of water restrictions more frequently, than to experience more severe and longer periods of water restrictions less frequently.

Figure 6 shows, for a simulated 10 000 year period, the median number of occurrences of storage volumes in Chinaman Creek Dam being below the trigger level for Level 4 water restrictions for longer than 1 month, 3 months, 6 months and 12 months. Figure 6 shows that, over a 10 000 year period, at a water demand of 1350 ML/a there are 3800 occurrences of the storage volume being below the trigger level for Level 4 water restrictions for more than 1 month, of which 1300 last longer than 3 months, 720 last longer than 6 months and 380 last longer than 12 months. Figure 6 also shows the extent that, with an increasing level of water demand, there is an increase in the number of occurrences of water levels being below the restriction triggers. The modelling outputs used in Figure 6 are provided in Table 4.

Figure 7 shows the median number of occurrences that the storage volume in Chinaman Creek Dam is below the trigger level for Level 6 water restrictions for various durations. The modelling outputs used in Figure 7 are also provided in Table 4

Together, the frequency, severity and duration of water restrictions, along with the ability to maintain a minimum supply during drought, are fundamental parts of water supply planning and form part of the 'level of service'. The level of service for Cloncurry is a matter for council to determine, in discussion with the community.

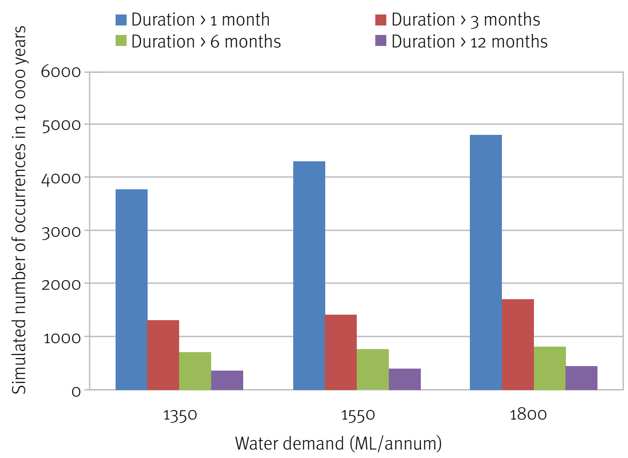


Figure 6: Number and duration of events where the storage volume in Chinaman Creek Dam is below the trigger level for Level 4 water restrictions at various annual water demands

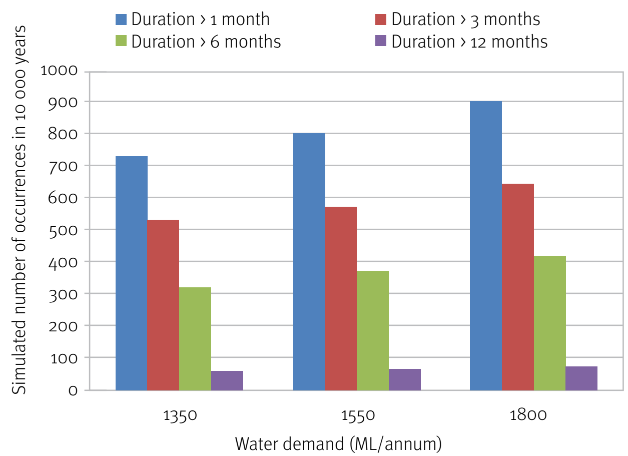


Figure 7: Number and duration of events where the storage volume in Chinaman Creek Dam is below the trigger level for Level 6 water restrictions at various annual water demands

Table 4: Number and duration of Chinaman Creek Dam water levels falling below water restriction triggers

		Demand (ML/a)		
	Duration	**1350**	**1550**	**1800**
Below Level 4 water restriction trigger:	› 1 month	3800	4300	4800
	› 3 months	1300	1400	1700
	› 6 months	720	760	810
	› 12 months	380	410	440
Below Level 6 water restriction trigger:	› 1 month	730	800	900
	› 3 months	530	570	640
	› 6 months	320	370	420
	› 12 months	60	68	80

Conclusions

Cloncurry sources its urban water supply from a variety of sources which include Chinaman Creek Dam, water harvesting from the Cloncurry River and Chinaman Creek, river wells in the bed sands of the Cloncurry River, and Julius Dam via the North West Queensland Water Pipeline. Cloncurry's average water demand is currently about 1300 ML/a and is projected to reach about 1350 ML/a by the year 2041. However, Cloncurry's average water demands could potentially be higher if new mining activity occurs in the local area (for example, around 1650 ML/a based on an additional population of 500).

This assessment found that, based on projected water demands to 2041 and Cloncurry's supply being augmented with water from Julius Dam, Cloncurry's urban water demand should be able to be met with a relatively high degree of reliability until at least 2041. However, council will need to continue monitoring population growth and mining developments in the area to maintain awareness of potential increases in water demand.

Historical and stochastic modelling both show that, assuming water restrictions are applied when triggered, Cloncurry's water supply is reasonably reliable for water demands of (up to) 1800 ML/a, with no water supply shortfalls occurring under historical modelling. The stochastic modelling results showed that, at a water demand of 1800 ML/a, a water supply shortfall could occur on average about once in 230 years, but the frequency of such shortfalls lasting for a duration greater than 1 month is less than once in 10 000 years. The assessment found that supplies from Julius Dam are an important element of Cloncurry's overall supply security, including providing an alternative supply during times of high turbidity in local supply sources.

The hydrologic modelling showed that at demands above 1800 ML/a, management of the supply under the current operational arrangements and restriction regime results in a marked reduction in supply performance—for example, at a demand of 2100 ML/a, even with water restrictions demand is not met about once in 40 years on average. It is anticipated that this could be alleviated by alternative operating arrangements, particularly relating to the Julius Dam supply and council's water restriction regime.

Moving forward

This RWSSA represents a collaborative approach between the Queensland Government and Cloncurry Shire Council to establish a shared understanding of the existing security of Cloncurry's water supply and its capacity to support future growth.

Cloncurry Shire Council recognises the need for safe and reliable water supply to residents and businesses in the local community, and is committed to ensuring the long term security of Cloncurry's water supply.

Reliable water supply for the community of Cloncurry is dependent on a number of water supply sources, including the local sources of Chinaman Creek Dam and Cloncurry River water, as well as water delivered from Julius Dam via the North West Queensland Water Pipeline and the Cloncurry Pipeline.

Cloncurry's water demand is projected to increase into the future, and council will face a number of challenging water supply issues, including issues with water treatment during times of high turbidity in the local supply sources and maintaining an appropriate level of service to the community from the available supplies.

Council plans to pursue avenues to ensure that it can continue to provide an ongoing reliable supply of drinking water for Cloncurry, including:

- Negotiating for a continued and appropriate supply of water to be provided through the pipeline from Julius Dam.
- Continuing to optimise operational procedures to ensure that available water supply sources are used in the most efficient and beneficial manner for the community.
- Working with state government departments and agencies and other key stakeholders to ensure that operational, licensing and other arrangements are appropriate to meet the water requirements of the community.
- Investigating demand management options such as education of the community on water saving measures, and appropriately applied tariffs.
- Further investigation of reuse options for treated effluent to reduce demand on the existing supply system.
- Continually reviewing demand to monitor changes in the patterns and volumes of water use over time.

Council will work with its community to identify an appropriate level of service that balances an acceptable water demand and supply against the lifestyle and expectations of the community. Council recognises that liveability is a key consideration in this balance, particularly in a dry climate such as Cloncurry's.

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

www.dnrme.qld.gov.au