

Regional water supply security assessment **Cairns**

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Regional Water Supply Security Assessment Cairns



Introduction

Cairns is a major regional centre within Queensland and, along with many other regional centres in Queensland, is expected to continue to experience economic and population growth over the coming decades.

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The Queensland Government Statistician's Office (QGSO) estimates the population of Cairns will grow from approximately 160 000 (June 2013) to around 240 000 by the mid-2030s. This estimated population growth does not consider the timing and impacts of significant developments such as the Aquis Resort at the Great Barrier Reef. Cairns is a popular travel destination with over 2 million visitors every year. Cairns also provides transport and services to local industry and agriculture.

Safe, secure and reliable water supplies are an essential resource for supporting growth, providing not only for the health and wellbeing of the community, but also supporting economic development. The development of Regional Water Supply Security Assessments (RWSSAs) is a key action of *WaterQ: a 30-year strategy for the Queensland water sector*. The Department of Energy and Water Supply (DEWS) and Cairns Regional Council (Council) have committed to a partnership to investigate and establish a shared understanding of the existing security of Cairns' water supply system and its capacity to support future growth.

Over a number of years, Council has undertaken significant work towards developing an informed, best-practice understanding of the behaviour of the

key factors affecting its water supply system and security. On the basis of this, and in direct collaboration with representatives of the community and key stakeholders, Council is currently developing its updated water supply strategy to confirm the short to medium-term actions required by Council, as well as any longer-term option of benefit to the broader region, to improve the security of the existing water supply.

Arising from the partnership and building on Council's current review of its water supply strategy, this RWSSA provides valuable information to the community and water supply planners about the water supply security for Cairns, and provides a foundation for future water supply planning.

This assessment has considered a number of growth scenarios to identify the timing and magnitude of potential water supply risks. The scope of the assessment is limited to the volume of available water and does not address water quality issues that may affect water supplies. It is important to note that information presented in the assessment considers no changes to the capacity of the existing water supply system and associated infrastructure.

Water supply sources

Cairns has two sources of water supply, as shown in Figure 1, comprising run-of-river extraction from Behana Creek and water stored in Copperlode Falls Dam on Freshwater Creek.

Council operates both sources in tandem on a day-to-day and seasonal basis to meet the demand requirements of Cairns and in accordance with licenced environmental flow conditions. Council holds a 16 060 ML/annum water entitlement for take from Behana Creek, with the daily take influenced by environmental flow requirements throughout the year and scheme operational constraints. Completed in 1975, Copperlode Falls Dam (capacity 37 100 ML) is situated near the headwater of Freshwater Creek with a catchment area of 44 km² within the Wet Tropics World Heritage Area. The dam is owned and operated by Council with water stored in the dam, known as Lake Morris, before releasing it into Freshwater Creek to be extracted for delivery to the 120 ML/day capacity Freshwater Creek Water Treatment Plant (Freshwater Creek WTP) located at Tunnel Hill. Council holds a 30 625 ML/annum water allocation from Copperlode Falls Dam.

Figure 1: Cairns' water supply system



Water users and water use

The reticulation network

The reticulation network extends from Palm Cove in the north to Gordonvale in the south on the coastal strip between the Coral Sea and the Great Dividing Range.

Information from the Statewide Water Information Management database shows that the Copperlode Falls Dam and Behana Creek reticulation network currently provides water access to approximately 154 000 people, or about 98 per cent of the population within the Cairns Regional Council Local Government Area.

Industry within this reticulated area is also connected to this reticulation network. In addition to the resident population, tourism is a significant factor for water supply within the area, with over two million visitors to the region each year providing an estimated additional transient population of up to 40 000 visitors to Cairns on any night with consequent water supply requirements.

Other users of the bulk water supply sources

Minimum flow requirement at Crystal Cascades

Cairns Regional Council, as the resource operations licence (ROL) holder for Copperlode Falls Dam, is required to operate in accordance with the Barron Resource Operations Plan (ROP), which stipulates minimum flows that must be maintained at Crystal Cascades in Freshwater Creek immediately downstream of the town water supply

diversion works (see Table 1). Council may be required to supplement naturally occurring flows in Freshwater Creek with releases from Copperlode Falls Dam to meet operating conditions in the Barron ROP. This requirement is suspended if the volume of water stored in Copperlode Falls Dam is below a specified level.

Table 1: Minimum flows as stipulated in the Barron ROP for Freshwater Creek

Copperlode Falls Dam storage volume	Flow requirement		
	January–April	May–August	September–December
Volume of water stored is greater than or equal to 9091 ML	20 ML/d	16 ML/d	15 ML/d



Agriculture

There is currently no irrigated agricultural activity supplied with water from Copperlode Falls Dam. There are however, small areas of irrigated agriculture within both the Freshwater Creek and Behana Creek catchments but these use run-of-river extraction from local watercourses for their irrigation supply. Water licences allowing irrigators access to water from Freshwater and Behana Creeks are downstream of the extraction point for town water supplies. As such, water extraction from these locations does not impact on the security of town water supplies for Cairns.

Historical performance of Copperlode Falls Dam

Figure 2 shows the historical water levels in Copperlode Falls Dam between 1994 and 2014. As can be seen, the storage behaviour of Copperlode Falls Dam is dynamic, with the storage reliant on regular seasonal inflows. Copperlode Falls Dam has no recorded water supply shortfalls (a shortfall is the inability of the system to meet water demand), though below average rainfall in 2002 and 2003 resulted in the storage falling below 50 per cent of capacity.

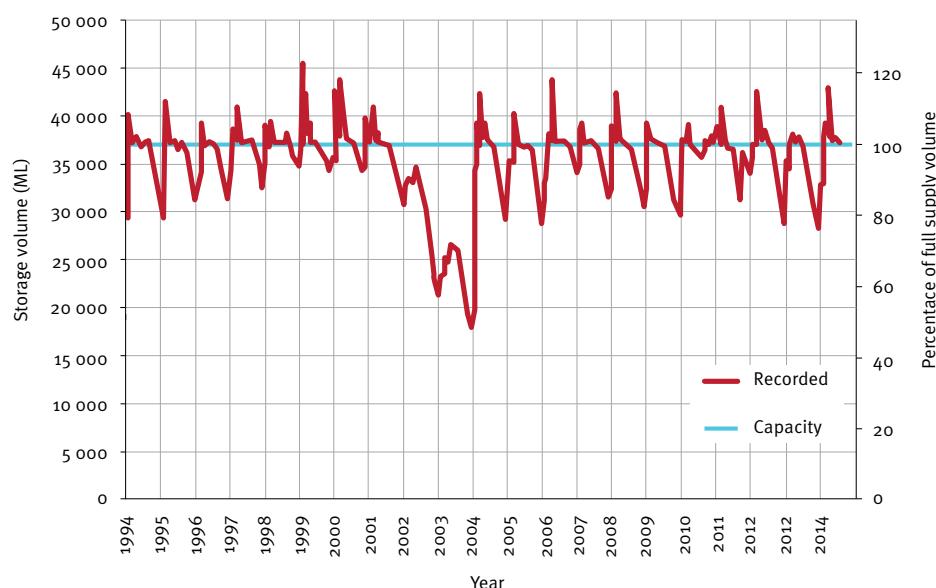


Figure 2: Recorded storage behaviour of Copperlode Falls Dam between 1994 and 2014

Figure 3 shows the recorded total water production by Council, by treating water extracted from the Crystal Cascades (offtake for water stored in Copperlode Falls Dam) and Behana Creek, compared to total annual rainfall between the 2005–06 and 2013–14 water years. Despite a growing population, total water demand has been trending downwards over recent years due to community response to water availability and Council's initiatives including demand management. The lower total water demand in the 2010–11 water year may be due to the higher rainfall in that period resulting in reduced outdoor water use.

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

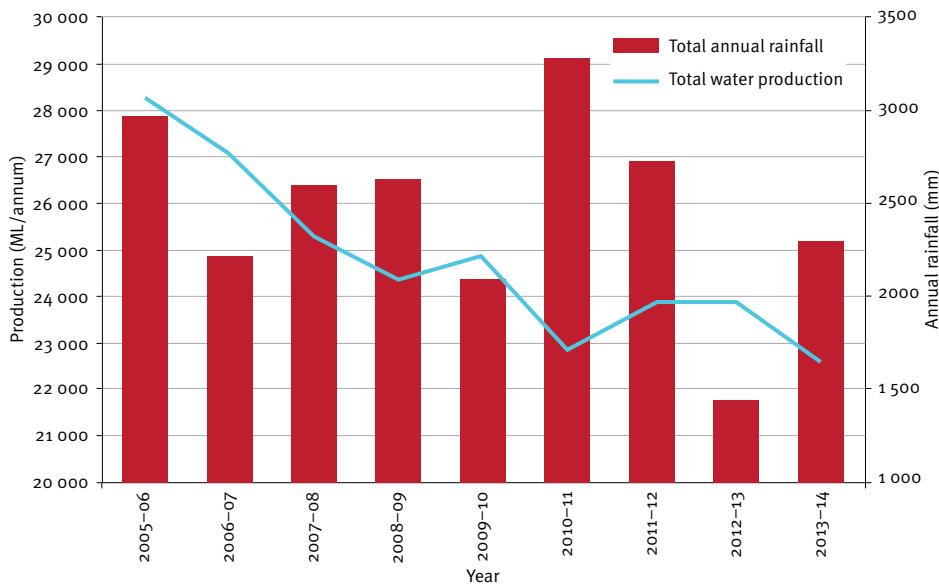


Figure 3: Total recorded production using water from Crystal Cascades and Behana Creek between 2005–06 and 2013–14



Future water use

Well-founded and secure water use planning necessitates an understanding of the likely (and possible) changes in water demand into the future.

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In developing an agreed forecast of Cairns' future reticulated water demand, it is essential that the rates of residential water use and the larger volume of water sourced for all use across the reticulated network are identified and agreed upon. These projections will, of course, remain subject to ongoing monitoring of actual population growth and variations in water use trends.

Cairns' reticulation network

QGSO growth projections for Cairns show that the population is expected to continue to increase, such that by 2021 the population will reach 183 166 and by 2036 will be 240 795.

When comparing water demand against the water supply systems capability, it is essential to consider water demands that take into account climate variability. With continuing trends towards water efficient appliances, ongoing demand management and water recycling, a figure of 418 L/c/d has been adopted for the Cairns' reticulated network. These figures incorporate the demand resulting from tourism.

As previously mentioned, existing water demand from industry is currently met through the reticulated supply system, and any future growth in this demand is expected to be approximately proportionate to population growth. As industrial demand growth may deviate from population growth, flexible water supply planning will be needed to take into account any variation. As such, growth in demand from industry will be reflected in the growth figures for urban demand.

Using the growth figures predicted for the residential population of Cairns, Figure 4 shows the projected total water demand for Cairns' reticulated network. The demand projections in Figure 4 assume an ongoing Cairns' total water demand of 418 L/c/d.

There are no known mining activities proposed within the Cairns Regional Council area. However, it is worth noting that Cairns acts as a service base for various mining operations in Far North Queensland and Papua New Guinea, as well as a major service centre and port for the surrounding area. Therefore, any significant changes in mining and/or industrial activities in the surrounding areas may have an impact on Cairns' reticulated water demands in the future.

Several major projects are currently proposed for the Cairns region, and some of these have the potential to expedite growth in population and tourism numbers. These projects include the proposed development of the \$8 billion Aquis Integrated Resort at Yorkeys Knob (Aquis Resort at the Great Barrier Reef). Similarly, there is planned construction of a \$35 million aquarium in the Cairns CBD, and numerous smaller projects which, together, have the potential to result in relatively rapid growth in demand for reticulated water in Cairns.

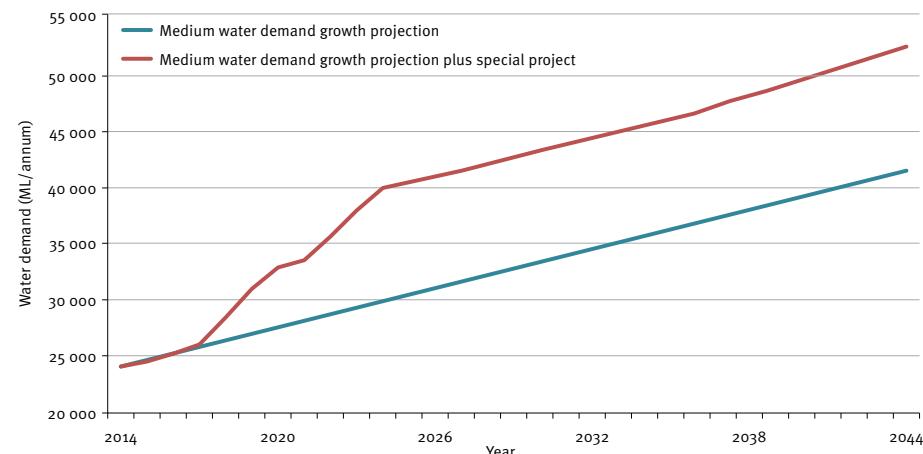


Figure 4: Bulk water demand projections for Cairns' reticulated network

To assist in understanding the potential changes in demand under varying forecasts, and provide an indication of the potential flexibility in water supply planning and development required, both a medium and medium plus special development growth scenario has been adopted and displayed in this assessment (See figure 4). If population growth and associated total water demand were to develop along the medium plus special project growth projection, then a water supply shortfall may occur sooner than under the medium level growth projection.

Agriculture

For this assessment, future development of agriculture is considered within the limits of existing entitlements. This does not preclude proponents from exploring options for developing agricultural or multipurpose proposals that may provide water for future agriculture expansion.

Water supply system capability

Cairns' water supply network

Hydrologic assessments have been undertaken based on models consistent with Council's independently developed modelling, to ascertain the capability of Cairns' existing water supply system (including existing operational arrangements and water entitlements) to meet current and projected future water demands.

Stochastic modelling involves generating data sequences that incorporate key statistical indicators from the historical record. Stochastic modelling was used, which accounts for a wider variation of potential climatic scenarios than the historic record. One hundred replicates of 10 000 years of stochastic data were generated for the Copperlode/Behana water supply scheme. The results were aggregated and the median output used to identify the likelihood of water supply shortfall for the system.

Hydrological assessment of the catchments and associated water courses that contribute to Cairns' water supply system assumed that all entitlements, other than those used to supply the Cairns reticulation network, were fully developed and operational. Those entitlements used to supply the Cairns reticulation network were represented at various levels indicating their water requirement at points in time along the forecast growth projection.

The hydrologic assessments included the application of the restriction regime for Cairns' reticulated network shown in Table 2. The assumed savings are only applied to 70 per cent of the demand to account for water sectors that are not affected by the restriction regime. The non-affected sectors include non-revenue water, including leakage and losses, as well as the tourism, industrial and commercial sectors where achieving the assumed water demand reduction may not be feasible.

Ongoing planning by Council is continuing the development of their contingency response as part of updating its water supply strategy.

Table 2: Copperlode Falls Dam water restriction and contingency trigger levels and response

	Copperlode Falls Dam level	Response	Effect on per capita water consumption
No Restrictions	Above 80%	Nil	418 L/c/d
Level 1	Below 80%	10% target demand reduction	389 L/c/d
Level 2	Below 70%	15% target demand reduction	374 L/c/d
Level 3	Below 60%	20% target demand reduction	359 L/c/d
Level 4	Below 50%	25% target demand reduction	345 L/c/d
Contingency	Below 40%	Contingency response	

The 2009 Overall Water Supply Strategy for Cairns endorsed by Council identified a portfolio of contingency options that could be implemented in the event Copperlode Falls Dam reaches 40 per cent of capacity.

Frequency of water restrictions and supply shortfalls

A water supply shortfall is defined as an event where water supply is unable to meet water demand. Therefore, if water demand is 140 ML for a particular day and, due to water availability or operational limitations the system is only able to supply 120 ML on that day, this would be identified as a supply shortfall.

As indicated earlier, Cairns receives its water supply from Copperlode Falls Dam and Behana Creek. Council has a restriction regime in place which is based on water levels in Copperlode Falls Dam as shown above in Table 2. The intent of this regime is to reduce water use and thereby extend the duration of the available water supply. Council has also adopted a 40 per cent trigger in Copperlode Falls Dam for the implementation of water supply contingency measures to ensure continuation of uninterrupted water supply if an extreme drought continues beyond the application of the water restriction triggers defined in Table 2.

Figure 5 provides information showing the frequency at which various water restrictions and the contingency response could be expected to be triggered, and the extent that Cairns might experience water supply shortfalls at a range of annual demands. As an example, under a total demand of 25 000 ML/annum, Level 4 restrictions (represented by the purple line) are estimated to have an average frequency of occurrence interval of approximately 100 years. Under demands of 33 000 ML/annum, the estimated average frequency of occurrence interval increases to approximately 10 years.

As indicated earlier, supply from the Freshwater Creek WTP is currently capable of 120 ML/day and supplies from Behana Creek are currently achievable up to 35 ML/day. Accordingly, at times when Cairns' daily water demand exceeds the existing systems capacity to treat and supply and/or sufficient supplies are not available from Copperlode Falls Dam and/or Behana Creek, shortfalls may occur. This will generally occur during periods when flows in Behana Creek are reduced or not available.

As illustrated by Figure 5, as Cairns' water demand increases, the frequency at which trigger levels are reached will also increase, with the consequent potential effects on the community. Considerations such as what is an acceptable frequency of the various restrictions levels being applied, and the underlying likelihood of not being able to meet demand are critical and fundamental parts of the water supply planning currently being undertaken by Council and generally across Queensland.

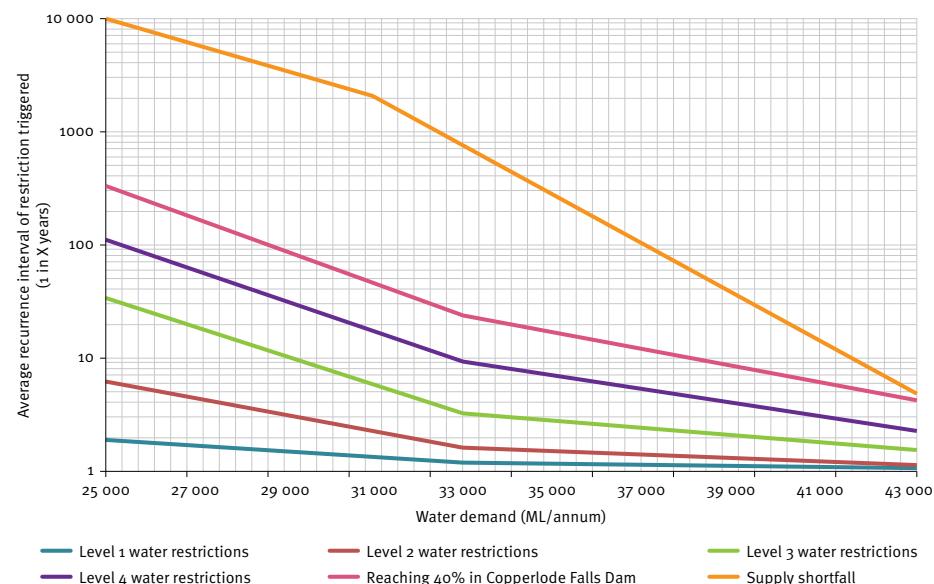


Figure 5 Frequency of water restrictions and supply shortfalls against total annual demand

Moving Forward

The RWSSA represents a collaborative approach between DEWS and Council to establish a shared understanding of the existing security of Cairns' water supply and the capacity to support future growth.

Council resolved in November 2013 to carry out a review of its water supply strategy for Cairns and in February 2014 endorsed the establishment of a reference panel as a component of the stakeholder participation and community engagement approach for the strategy review. A media release on 25 March 2014 announced the Water Security

Advisory Group (WSAG) and an independent chairperson to facilitate discussion.

The development of the strategy is being guided by the WSAG, which includes DEWS and a wide range of other government and community stakeholders. The strategy will confirm the short to medium-term actions required by Council, as well as any longer-term options of benefit to the broader region, required to ensure continued secure and reliable supply of water within the Cairns reticulated water supply network. The RWSSA and other information developed by Council will be used to establish the Levels of Service that will underpin the assessment of options and development of the strategy. While the strategy will plan for long-term predicted growth (30+ years), it is anticipated to be reviewed at least every five years to respond to actual growth and associated water demand.

The strategy development process is ongoing and further work currently being, and to be, undertaken includes:

- determination of what is an appropriate Level of Service for water supply security for Cairns consistent with the concepts described within this RWSSA;

- assessment of the cumulative impacts of future population and demand of water supply requirements, including significant projects such as the proposed Aquis development;
- description of water supply options such as raising Copperlode Falls Dam, including new supply options, such as groundwater and surface water options;
- screening and assessment of options with consideration of a range of criteria including engineering cost estimates, environmental and social outcomes;
- finalising Levels of Service and Demand Management Strategies for the provision of long-term water supply security for Cairns.

It is planned to submit the 'Our Water Security' strategy report to Council for endorsement by March 2015.





**For more information on the
Regional water supply security assessment
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