

Paradise Dam

Fact Sheet: long-term concrete strength issues and new dam wall

January 2024

This fact sheet provides information about the new issues uncovered with the concrete mix used in the original construction of Paradise Dam, completed in 2005.

Results from a bespoke and world-first testing program show that Paradise Dam's concrete will lose strength over time and that no amount of improvement work will fix the dam.

Sunwater is now focused on planning for a new Paradise Dam wall on the Burnett River, immediately downstream of existing structure. Project costs and delivery timeframes will be confirmed as part of a detailed business case process.

Reliable water supply is critical to jobs, growth and liveability in regional Queensland, and that's why we remain committed to delivering the best possible outcome for the people of Bundaberg.

Previously known concrete issues

Issues with the original construction of Paradise Dam have been widely understood for many years. Sunwater has previously shared detailed information about the issues that led to the 2019 decision to lower the primary spillway to reduce upstream pressure on the dam wall and the risk of dam failure.

These issues were related to the bond between the layers of roller compacted concrete (RCC) within the dam, the foundations under the secondary spillway, and the risk of erosion immediately downstream of the dam wall.

New concrete issues

We have been progressing the Paradise Dam Improvement Project Detailed Business Case (Stage 2) since December 2021, when the Queensland Government confirmed that the dam would be returned to its full height and original capacity.

As part of the detailed business case, Sunwater has been undertaking a program of intensive testing to inform design development.

It is through this testing that **three unexpected new issues** regarding the long-term strength and quality of the dam's concrete were identified and investigated further:

- **Swelling clay:** Due to the porous nature of the concrete, low cement content, and high clay content, moisture in the wall causes repeated swelling and contracting.
- **Cement leaching:** Porous concrete causes key ingredients that bond the cement to leach out of the concrete, leading to deterioration and strength loss.

- **Carbonation:** The mix of carbon dioxide, moisture, and cement results in low pH (increased acidity), increasing the negative effects of the swelling clay and lowering the concrete's strength.

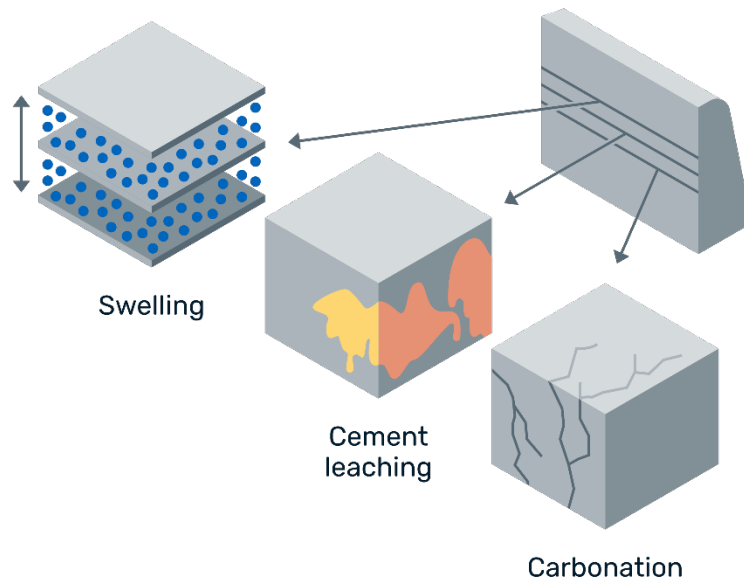


Figure 1: Three new issues impacting long-term strength and quality of Paradise Dam

These issues result from a poor concrete mix used in the original dam – completed in 2005 by the Burnett Water Alliance – which combined a large amount of clay with a small amount of cement content.

When compared against more than 900 publicly recorded RCC dams worldwide, Paradise Dam is within the lowest first percentile for cementitious content – see Figure 2 below.

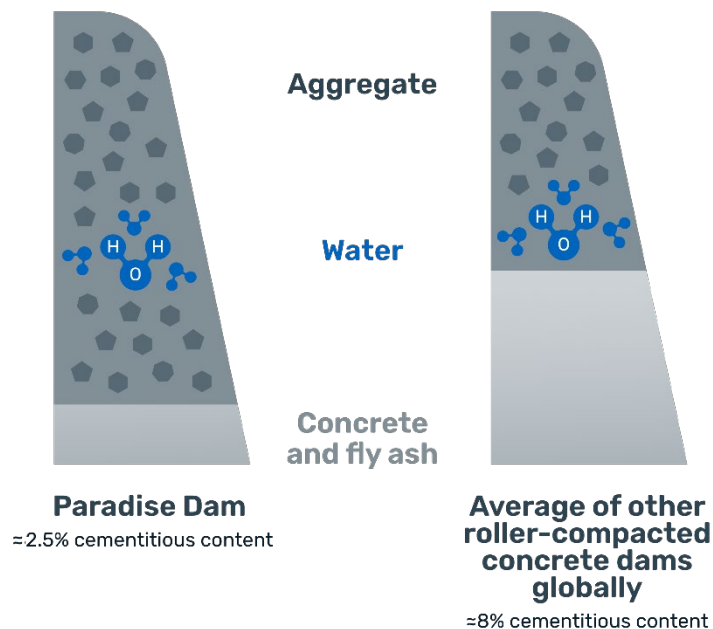


Figure 2: Paradise Dam cementitious content compared to other RCC dams

As part of the stage 2 detailed business case process, Sunwater has been working through design solutions to repair and improve the dam and meet safety guidelines.

In light of these newly identified issues, we are in no doubt that Paradise Dam is a compromised asset, that no amount of improvement work will fix.

World-first testing program

The new issues identified are unprecedented – dams are usually not tested for long-term strength loss, and as Paradise Dam was only constructed 18 years ago, it should not be experiencing issues of this degree.

Because of this, Sunwater, along with our partners and independent experts were required to develop a bespoke and world-first testing program.

What did the testing program entail?

Once the program was developed and the testing laboratory engaged, Paradise Dam’s concrete samples were put through a range of scenarios. These included climatic and in-situ conditions applied under accelerated timeframes to understand how the concrete may perform over time.

Testing methods applied are detailed in Figure 3 with images of the methods on the following page.

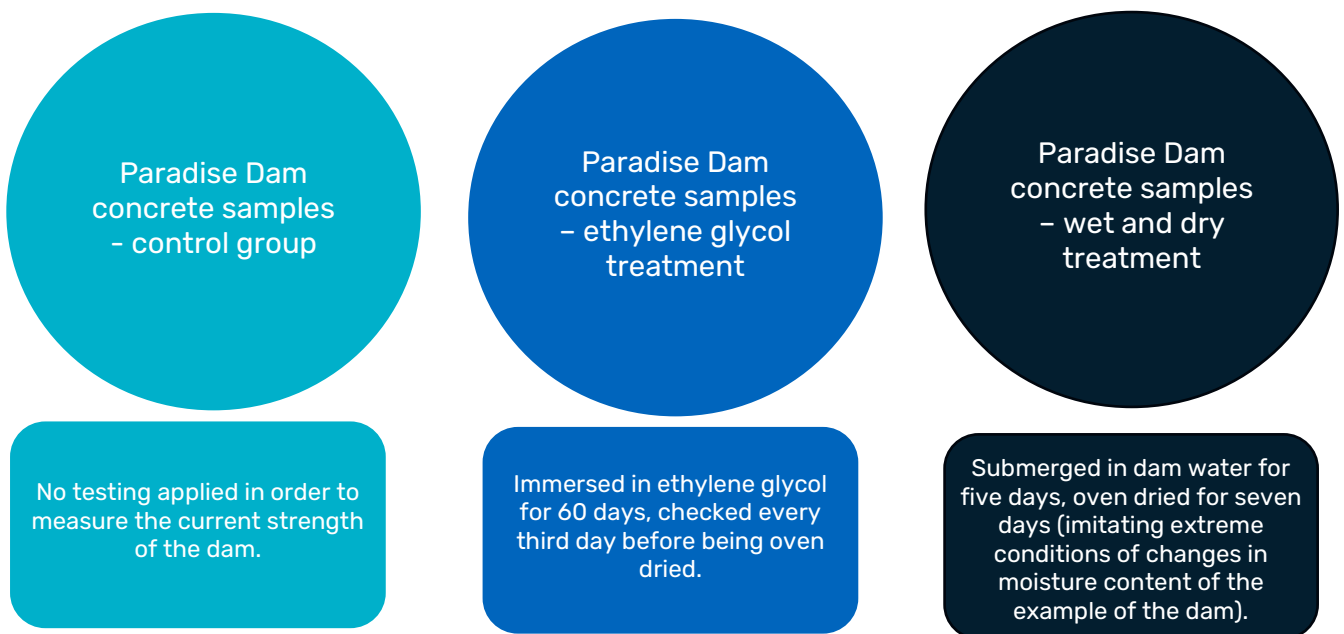


Figure 3: Testing methods applied

After the samples were treated (as outlined in above), they were then subjected to compressive and tensile testing. The non-control samples showed little resistance to these tests, crumbling and/or significantly reducing in strength. This is not how quality concrete should perform.

This process took time (including a second round of testing) to ensure the results were accurate and to understand implications to the improvement design for Paradise Dam.



Figure 4: Soaking of Paradise Dam core samples in ethylene glycol



Figure 5: Applying compressive testing to Paradise Dam core samples

New Paradise Dam wall

Sunwater is now planning through a detailed business case for a new Paradise Dam wall on the Burnett River.

The new structure will be immediately downstream of Paradise Dam and will ensure a safe and secure water supply for the Bundaberg region for future generations.

Project costs and project delivery timeframes will be confirmed as part of the business case process.

Sunwater has formed an alliance to deliver the new dam wall project – recently appointing CPB Contractors and Georgio as construction partner and GHD as the ongoing design partner. This will ensure design and construction challenges are considered and addressed early.

Construction of a new dam wall would see the original structure at least partially demolished to ensure it does not impact on the operation of a new dam wall. The existing dam may also be used as a coffer dam to create a dry and safe working environment during construction of the new asset. The scope for this work will be confirmed as part of the detailed business case.

There are a range of activities and enabling works, already planned as part of the improvement project, that can continue including road upgrades, geological and quarry investigations, environmental approvals, a workers' accommodation village and native title and cultural heritage activities.

It is critical that this job is done safely and to a standard that will provide certainty for years to come, supporting the region's economy and one of Australia's most important food bowls.

Figure 6 shows the expected pathway to construction of a new dam wall.



Figure 6: new dam wall pathway

Is the existing dam safe?

By lowering the primary spillway as part of the Essential Works, pressure on Paradise Dam's upstream wall was reduced and the dam became safer than it was.

Completion of these works in early 2021 reduced the risk of dam failure to a 1 in 5000-year event. Prior to this, the dam failure risk was a 1 in 200-year event (similar in scale to the 2013 flood event).

While Paradise Dam is safer than it was and will be so for the life of the project, it is still not within the acceptable level of risk for the long term or to meet Queensland Dam Safety Management Guidelines.

The new dam wall will meet stringent safety criteria so that it will reliably service the Bundaberg region for the next 100 years.

Additional resources

- Information on the Paradise Dam Essential Works is available here: [March 2021 Fact Sheet: Essential Works Risk Reduction](#).
- Further information regarding testing undertaken on the bond between the concrete layers is available here: [May 2021 Fact Sheet: RCC Shear Strength Testing Results](#).
- A timeline from the dam's construction to the Essential Works is outlined here: [Paradise Dam Timeline Construction to Essential Works \(sunwater.com.au\)](#)

Stakeholder engagement

Sunwater is sharing information about these new concrete issues and plans for the new dam wall with customers in the Bundaberg Water Supply Scheme, the Paradise Dam Reference Group (PDRG) and via the Paradise Dam Facebook Page.

Drop-in and online sessions will also be held to provide the community with information and the opportunity to ask questions, and further information on these sessions is provided on [this webpage](#).

Sunwater is committed to ongoing stakeholder engagement and continuing to share information.

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