Key findings:

Drought and water security: Kalgoorlie and Broken Hill

The context
Kalgoorlie in Western Australia and Broken Hill in New South Wales are towns with populations of around 30,000 and 20,000 respectively in semi-arid environments with limited local water supplies. Each has a rich history based on mineral resources and, more recently, a developing tourism industry. The catalyst for development has been the exploitation of mineral resources (silver, zinc and lead in Broken Hill and gold in Kalgoorlie); this development has been constrained and tested by water limitations.

Throughout the history of each town, the reaction to extreme dry periods and economic booms has been to develop new infrastructure and strategies to deliver more water and increase efficiencies. The challenges of balancing water supply and growth are ongoing and likely to become more severe with climate change.

Scale of the challenge

Broken Hill
Broken Hill is in an extremely arid area receiving, on average, 252 mm of rain each year (records since 1889). Under a highly variable climate, rain is experienced in cycles of drought and flood. Mining of the region has been intensive since the discovery of silver in the late 1800s. As demand for water outstripped supply with the expansion of the town’s population, particularly during periods of drought, new engineering schemes to supply more water were introduced:

- In 1892 the Stephens Creek Reservoir was built and then operated by the privately owned Broken Hill Water Supply Company. In 1903 it was completely empty and in 1907 and 1909 it almost dried up. It was the only source of supply until the government-funded Umberumberka Reservoir was completed in 1915, following which the government took over the supply of water to Broken Hill.
- In the 1902-1903 drought there was rail-cart delivery of water from Silverton, South Australia, a distance of around 26 km. This was repeated in 1925-26, 1941-6 and 1948-51.
- Development of flotation extraction processes in the 1900s increased industrial demand for water.
- The Menindee pipeline construction was completed in 1952: bringing water from the Darling River to Broken Hill (a distance of 99 km.)

Already exposed to hazard in the form of heavy metals from mining and smelting operations (lead dust, for example, has long been part of the environment), Broken Hill residents are also vulnerable to disease due to poor water quality during periods of water shortage. Drought following the installation of the Menindee pipeline led to high salinity in the water pumped from the Darling, and very poor water quality. A recent review considered various options including renewing the transport of water by train (which was found to be not cost effective) and the installation of a desalination plant for emergency water production. A portable desalination plant has been installed at a cost of $4 million that can treat 6 million litres of water per day, which is about a quarter of normal consumption by the city. The plant has not yet been used.

Poor water quality is an ongoing issue: whereas people can use bottled water, highly saline water damages infrastructure and household appliances. Voluntary water conservation strategies have been generally successful, but have created their own problems. These include inadequate flushing of toilets and a reduction in the amount of green space needed to mitigate the endemic lead pollution.

Kalgoorlie
Kalgoorlie is the largest regional city in Western Australia. It has very strong and prosperous gold and nickel mining industries. The average annual rainfall total is 264 mm. The gap between demand and supply for water has been historically augmented by transporting water and providing engineered water solutions.

At the end of the nineteenth century, the gold rush had brought around 30,000 people to Kalgoorlie. They had no reliable water supply. Water was carried by rail from Coolgardie at great expense, or was supplied from a nearby salt lake by distilling on wood stoves. Lack of freshwater was causing poor sanitation, diseases such as typhoid and many deaths.

The decision was taken in 1896 to build a pipeline from the Perth Hills. In 1903 a reservoir was completed at Mundaring (in the Perth Hills, some 35 km to the east...
of Perth), with a pipeline to Coolgardie and then on to Kalgoorlie (a distance of 526 km). At the time of completion, it was the longest fresh-water pipeline in the world. The storage capacity of the weir at Mundaring was trebled when the wall was raised 10 m (completed in 1951) to support agricultural expansion into inland areas. The pipeline is now a component of the Integrated Water Supply Scheme (IWSS), which provides water to approximately 78% of the state’s population. Since 1980, expansion of gold mining activities has exceeded the capacity of the pipeline system and new sources are being found in local saline groundwater resources. However, as is often the case with groundwater exploitation, extraction is outstripping rates of recharge.

Adaptation actions

Kalgoorlie

As the climate of Perth dries, runoff from water catchments into the main dams has now reached an “all time low”. The regional water authority, Water Corporation (www.watercorporation.com.au), has responded by commissioning a desalination plant and has commissioned another to start in late 2011. In addition, due to the current demand for water, the Water Corporation has requested that it be permitted to take more water from the aquifer known as the Gnangara Mound. The Mundaring Reservoir is currently (November 2010) at 40% capacity.

Broken Hill

The Australian Government is supporting further investigation into regional groundwater resources and the potential for managed aquifer recharge. There has also been speculation about the possibility of a connection to a proposed BHP coastal desalination plant 350 km away at the head of Spencers Gulf in South Australia.

Vulnerability

For both towns, the cycles of drying and flooding throughout their histories have caused swings from water supply crisis to prosperity and complacency.

Kalgoorlie

A continuation of the current drought over south-western Australia will see a major crisis in water supply security and potential for failure of the water supply. But this will be a crisis for the whole region, not for Kalgoorlie alone. Building the pipeline from the Perth Hills, and integrating the pipeline supply into the wider IWSS, ended the isolation of Kalgoorlie in terms of its water supply challenges.

Broken Hill

Extensive rain in the Murray Darling Basin and in the Broken Hill Region itself in the second half of 2010 has delivered about two full years of water security. In the past, such drought breakers have slowed engineered solutions and encouraged complacency opening vulnerability to the next drought. The Menindee pipeline delivers water only to Broken Hill, and that water is of low quality at times of drought. Broken Hill seeks to address this through desalination, but only time will tell whether this delivers a long-term sustainable solution for the community.

Managing water security: successes and failures

Both Kalgoorlie and Broken Hill have dealt with a dry climate and population-driven increases in demand by using water supply engineering solutions. Broken Hill’s engineered solutions have failed on many occasions and have had to be altered several times. Kalgoorlie’s engineered solutions, although over 100 years old, have progressively been modernised so as to deliver a high degree of water security.

In both towns, the economies and the health of residents have been severely compromised during periods of severe drought. Water has become an extremely expensive commodity in these communities. Neither Kalgoorlie nor Broken Hill has found a permanent solution to their problems of reliable water supply and, indeed, in economic terms this is unlikely to be the most cost effective approach.

Future Challenges

In Broken Hill the planned closure of the large-scale Broken Hill Mine in ten years time will fundamentally alter the economy of this town. The mines heavily subsidise water prices at present and the removal of this support will expose residents to the full costs of maintaining and upgrading water supply infrastructure. Broken Hill’s pipeline is at the end of a hugely complex catchment, the Murray-Darling Basin (MDB). The MDB is currently undergoing a new phase of planning with respect to how water in the Basin is allocated to various uses (e.g., agriculture, non-agricultural industry, town water supply, environmental flows, ecological needs etc). The Murray Darling Basin Plan will be instrumental in determining the ultimate fate of Broken Hill’s water supply from the Darling River.

Kalgoorlie has experienced a relatively stable water supply since the building of the pipeline from Perth in the early 1900s. However, the increased demands on its water supply will be exacerbated by the reduced availability of water in the Perth catchment area. Under climate change, the area is predicted to experience increased temperatures, declining rainfall and increased evaporation, all of which would reduce the supply of water, and its quality.

About this study

This study is one of a suite of Historical Case Studies of Extreme Events conducted under Phase I of the NCCARF Synthesis and Integrative Research Program. The authors are Glenn Albrecht, Helen Allison, Neville Ellis and Megan Jaceglav of Murdoch University. The study will be available online at www.nccarf.edu.au

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