PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE

Official publication of The Australian Rangeland Society

Form of Reference

The reference for this article should be in this general form;
Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).
For example:
Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite *(Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15th Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

THE ENVIRONMENTAL LEGACY OF BORE DRAINS

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ABSTRACT

The Great Artesian Basin (GAB) has provided a valuable resource for the development of rangelands in Australia. Management recommendations for the basin currently, and in the past, primarily concentrate on water conservation. Environmental, economic and social impacts were initially under-appreciated, and are still poorly recognised. These aspects should be included in management plans to ensure appropriate and sustainable use of the basin.

INTRODUCTION

Management recommendations for the GAB in the past, emphasised the need for water conservation, to control discharge and avoid wastage. The main cause for concern was a perceived risk that basin pressure would be depleted, leaving many pastoralists without water supplies (ICAW 1913). Today, security of access to the water resource is still a focus of management plans (GABCC 1998), echoing recommendations made 80-90 years ago. More recently, other key issues have been identified, including provision of water for new and high value uses, natural resource management initiatives, social implications and protection of environmental and heritage values (GABCC 1998). A program has been developed to evaluate the Bore Drain Replacement Project (BDRP) in the south west Queensland section of the basin (see paper by same authors).

HISTORY

Prior to tapping the GAB, artesian springs provided a focus for human activity for thousands of years. Springs were relied upon by Aboriginal people, European settlers on their travels into the interior and early pastoralists. The alignments of the Overland Telegraph and Ghan railway line between Marree and Oodnadatta were largely dictated by the locations of springs (Harris 1992).

European settlers ventured west of the Great Dividing Range, onto the productive plains of western Queensland and New South Wales in the 1860s-1880s. Encouraged by good seasons, these pioneers grazed sheep and cattle until it became apparent that drought was a common occurrence in Australia (Noble1997). Although there were many rivers and creeks, permanent waterholes were a rarity. Reliable supplies were needed for stock to survive and to provide water for growing towns that serviced the rural areas.

The first flowing artesian bore was drilled near Bourke in New South Wales in 1878. Within two years of drilling the first bore, pastoralists established artesian water supplies over extensive areas, and property managers reported they 'were able to run creeks on their stations at pleasure' (Powell 1991). As more bores were drilled, livestock numbers increased accordingly (Figure 1). By 1912, four and half million acres in NSW were grazed by stock watering from artesian bores, and the value and productivity of the land increased due to permanent water supply. Bores were also used for operating shearing and electric lighting plants and wool scours, as well as for domestic supplies.

Decreases in bore flow were recognised near Cunnamulla in Queensland, as early as 1912, and were initially thought to be due to escape of water from the casing, but tests did not support this theory. At this time, many bores were uncontrolled, and it was then suggested bores be fitted with control valves, as well as employing methods for efficient distribution of water, including restricting the use of natural watercourses as conduits (ICAW 1913).

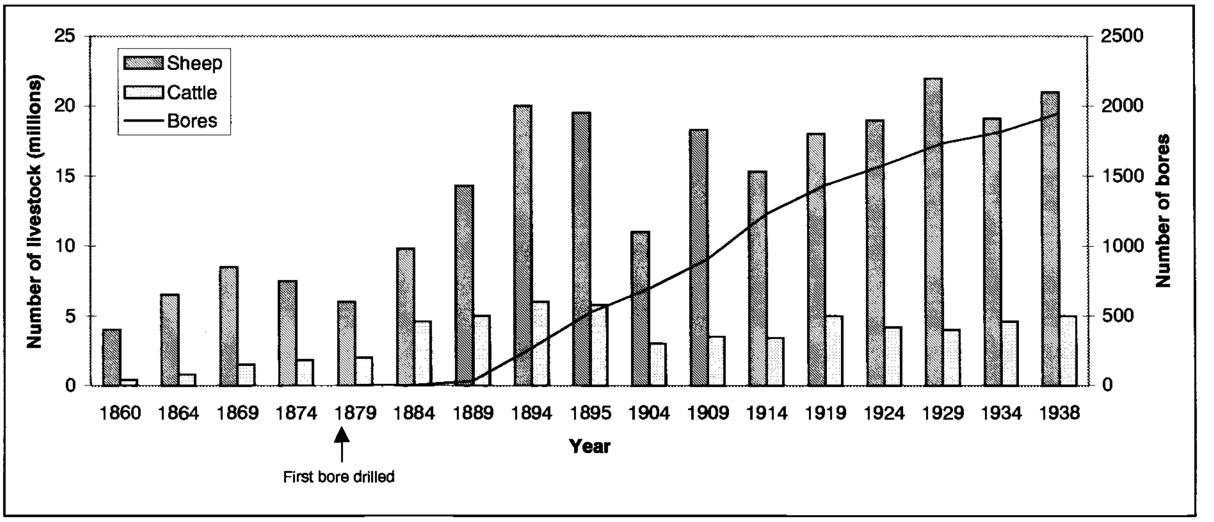

Figure 1: Number of livestock (sheep and cattle) and number of artesian bores between 1860 and 1938 in Queensland. Arrow indicates year when first bore drilled.
Source: Queensland Year Books and *Artesian Water Supplies*, First Interim Report of the Committee appointed by Queensland Government to investigate certain aspects relating to the Great Artesian Basin (Queensland section), with particular reference to the problem of diminishing supply, Government Printer 1945, In Powell 1991.

Over the last 100 years, many artesian bores have flowed in an uncontrolled state along open bore drains - a series of small open earth channels about 25 cm deep - as this was the most economical method for water distribution. These drains constitute a massive waste of water resulting in reduced groundwater pressures. Bore drains, if well maintained, were perceived as the most appropriate method to distribute water to livestock, as this would enable animals to have access to a large body of water throughout paddocks (ICAW 1913). This view remains an impediment to implementation of bore drain replacement schemes across the Basin.

Different drain efficiencies were acknowledged in different land types due to slope and soil type. The effects of seepage, standard of maintenance, evaporation and the problem of stock widening drains have been discussed since 1912 (ICAW 1913; Department of the Co-ordinator-General of Public Works 1954). Water losses due to evaporation were identified as a major cause of decline in drain flow. It was also recognised that a great deal of water was lost by seepage into surrounding soils, more so in sandy red earths than black clay soils. Eventually, drains in red soil become relatively efficient due to sealing or hard-setting of the walls which makes them less prone to breaching (breakouts). Replacement of calcium and magnesium by sodium cations, which causes structural decline, has a greater effect on red sandy soils than clay soils. Large declines in pressure and therefore flow, could cause drains to dry out and crack more frequently, causing severe erosion when bore drains refill.

There is no mention in historical records, of breakouts caused by overland water flow, as is most commonly attributed now (Pegler and Bentley 1999). Increased frequency of overland flow could be due to reduced ground cover and therefore higher run-off rates, acknowledged as consequences of land degradation in grazed rangelands (Noble and Tongway 1986).

Natural drainage lines were often used for distributing artesian water, although the environmental impact of this practice was not widely recognised. Early bores were often located low in the landscape, to reduce the distance drilled to aquifers, and increasing the likelihood of obtaining shallow supplies and with the convenience of siting drilling operations near existing surface water. Often it was convenient to use natural drainage lines for water distribution. This practice was perceived to be wasteful, although no consideration was given to the detrimental effect on the natural surface hydrology of the area, or ecological imbalances downstream. Many drains ran into artificial or natural swamps, which would have an enormous influence on local ecological and hydrological processes, but was considered to be beneficial, by creating a permanent watering hole for livestock.

The effect of bore water on different soil types was more closely examined in relation to irrigation potential. Some believed irrigation would be possible, others only on suitable soil types, such as heavy black soils (clay). The Pera Farm (western NSW), which ran for several years very successfully, ultimately became extremely alkaline and fruit crops eventually failed. R.D. Watt, Professor of the Agriculture, University of Sydney, gave evidence relating to the chemical nature of artesian bore water.

"There is no question about the fact that the bad effect of bore water, when used for irrigation, is due to its containing a certain amount of sodium salts, especially sodium carbonate. Any sodium salt, or soluble salt..., will have a bad effect on crops by the mere fact of its being present in too strong a solution."

> *"Secondly it has a corrosive effect on the plant reeds; thirdly, it has a solvent effect on the humus of the soil; and has a deflocculating effect on the clay particles of the soil. The last two very frequently render the soil unfit for cultivation, as it makes it puddle when wet, and cake into a stone-like mass when dry."*

This sodic effect is more pronounced in red sandy soils with smaller proportions of clay than in heavier clays, and Professor Watt used the analogy of proportions of cement in concrete to describe this hard setting of bore drain walls (ICAW 1913).

CURRENT USAGE

The rural industry is by far the largest current user of artesian water with an annual extraction of 500,000 ML (GABCC 1998). The use of bore drains for distributing stock water is still extremely inefficient, with up to 95% of total bore flow lost by evaporation and seepage. Bore drains continue to contribute to land degradation in the following ways (GABCC 1999):

- Salinity, due to evaporation of saline artesian water. For example, a bore discharging 0.6 ML/day of water with a salt content of 700 mg/L, will bring more than 400 kg of salt to the surface each day, or 150 tonnes/year.
- Soil structural decline adjacent to drains.
- Erosion from cracked banks of drains, usually as a result of soil structural decline.
- Bore drains built across the slope intercept runoff water, reducing rainfall infiltration below drains and consequently limit plant growth.
- Enhancing the spread of invasive woody weeds, such as prickly acacia, along drains.
- Providing feral animals with habitat and permanent watering locations.
- Restricting management options, such as spelling of paddocks.

With development of technologies such as medium-density polyethylene pipe, proposals originally made in 1910 to pipe artesian water, have been made possible. The cost to construct a drain in 1912 was up to £20 per mile (~$AU7500 currently), but averaged between £11 and £15 (~$AU4000 and $AU5500). Suggestions to pipe were quickly dismissed as "absolutely impossible...impossible in the first place, so far as cost is concerned" (ICAW 1913). Today, piping remains economically prohibitive for most pastoralists, unless financially assisted. Currently, the average costs to install a piped system are between $3000 and $4000 per kilometre (D. Conway *pers. comm.*).

In 1994, the Bore Drain Replacement Project (BDRP) was implemented to initiate rehabilitation of the south west Queensland section of the GAB, and is funded by the National Heritage Trust, the Queensland Government and land managers. Land managers receive assistance to plan, design and install pipeline schemes. Evaluation of the project includes monitoring of environmental, economic and social impacts (see paper by same authors).

CONCLUSION

Since the GAB was first utilised, declines in pressure and flow have been recognised, primarily due to the use of bore drains for water distribution. Other significant natural resource degradation is also identified with the use of bore drains. Integrated management of the resource across the basin is essential to ensure long-term access for all users. Rehabilitation of bores and replacement of bore drains with polyethylene pipelines is the most effective solution to problems currently experienced by users of the GAB. The full impact and benefits of piping should be assessed as part of any coordinated plan for basin rehabilitation.

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