

PEOPLE-CENTRED APPROACHES TO WATER AND ENVIRONMENTAL SANITATION

Aboriginal perceptions of incompatibility of location, lifestyle and water resources

M. Pearce, E. Willis and T. Jenkin, Australia

This paper conveys the verbal account of Nepabunna community's perceptions of their water resources, and the usability and sustainability of their water supply. Nepabunna, a remote Aboriginal community in South Australia relies on meagre rainfall for its potable supply. Non-potable groundwater is reticulated to community buildings to make up for the shortage created by the paucity of potable water. One of the issues raised by the community is the incompatibility of its' location with the available water resources. It is estimated that the groundwater resources will not be able to sustain the community beyond ten to fifteen years. Results indicate an incompatibility between available water and lifestyle, that is, despite the paucity of water, the community has flush toilets and water-based air coolers with the resultant per capita consumption going up to about 836 l/p/d. The community has high expectations in terms of water supply, and for a way forward to be found changes will have to occur in water management, and the community engaged to enable ownership and acceptance of future water supply options.

Introduction

The traditional nomadic, subsistence lifestyle of Aboriginal people in remote Australia was largely broken down by colonisation. Since the 1960s, there has been an increase in the number of fixed-location Aboriginal communities with the concomitant resource challenges (Knott and MacDonald, 1983). The difficulty of providing a sustainable water supply to Aboriginal communities is acknowledged (HREOC, 2001). Recognition of cultural knowledge about water is seen as a crucial element in the development of sustainable water supply frameworks for these established and emerging communities. Toyne et al. (1996) propose a bicultural water supply framework where service providers acknowledge traditional water knowledge and include it in water provision strategies. This process promotes meaningful contributions from Aboriginal people in the community to water supply developments. The bicultural issues relating to water, however, need to be put on State and National agendas to resolve emerging conflicts. For example, a key element of the Coalition of Australian Governments Water Reforms is to separate service provision from water resources management (McKay, 2002). However, in terms of Aboriginal understandings of water, it is more appropriate to consider managing water as involving both service delivery and broader catchment management. Work needs to be done to ensure bicultural aspects of water management are recognised within mainstream arenas and embraced as approaches of benefit to Aboriginal communities.

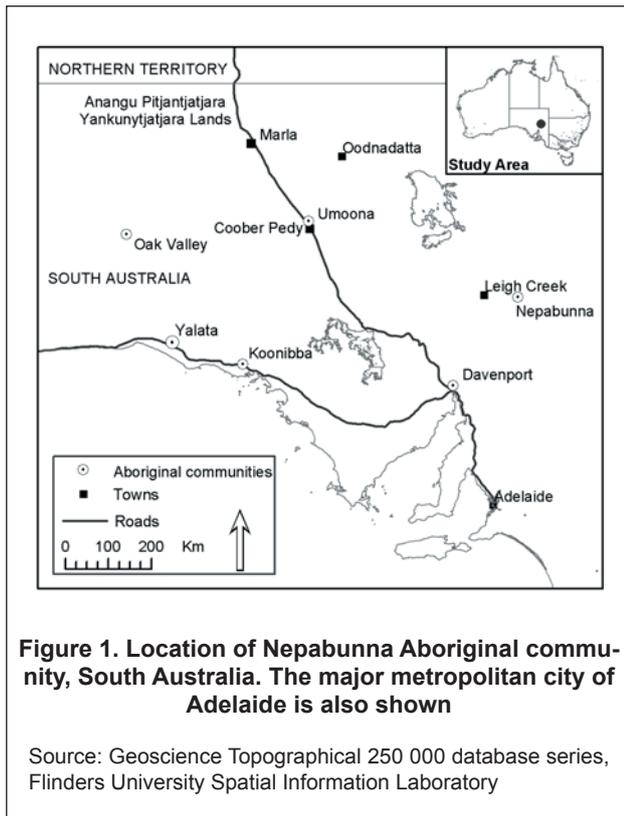
Significant expenditure has been directed towards improving water infrastructure in Aboriginal communities since the 1990s (Bailie and Runcie, 2001; ATSIC, 2002). Evidence of

the impact of these infrastructure investments is demonstrated by the reduction in the number of communities carting water from 56 in 1992 to only one community at present (Bailie et al., 2002). The development of water infrastructure is currently based on health criteria. International thinking has, however, prompted water service providers to focus on the development of sustainable solutions that meet present needs without compromising future provision. This means that solutions should be cost-effective and take into account both the constraints on water as a natural resource and the availability of financial resources (Black, 1998).

Despite such advancements, Nepabunna Aboriginal community (Figure 1) in remote, semi-arid South Australia is facing an uncertain water future. The community relies on meagre rainfall (249 mm per annum) for its potable supply. Low yield, highly mineralized groundwater resources, which constitute the non-potable supply, are expected to last a further ten to fifteen years (Morgan et al., 2003). The growth and development of the community, as with a number of other remote Aboriginal communities, is thus restricted by the paucity of water resources. Despite a history of water shortages, and the site being largely devoid of 'traditional' value (Brock, 1993), the community was formalized in 1973 with the building of permanent housing and supporting infrastructure (Raynes, 2002).

Objectives

This paper conveys the verbal account of the community's perceptions of their water resources, and the usability and sustainability of their water supply.



Methodology

The research employed a qualitative case study approach based on a semi-structured, focus group interview with members of the community. This method is seen to provide a more complex account of the richness of community attitudes than the structured one-to-one interviews (Cameron, 2000). The opportunity for dialogue between members on the issues under investigation allow for reflection on shared attitudes. In focus groups differences of opinion may emerge during the interviewing session and can provide an opportunity for further resolution of the issue or confirmation of continuing conflict (Kitzinger, 1995; Morgan, 1997). The focus group method was employed as it creates a more comfortable research environment for participants than methods such as one-to-one questionnaires. Furthermore focus groups are an efficient means of gaining insight into the perceptions, experiences, feelings and desires of individuals and groups (Cameron, 2000).

Approval to conduct the research was gained from the South Australian Aboriginal Health Council and Flinders University Social and Behavioural Science Ethics Committees, and in consultation with an Aboriginal reference group.

A focus group session was held with four men and six women (i.e. nearly a third of the adult population) of the Nepabunna community on the morning of 12th February 2003. Participants, ranging from early 20s to over 50 years in age, were interviewed together in English. The group included among others, Council members, Essential Services Officers and Health Workers. Most of the participants were 'long term residents' of the community. The focus

group was taped, transcribed and returned to participants for verification and acceptance. Following this the transcripts were analysed by the research team for emerging themes. A report focusing on the key themes was then generated and verified by the community. The participants were eager for an accurate account of their opinions to be voiced to organisations involved in their water supply. Participants were given the option to be named in any publications; for consistency names are not cited in this paper.

The focus group session was semi-structured in that the participants raised and discussed the water issues of concern to them. The researchers had a predetermined list of key topics (cultural relationships to water; water regulation; user pays; quality, future availability; conservation and recycling) that, if towards the end of the focus group session had not been discussed by the participants, were raised by the facilitator.

In addition to the focus group session, field observations of the water supply system and sites of historical significance were conducted. Water quality data were obtained from the Department for Aboriginal Affairs and Reconciliation (DAARE), with water consumption estimates provided by the Department for Water, Land and Biodiversity Conservation (DWLBC).

The community

Nepabunna community is situated in the semi-arid, rugged terrain of the Northern Flinders Ranges, 600 km north of Adelaide (Figure 1). Rainfall is highly variable and characterised by lingering periods of drought, with occasional high rainfall events. Temperature variation is extreme with the mean daily summer temperatures exceeding 33°C and frequently above 40°C. Daily winter maxima fall below 17°C, while minima drop below freezing (Bureau of Meteorology, 2004).

The Flinders Ranges region is a valuable domestic and international tourist destination, although the majority of tourist activity is focused around Wilpena Pound to the south. The other land uses in the region are pastoralism, mining and conservation.

Nepabunna's population, as with many Aboriginal communities, varies considerably - ranging from 50 to over 120 people (SAMLISA, 2000; ABS, 2002). The 2001 census (ABS, 2002) was 53, of whom 45 identified as Aboriginal - 25 males and 20 females, 37 of whom are over 15 years of age.

Nepabunna was established during the 1930s as a result of colonial and missionary activities. The site was situated on rocky ground that would not normally be used for a traditional camp and had no large supply of permanent water - only a creek (small river) with a spring nearby (Brock, 1993). Water supply has been a significant problem throughout its history (Foley, 1984; Willis et al., 2004). During mission times and in the early years under State control, the health and general living standard of Nepabunna's residents was poor. In 1945 lavatories were not in use and effluent was disposed of in

the creek. Disposal of effluent remained a problem as late as 1967 (Foley, 1984).

The State government took over the control in 1973 at the request of the community who had expressed concerns over housing conditions and continuing water shortages (Raynes, 2002). The community now holds an Aboriginal Lands Trust lease for the property, which expires in 2081. The community is self-governing and administered by an elected Community Council. Nepabunna is relatively isolated and has few local services. At present there are 20 houses and several community buildings including an administrative centre, a women's centre and a health clinic. Residents rely on the services provided in the township of Copley and the coal-mining town of Leigh Creek, which are around 60 km to the west by unsealed road.

Although statistics (ABS, 2002) indicate that around 55% participate in the workforce, 85% of workers in Nepabunna are employed through Community Development Employment Projects (CDEP). CDEP is effectively a 'work-for-welfare' programme for Indigenous Australians, with wages marginally above unemployment benefits (Bernardi, 1997). Currently over 32,000 people across Australia are employed through CDEP (CDEP, 2004). The median income of Aboriginal people within Aboriginal communities is around 3 to 10 times below that of non-Aboriginal incomes. Individual median weekly incomes in Nepabunna are \$160-\$199 (ABS, 2002). The figures, however, in terms of purchasing power reveal a community of predominantly low income earners.

Results

A brief overview of the community water resources is given below to provide the context for the issues raised in the focus group discussion.

Current water supply to Nepabunna

A dual reticulation system operates with groundwater from two production boreholes providing water for all non-potable uses, and rainwater providing the potable supply. Groundwater is pumped into two 195 m³ ground storage tanks and gravity-fed throughout the community.

Rainwater is collected at individual household tanks and supplemented with rainwater collected from the roof of the community basketball stadium (Photograph 1). The rainwater from the roof of the stadium feeds into a 195 m³ ground storage tank, then passes through an ultraviolet (UV) light disinfection plant (housed in a small shed) before being provided to households via a pressure system. Rainwater is reticulated to one tap in each dwelling and community building and is located next to the kitchen sink.

The quality of groundwater at Nepabunna is poor and so is considered a non-potable resource with average Total Dissolved Salts 1400 mg/l, hardness 1000 mg/l, iron exceeding 8 mg/l and sulfates near the health limit value of 450 mg/l. Tests conducted in October 2000 indicate higher than recommended levels of arsenic (21 µg/l) and lead (30



Photograph 1. Rainwater collection, storage tank and ultraviolet light treatment plant at the Nepabunna basketball stadium

µg/l). No subsequent testing for these parameters has been conducted, but is recommended. Fluoride and nitrate values are within Australian Drinking Water Guidelines (NHMRC, 1996; DOSAA, 2002; Morgan et al., 2003).

Samples taken from the community rainwater tank, non-potable water supply (at a fire hydrant and from the two storage tanks) and UV-treated water from a drinking water tap and a rainwater tap were tested in May and July 2003 for Total Coliforms and E.coli organisms. Positive results for Total Coliforms (140 and 31 organisms/100 ml) and E.coli (68 and 17 organisms/100 ml) were found in non-potable storage tanks 1 and 2 respectively. According to Morgan et al. (2003), although the presence of organisms was found in the non-potable supply, the fact that the water comes into contact with people's skin during ablutions means that some form of disinfection of the water supply would be prudent to minimise the risk of infection.

The community is on a septic tank effluent disposal system. Wastewater is treated (filtered and chlorinated) to a acceptable Environment Protection Authority Standards that allow it to be used on planted landscape areas (DOSAA, 2002).

Sustainability of the water supply

Data obtained from the Department for Water, Land and Biodiversity Conservation (DWLBC) show an average monthly groundwater use of 1755 m³ (Sampson and Dodds, 2002). These data are based on a four-month period from December 1999 to March 2000, and for one of the two boreholes over a five-month period. A large proportion of Aboriginal people remain highly mobile which makes it difficult to determine the exact population that corresponds with the water consumption figures. The population of Nepabunna is known to fluctuate between 50 and 120 people (SAMLISA, 2000). Using this population data gives an average daily water use of between 488 and 836 l/p. By comparison the mean daily per capita water use in the nearest major city, Adelaide (Figure 1) and rural South Australia is 455 and 599 l respectively. There are currently no data available on the daily per capita consumption of rainwater in Nepabunna, but

meters installed recently will enable this data to be collected in the future (ABS, 2002).

For the last five years both of the boreholes have been pumped at what are considered sustainable pumping rates (Morgan et al., 2003), yet the boreholes show signs of stress. The population has not changed much during this period. The fact that the boreholes are exhibiting signs of stress may be the result of reduced aquifer recharge although further investigation is warranted. To date, since 1990, the region has received significantly less than average rainfall. From January 2001 to June 2004 Nepabunna received between 50 to 70% of its mean annual rainfall (Bureau of Meteorology, 2004).

Exploration drilling has not revealed any alternative sustainable groundwater resources in the area. Local fractured-rock aquifers tend to be small and hard to find (Clarke et al., 2000). Aquifer storage and recovery has, however, been considered in a number of arid parts of South Australia but deemed unsuitable due to the low and highly variable nature of the rainfall (Martin and Dillon, 2002).

In 2000, a feasibility study considered whether excess surface flows in the creek during occasional periods of high intensity, short-duration rainfall might be directed to a temporary storage area; for subsequent aquifer storage and recovery (Clarke et al., 2000). Permanent surface storage is not feasible due to the high rate of evaporation and potential for salinisation. Detailed recharge-recovery tests on the fractured rock aquifer would be required. The study concluded, however, that the small size of the known aquifer, the difficulty in locating aquifers and the cost of such a scheme were major obstacles (Clarke et al., 2000); the idea has not been considered further (Wurst, 2004, pers. comm.).

Community perceptions

The main issues raised in the focus group discussion highlight the incompatible location and water supply infrastructure of the community with the available water resources. Key statements from participants (in italics) are presented with some discussion, under the following headings:

- Cultural changes in relationships to water
- Usability of the water supply
- Feasibility of alternative water resources
- Sustainability of the water supply

Cultural changes in relationships to water

Prior to settlement in formal communities, when the lifestyle of Aboriginal people was more mobile, strong cultural and environmental relationships to water existed. Traditional knowledge about water sources was able to sustain the mobile groups: *'we know where to dig for water too, you know like soakage. Drinking water'* (Participant 3). Changes such as formal settlement, pastoralism and the increasing impact of drought have resulted in a loss of much of the knowledge and use of traditional water sources:

Participant 8: *I think like the rock holes, they [dying].*

Participant 3: *Like little rock holes we use to go along and weed, we use to never carry water, because we know [where] the waters are, and they use to cover it up with rocks. But I don't know, they dried up now ... there's no rain I suppose, keep 'em full.*

Continued relationships with traditional water sources was felt to be important, however, as one participant said, *'[we] want to keep traditional ways, but you know if there is just no water, there is no water, eh'* (Participant 3).

The social changes imposed through colonisation were also seen as significant in altering the people's relationship to water:

Participant 3: *Like the olden days, like the old people, when they use to live here, like they'd live here and when everything's dried up they'd go and set up camp somewhere else where there was water and plenty of food is, until this place come back.*

Participant 1: *But we can't do that.*

Participant 3: *We can't do that because we got a house, we live in a house, we don't live in a wurley¹ no more.*

Participant 1: *White man told us to live in a house.*

Despite these social shifts and environmental changes, strong cultural relationships to water were apparent during our field visits. Particularly when visiting nearby waterholes, the cultural and historic connections melded in reminiscing about old days, and utilising water from the creek which used to be of far better quality and quantity than it is today. In essence, there were expressions of both continuity and change.

Usability of the water supply

While there have been water shortages, either due to lack of rainwater, contamination of rainwater, or restricted access to water supply through pipes freezing, the poor state of the groundwater is a prime concern:

Participant 1: *... our water is not very good, ... not good drinking water. It has got a lot of calcium and salt in the water. You can't drink it, cook in it. It would be good if we can make it better somehow.*

Participant 8: *... the bore water you can't drink it, it is really hard.*

Community members understand that the poor quality of the groundwater is a local resource issue. For example, when asked why the water is of such a poor quality, the response was:

Participant 8: *Just the situation with where we live I suppose.*

Participant 1: *I think it is where we just live. Maybe if we was living in flat areas, flatter ground, might be better water maybe than in the hills. No one know, no one wouldn't tell us.*

Participants felt that the water collected from a well in a nearby creek prior to the 1970s was of a much better quality than the current supply:

Participant 4: *It is no good, it is bad water. We want good water. Well there is good water up there isn't it ... At one time we had good water up the creek there, we had a well there, and it was good water.*

Interviewer: *In the old days?*

Participant 4: *Yeah. All their water, and good water to wash, good water to drink. Yeah. We use to use the shampoo and things. It was good water.*

The intermittent creek has mostly dried up as a result of the below average rainfall from 1990 to date. Concerns were raised that when the rainwater supply runs out, the groundwater cannot be used for drinking:

Participant 8: *And when we run out we use that, you get sick straight away..*

Interviewer: *So how do people get sick?*

Participant 1: *You walk around and you're drowsy and all your mouth go white. You can fill up out of the tap, and all of a sudden it's got this white fizzy froth just comes up. It is just like mixing Sal Vital in the water, that's how it is. You put your ears next to it and you can hear it sizzling up.*

Participant 8: *... [if] we haven't got any rainwater, we can't drink the bore water because it makes the people very sick, people get sick.*

Other health issues participants associate with the water supply are known through visitors' reactions. While Nepabunna residents are 'used to the water' (Participant 7), visitors suffer as a result of the water quality and comment '*... gees this water's hard*', [and] '*their skin starting to crack*'. These current water-related health experiences are again compared with past conditions:

Participant 4: *[we use to never get sick] When the water use to be up there [from the creek], we use to walk, go and dig with a bucket, yeah. We never use to get sick. ... Cause it was rainwater was laying ... in the, water, it would be in the creek all the time.*

While the groundwater is only used for non-potable applications, with rainwater providing the potable supply, the poor quality of the non-potable supply comes at some cost to householders and the community. For householders, washing clothes and keeping clean is made both difficult and expensive. People need to use expensive, concentrated washing powders and shampoos in order to obtain a lather and the results are often poor.

The groundwater also limits horticultural opportunities:

Participant 8: *... if you try to have like garden or vegetables, ... you can't put the sprinklers on them because ... the water just get to the plants after a while, you might grow one crop but the next lot will be no good.*

Participant 1: *If you had a bunch of carrots out there or cabbage, if you put a sprinkler on it, you would see the salt on the leaves hanging down.*

Participant 8: *They would be just white.*

The Aboriginal and Torres Strait Islander Commission (ATSIC) and Department for Aboriginal Affairs and Reconciliation (DAARE) fund the water infrastructure and maintenance costs in most Aboriginal communities across South Australia. In the 2003/2004 financial year for example, \$7.8m was spent on water, power and sewerage infrastructure and maintenance in South Australia (ATSIC, 2004). Furthermore, SA Water, the service provider to metropolitan Adelaide (with a population



Photograph 2. Filters from water-based air coolers clogged up with salts (inset: salts accumulating at the base of a cooler)

of 1.07 million), has commented that the work of DAARE in remote Aboriginal communities is 'best practice' and 'far superior' to comparable non-Aboriginal communities, with careful thought having gone into spending money well, and appropriate for the harsh environmental conditions (Morgan, 2004, pers. comm.). Despite receiving a Community Services Supply grant to cover housing maintenance, participants expressed frustration at the costs and on-going maintenance of water-based air coolers, hot water systems, septic tanks, filters and elements which continually get clogged up with precipitations of salts (Photograph 2) in the water supply:

Participant 8: *... the hot water systems, you get like big solid lumps ... And the air conditioners [inaudible], you have to replace the pads every what, ... we got to replace them every six weeks or so. Because they're solid, they're hard.*

Feasibility of alternative water resources

The technology to improve the quality of the water supply is available through reverse osmosis, for example. Currently, two of the South Australian Aboriginal communities (Yalata and Umoona; Figure 1) receive water treated by reverse osmosis, at a cost to the Government of \$4.50/m³ (as opposed to the 0.97 cents/m³ cost of water charged to metropolitan consumers). This option is not feasible at Nepabunna on two accounts, firstly, the reverse osmosis process would result in around 50% of the treated water being discarded as brine effluent; this is unsustainable given the low yield of the Nepabunna boreholes. Secondly, there is the issue of cost. At present the community does not pay for its water supply and use, and no cost recovery would be likely for such a service at Nepabunna (discussed below).

Participants were aware that the Department for Aboriginal Affairs and Reconciliation (DAARE²) has been talking about the possibility of the community paying (a nominal amount) for water in the future. While the ability of individuals to afford to pay for water was a concern for

focus group participants, there was resistance on the grounds that the community 'want better water before we pay for it' (Participant 1). 'You not pay for water when the water is not to good. Bad water, not going to pay for it' (Participant 4). If user-pays were introduced under present water supply conditions, it would be strongly resisted by the community. While participants recognised that other remote Aboriginal communities pay for their water (often a nominal fee of around \$5 per household per week deducted along with the weekly household rent), it was also recognised that other communities have a better water supply while Nepabunna has 'all kinds of faults' (Participant 5).

Despite not paying for their water supply, there were expectations among the group for improvements in water services, although views were mixed in terms of the current service provision: 'Treckon DOSAA²... not doing enough. How long have we talking about the water for?' (Participant 4).

Participant 1: ... They only come in for about half a day or something. When there's a problem they come, if there's no problem you don't see them. If there is no problem here, ... in the next twelve months you'd think they'd come along and offer a good, another programme at least. Like the plant we was talking about, and even just talking about water softeners next to the house you know. You put them next to the house. We've been talking about those for years.

Of concern though, is in the case of breakdowns, there is little in the way of an alternative supply:

Participant 8: *If the bore breaks down we don't ... we don't have any other options.*

Participant 1: *DOSAA² doesn't provide emergency pumps or anything you know. If they break down, you have got to ring them and they'll send it or they'll bring it. There'd be a day or two before they get here. They won't leave any spare pumps here.*

The DAARE Infrastructure Services Group, in their role as the service provider, operates under financial and personnel constraints. The team comprises four people who project manage or are directly involved in the maintenance of water services in 18 rural and remote Aboriginal communities. Nonetheless, there is scope for a deeper level of community engagement and ownership of the water supply decisions. In terms of alternative water resources, a number of options have been looked into by DAARE including a surface water storage dam, aquifer storage (recharge) and recovery, a desalination plant and household water softeners. The general consensus among the group was that the cost of these developments was prohibitive.

Sustainability of the water supply

The community is aware of the paucity of the groundwater supply, nonetheless, in terms of water conservation, the comments below indicate a dichotomy of behaviour within the community:

Participant 8: ... *people always say if they see you doing something, don't waste water, tell you straight away. Yeah. When we walk, we tell one another:*

Participant 8: ... *see [someone] mucking about washing the car, you don't waste water. [Go] turn the hose off.*

Participant 2: *Turn someone else's tap off if they left it on.*

Participant 8: *And tell them when they come back, you got to turn your taps off.*

Participant 1: *Everybody here. ... Water is precious to us.*

Participants outlined that when there are water shortages or water levels in the tanks are low, a community notice is posted and residents respond appropriately. Caring for water is partly due to the lasting influence of the missionaries who, prior to the 1970s, 'used to creep around in the night to turn people's taps off' (Participant 8).

Participant 1: *We, more or less learnt it from the missionaries. You'd see a torch light coming around the house, you'd know it was the missionary checking all the taps. If he heard a tap dripping inside, he'd knock on the door, oh it's you, turn your tap off he'd say.*

Particular care was taken to avoid wasting water:

Participant 3: *Some people use to fill up the 44 gallon drums, big things, store the water.*

Participant 8: *When the tap was dripping. ... Saving it when you couldn't stop the tap dripping.*

Participants see the treated wastewater from the septic tank effluent ponds as an under-utilised resource and were strongly in favour of using it. They have discussed plans to irrigate bush tucker³ plantings with recycled water. There have, however, been problems maintaining the irrigation infrastructure with children pulling up pipes and interfering with sprinklers. The condition of the town irrigation system appeared poor as a result.

Conclusion (learning points)

The increase in the number of fixed-location, Aboriginal communities in remote parts of arid Australia can be attributed in part to the technological advances in water resource exploration, drilling and treatment and hence availability of groundwater supplies (Knott and MacDonald, 1983). Nepabunna community has high expectations in terms of water provision, desiring a supply similar to that of the Adelaide metropolitan population, however, a discrepancy arises in that the water resources in the region are a limiting factor, not technology. Attempts to find alternative water resources, at a reasonable cost, have been unsuccessful. The groundwater resources will not be able to sustain Nepabunna community in the medium term despite the fact that the boreholes have been pumped at what are considered the sustainable pumping rates; the community acknowledges this is due to its locality. The limitations on the amount of water that can be extracted from the aquifer may have been exacerbated by the long-term drought in the region. This raises the question: Should communities attempt to establish in areas of known water scarcity where water resources cannot sustain the population? In terms of management of the water resources and supply, a coordinated effort between the organisations responsible for housing and those responsible for water supply is required to manage demand and provide an infrastructure

that is compatible with available resources.

Although open to debate, the people of Nepabunna feel that they are cautious in their use of water, and while this may be so, there remains in place water-demand infrastructure such as flush toilets, and water-based air coolers that are required to operate on maximum flow rates to prevent clogging by salt precipitation. Such infrastructure is not compatible with scant water resources. Further research is required to determine actual water use before appropriate household-based water management strategies can be developed in partnership with the community.

A partial solution to the water shortage would be to further develop, in partnership with the community and in line with their current aspirations, the currently under utilised water recycling programme. Management needs to incorporate any new developments into a community water plan that takes into account current and future water supplies. There needs to be an increase in the transparency and engagement of the community as a partner regarding the options for and feasibility of future water supplies, particularly if there is to be any attempt at cost-recovery in the future. In the meanwhile, the community feels it is the responsibility of DAARE to ensure an adequate water supply in the future, they are reluctant to consider any level of payment until the quality of the current supply is improved.

Acknowledgements

Veolia Water (Australia), Department for Aboriginal Affairs and Reconciliation (DAARE), and Flinders University are thanked for funding the research. Simon Wurst and Grant McLean (DAARE), Jacqueline Best and Robert Keane (Flinders University Spatial Information Laboratory) for their contribution.

References

- ABS (2002) 2001 Census of Population and Housing. Australian Bureau of Statistics, [Online], Available: www.abs.gov.au/austats/abs@census [Accessed 1 May 2004].
- ATSIC News (2000) Nepabunna looks to cultural tourism. Aboriginal and Torres Strait Islander Commission (ATSIC), February: pp. 42-43.
- ATSIC (2004) 13 Years of ATSIC: The true story. Aboriginal and Torres Strait Islander Commission. Internal Report.
- Bailie, R. and Runcie, M. (2001), Household infrastructure in Aboriginal communities and the implications for health improvement. *Medical Journal of Australia*, Vol 175: pp. 363-366.
- Bailie, R.S., Siciliano, F., Dame, G., Bevan, L., Paradies, Y. Carson, B. (2002) Atlas of Health-related Infrastructure in Discrete Indigenous Communities. Aboriginal and Torres Strait Islander Commission: Melbourne, Victoria.
- Bernardi, G. (1997) The CDEP scheme: a case of welfare colonialism. *Australian Aboriginal Studies*, Vol 2: pp. 36-46.
- Black, M. (1998) Learning What Works: A 20 Retrospective View on International Water and Sanitation Cooperation. UNDP-World Bank Water and Sanitation Program, Washington DC. [Online], Available: www.wds-worldbank.org [Accessed 16 February 2002].
- Brock, P. (1993) *Outback Ghetto: Aborigines, Institutionalisation and Survival*. Cambridge University Press, Cambridge.
- Bureau of Meteorology (2004) Australian Climates. [Online], Available: www.bom.gov.au/climate [Accessed 15 July 2004]
- Cameron, J. (2000) Focusing on the focus group, in *Qualitative research methods in Human Geography*. I. Hay (ed.), Oxford University Press: Melbourne.
- CDEP 2004, About CDEP. [Online], Available: www.cdep.com.au [Accessed 29 May 2004].
- Clarke, R., Gerges, N., Osei-Bonsu, K., Dodds, S. (2000) An investigation of the potential for rainwater harvesting at Nepabunna, North Flinders Ranges, South Australia. Report Book 2000/00010, Department of Primary Industries and Resources: South Australia.
- Davis, C., Coulthard, C. and Coulthard, D. (1986) *The Flinders Ranges: An Aboriginal View*. 2nd edition, Aboriginal Heritage Branch, for Environment and Planning: Adelaide, South Australia.
- DOSAA (2002) 2001/2002 Annual Report: Routine Bore Water Supply Maintenance 2001/2002. Specification No. AAM-02, Division of State Aboriginal Affairs, Adelaide.
- DWLBC (2003) Interim Report on Monitoring of Water Wells in Aboriginal Lands: October 2002 to April 2003. Department for Water, Land and Biodiversity Conservation: Adelaide.
- Foley, G.E. (1984) The Report of the Committee of Review into Aboriginal Health in South Australia. unpublished report.
- HREOC (2001) Review of 1994 Water Report, Human Rights and Equal Opportunity Commission. [Online], Available: www.hreoc.gov.au/racial_discrimination/water_report/index.html [Accessed 12 December 2001].
- Kitzinger, J. (1995) Introducing focus groups, *Qualitative Research*, Part 5. *British Medical Journal*, Vol 311, No 7000: pp. 299-302.
- Knott, G.G., McDonald, P.S. (1983) "Groundwater for Central Australian Aboriginal communities": Papers of the International conference on groundwater and man, Australian Water Resources Council Conference Series, Vol 3, No 8: pp. 141-150.
- Martin, R., Dillon, P. (2002) *Aquifer Storage and Recovery: Future Directions for South Australia*. Report DWLBC 2002/04, Department of Water Land and Biodiversity Conservation: Adelaide.
- McKay, J. (2002) Onshore water project: briefing paper in Background Briefing Papers. Lingaiari Foundation: Broome, Western Australia.
- Morgan, D.L. (1997) *Focus groups as qualitative research*. 2nd edition, Sage Publications: London.

Morgan, L., Venema, D., Pelekani, C. (2003) Water Quality and Quantity Appraisal for Remote Aboriginal Communities for Water Service Improvement. (Draft Report), SA Water: Adelaide.

NHMRC (1996) Australian Drinking Water Guidelines. National Health and Medical Research Council: Canberra.

Raynes, C. (2002) A little flour and a few blankets: An administrative history of Aboriginal Affairs in South Australia, 1834-2000. State Records of South Australia: Gepps Cross, Adelaide.

SAMLISA (2000), Sustainable Resource Management: Strategy for Aboriginal Managed Lands in South Australia. (SAMLISA), Aboriginal Lands Trust: Adelaide, South Australia.

Sampson, L., Dodds, A.R. (2002) Hydrogeological Report on Water Well Monitoring in Aboriginal Lands to May 2002. Department of Water Land and Biodiversity Conservation: Adelaide.

Toyne, P., Japanangka, J.G. and Zimran, S. (1996) Towards a Bicultural Regional Water Program in Central Australia: Consultations with Aboriginal Community Groups. Australian Geological Survey Organisation, Department of Primary Industries and Energy: Canberra.

Willis, E., Pearce, M., Jenkin, T., Wurst, S. (2004) Water Supply and Use in Aboriginal Communities in South Australia. Flinders Press: Adelaide.

Notes

1. Traditional, temporary, tent-like shelter
2. DAARE (Department for Aboriginal Affairs and Reconciliation), formerly DOSAA (Department for State Aboriginal Affairs) manages or maintains water service provision in 18 Aboriginal communities across South Australia
3. Traditional, indigenous food plants used in cultural tourism

Contact address

Meryl Pearce
School of Geography, Population and Environmental Management

Flinders University, GPO Box 2100
Adelaide 5001 South Australia

Eileen Willis
School of Medicine
Flinders University, GPO Box 2100
Adelaide 5001 South Australia

Tom Jenkin
School of Geography, Population and Environmental Management
Flinders University, GPO Box 2100
Adelaide 5001 South Australia
