Safe water and sanitation in remote Indigenous communities in Australia: conditions towards sustainable outcomes

Nina Lansbury Hall, Kumudini (Kumi) Abeysuriya, Melissa Jackson, Charles Agnew, Cara D. Beal, Samuel K. Barnes, Simone Soeters, Pierre Mukheibir, Suzanne Brown & Bradley Moggridge

Published online: 02 Jun 2022.

Submit your article to this journal ↗

View related articles ↗

View Crossmark data ↗

Taylor & Francis
Taylor & Francis Group

Check for updates

Safe water and sanitation in remote Indigenous communities in Australia: conditions towards sustainable outcomes

Nina Lansbury Hall[a], Kumudini (Kumi) Abeysuriya[b], Melissa Jackson[c], Charles Agnew[d], Cara D. Beal [c], Samuel K. Barnes[a], Simone Soeters[b], Pierre Mukheibir [b], Suzanne Brown[e] and Bradley Moggridge [f]

[a]School of Public Health, University of Queensland, Herston, Queensland, AUSTRALIA; [b]Institute for Sustainable Futures at the University of Technology Sydney, New South Wales, Australia; [c]Cities Research Institute, Griffith University, Brisbane, Queensland, Australia; [d]Sydney Water, Sydney, New South Wales, Australia; [e]WA Water Corporation, Western Australia, Australia; [f]Centre for Applied Water Science, University of Canberra, Canberra, Australia

ABSTRACT

Safe drinking water and effective sanitation is a basic human right. The health of Aboriginal and Torres Strait Islander Peoples living on traditional Country in remote Australia can be supported or undermined by these essential services. Despite global and Australian commitments to the Sustainable Development Goals, water and sanitation service levels have regularly been identified as unreliable, unsafe, and of a lower standard than non-Indigenous and non-remote settlements. This research sought to identify the optimal conditions to enable consistent delivery of safe water and sanitation in remote Indigenous communities of Australia. Using a combination of literature reviews, interviews with key stakeholder groups and applied research findings, key conditions for improved water and sanitation outcomes were identified. These included technology for water and sanitation that is fit for purpose, people and place; capacity-building, training and ongoing support for local Indigenous service operators; and that all personnel involved in delivery require a level of cultural competency to the local and Indigenous context. These findings are intended to contribute to informing more sustainable water and sanitation outcomes in Indigenous communities.

1. Introduction

Connection to Country (traditional estate) is core to the holistic view of social and emotional well-being of Aboriginal and Torres Strait Islander Australians (also respectfully referred to as Indigenous Australians in this article) (Rigby et al. 2011). Living on and connecting to Country extends beyond cultural contexts for Aboriginal and Torres Strait Islander Australians to provide positive physical and mental health outcomes (Green and Minchin 2014; Lyons and Barber 2021).

It is imperative for the health of community residents who live on Country that essential services, notably water, sewerage and power, are available and functional (Creamer and Hall 2019; QPC 2017). As of the 2016 census, approximately 18.4% of the Indigenous Australian population live in discrete remote or very remote communities (hereafter referred to as remote Indigenous communities)(ABS 2016). As safe drinking water and effective sanitation (sewage management) constitute a basic human right, it is therefore essential to consider how to ensure sustainable and consistent delivery of these in remote and very remote communities (Hall et al. 2021b; Productivity commission 2021a; Beal 2017).

Improved drinking water and sanitation standards across Australia should align with the Australian Government's commitment to attain the Sustainable Development Goals (SDGs), including realising SDG 6 'to ensure water and sanitation for all' (United Nations 2015). Despite this pledge, service levels in remote communities have been noted to be at a lower standard and suffer more major disruptions than in non-Indigenous communities of a similar size and location and in urban areas (Productivity commission 2016, 2021a; Beal et al. 2019). Many services in remote areas have been recorded as not meeting basic regulatory requirements nor the Australian Drinking Water Guidelines (ADWG) (AECOM 2010; ABS 2007; Productivity commission 2016). Poor water, sanitation and hygiene-related issues have been identified as contributors to inequitable health outcomes in these communities for several decades (Ali, Foster, and Hall 2018; Bailie et al. 2010; Pholeros, Rainow, and Torzillo 1993; Hall et al. 2017). Indeed, the Australian Government's voluntary review of its status of attainment of the UN Sustainable Development stated that:

"rural and remote communities in particular may not have the same level of access to water and sanitation services as urban centres. This is particularly the case for remote Aboriginal and Torres Strait Islander communities and can have important flow on effects to health outcomes."

(Australian Government 2018, 50).

It has been repeatedly documented that improvements to the supply and use of water and wastewater services are needed in remote Indigenous communities and are the responsibility of state and Territory governments or their sub-regional agencies (Hoverman and Ayre 2012; Ross et al. 2014b; Jackson et al. 2019b; Beal et al. 2019, 2020; Hall et al. 2017). The 2020 review of the National Water Initiative, a collaborative initiative of national water reform between state and Territory government, stated that a renewed National Water Initiative should include a commitment to 'ensuring access to a basic level of service for all Australians, including for safe and reliable drinking water' (Productivity commission 2021b, 11).

There are significant public health benefits from adequate water and sewerage services, yet progress towards eliminating the gap in health equity between Indigenous and non-Indigenous Australians has not been on track. This is despite the consideration of the 'Closing the Gap' in Indigenous equity agenda of the past decade (NIAA 2021). The recently-revised Closing the Gap agenda sets a stronger ambition; there is now a specific priority focus on remote community infrastructure including 'essential service provision to Aboriginal and Torres Strait Islander communities, including water and sewerage … ' (Australian Governments and the Coalition of Peaks, 2020, 86b(i)).

In response to this context, this research sought to integrate and build on previous work to identify the required conditions, in terms of structure, resources and other aspects, for consistent delivery of safe water and sanitation in remote Indigenous communities of Australia and to highlight some of the complexities around meeting those conditions. It was written by authors working and researching in complementary areas within the field of water and sanitation services in remote Australia. Australia's commitment to attaining the SDGs, particularly SDG 6, provides a strong driver for water utilities and other relevant agencies and decision makers to explore how they can contribute to improving water services in remote Indigenous communities in Australia and potentially in similar settings outside of Australia. This research is provided to contribute to that guidance.

2. Methods

This research is based on the analysis and synthesis of existing literature including commissioned reports by the collaborating authors. In the interest of informing implementation of on-ground water services, four social research projects relating to water and sanitation issues and services in remote Indigenous communities in Australia were co-analysed. These were conducted variously by the authors between 2016 and 2019. In bringing together this collation, the commissioning organisations and their data were protected while the publicly-relevant findings were able to be shared. These complementary projects included a review of priorities for meeting water, sanitation and hygiene needs (Hall et al. 2017), a trial of effective co-development models for water management (Jackson, Stewart, and Beal 2019a; Jackson et al. 2019b; Beal, Gurung, and Stewart 2016; Beal et al. 2018), identification of opportunities for an urban utility to contribute to improving remote water service outcomes (ISF-UTS & QUU 2017), and an exploration of roles and opportunities for the Australian water industry in ensuring safe water services in remote settings (Abeysuriya et al. 2019). The four projects were funded diversely from internal university funds, commissioned by water agencies, and funded by the Australian Research Council. This synthetical approach enabled a public sharing of the restricted access report findings while maintaining the commercial-in-confidence arrangement by the commissioning agency of some of the reports. This was considered by the authors to be of value to the user-focused audience of this journal.

The research scope of these projects covered the Northern Territory, Queensland and Western Australia as this encompasses the greatest proportion of the remotely-located Indigenous communities in Australia (Commonwealth of Australia 2017). The social research projects were compliant with each collaborating university's Human Research Ethics Committee approval requirements, including maintenance of anonymity to protect the confidentiality and privacy of research participants (UQ #2016001540; UTS #ETH18-2599; and GU/ENG/15/14/HREC). In combination, the interviewees in the projects included representatives from water service providers, federal, state and local governments, peak bodies, local community, academic institutions and Indigenous organisations. The authors of each of these four projects provided a reanalysis of the interviews with a range of key informants who all had experience in delivering water services to remote communities (see Table 1). This meant that the collaborating authors

Table 1. Details of interviews from which the synthesis was drawn.

	Interviewee affiliations	No. interviews (time frame)	Source
Priorities for meeting remote water, sanitation and hygiene needs under UN SDG6	State and territory government agencies; water utilities; Indigenous organisations; research organisations; non-government organisations.	17 (January–February 2017)	(Hall et al. 2017)
Identification of opportunities for an urban utility to contribute to improving remote water service outcomes	State government agencies; peak water bodies	10 (late 2017)	(ISF-UTS & QUU 2017)
Assessment of current water management approaches and identification of barriers to collaborative management of water in remote Indigenous communities	Water managers, technicians, and others involved in water management from government, utilities, industry, non-government groups and communities	21 (June 2016–January 2018)	(Jackson, Stewart, and Beal 2019a, Jackson et al. 2019b, Beal, Gurung, and Stewart 2016, Beal et al. 2018)
Compilation of opportunities for the Australian water industry in remote settings	Urban water utility; Indigenous resource agency	2 (late 2018 to mid-2019)	(Abeysuriya et al. 2019)

did not have access to social research data from a different university's project that, furthermore, responded to different initial research questions.

To integrate data in this restricted setting, a synthesising tool was developed by adapting the 'Social, Technical, Environmental, Economic and Political' (STEEP) framework (Morrison 1992), shown in Table 2. The reanalysis was achieved by each lead author separately re-examining their social research data from their respective projects through the analytical lens of the STEEP framework. This enabled each researcher to identify the nature of issues raised in their research interviews with respect to values and meanings and the infrastructure life cycle around water services. The outputs were shared among collaborating authors to enable a collaborative view of the emerging results through the lens of the STEEP tool. De-identified quotes were included to illustrate or elaborate the findings as relevant. The interview quotes do not have specific details regarding location and date to adhere to ethical clearance requirements to protect the identity of responding organisations and individuals and thus protect the commissioned reports. Furthermore, the quotes are used to illustrate an issue that was raised by multiple respondents. Given the synthetical approach, the total interviews and representatives from each sector could not be meaningfully quantified.

The literature review included targeted academic, grey and white literature gathered through a combination of keywork searches on journal database searches and the shared libraries of the collaborating authors, as well as new publication alerts. To enable coherent presentation of the findings from the

Table 2. STEEP framework for interrogation of existing social research projects (adapted from (Morrison 1992).

|	Meanings/Values	Planning and Installation	Operations & Maintenance Repairs and Replacements
Social	• Values and taboos around drinking water and sanitation?	• How are decisions made? Who is involved?	• Issues around operator skills and capacities • Staff retention issues • How people engage with the infrastructure (use/abuse, maintain) • Emergency response – who and how? • What access to support networks
Technological	• Views about convenience, safety, dignity, reliability, ease of maintenance	• What was the process for selecting from options? • Appropriateness of technology choices (for situation and operator)?	• Performance/ Service delivery standards • Quality/Quantity • Reliability of service • What happens when there are significant/major failures? • Decision making regarding replacement vs repair?
Economic (resources and constraints)	• Valued enough to pay for (water/ sanitation)?	• Economic analysis of costs, affordability?	• Who pays for the service delivery/ replacements/major repairs? • Funding, costs
Environmental	• Environmental issues of concern to stakeholders	• Source water quality • Effluent discharges	• Impact on waterways • Groundwater resources
Political/legal/ institutional	• Preferences about power and influence • Views about what 'should' happen	• Drivers, Approval process, Standards • Ownership of infrastructure	• Who holds responsibility for operations? • Compliance (monitoring, reporting)? • What are the regulatory requirements re upgrades etc.
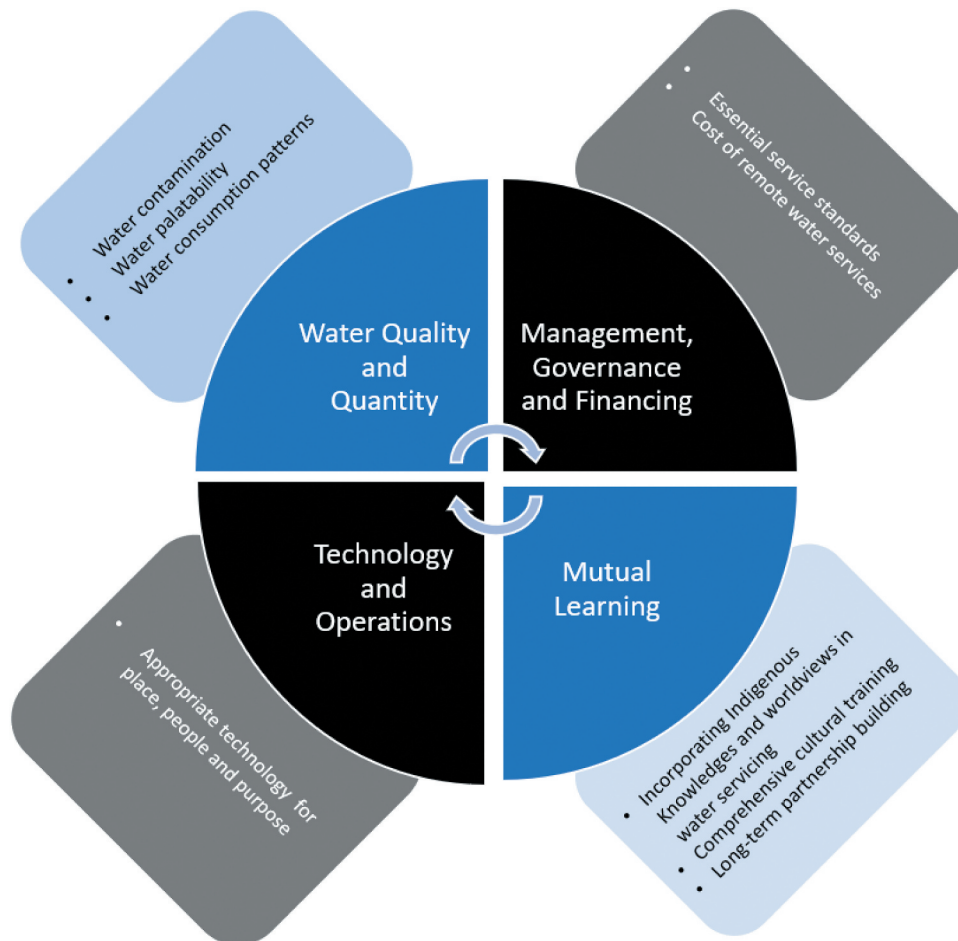
Figure 1. Resulting themes from analysis of literature and social research on conditions for sustainable remote water provision.

literature review and the social research, they were grouped under sub-headings, and arranged under the four themes reported in the Results section.

3. Results and discussion

Synthesis of the social research projects and literature through the application of the STEEP tool resulted in the identification of four broad themes of relevance to conditions for attaining sustainable outcomes: water quality and quantity (incorporating contamination, palatability and consumption); management, governance and financing (incorporating standards and costs); technology and operations; and mutual learning. These results are displayed and summarised visually in Figure 1 and are detailed in an integrated manner with the discussion and relevant literature to expand on the themes. The themes were presented visually in this integrated manner in recognition that all occur in combination and influence the surrounding themes. For example, drinking water quality outcomes are influenced by the treatment technologies available (and functioning) in a given community, and that the governance of the water services influences both the

physical outcomes (through available technologies) and the social outcomes (including the support for water operators who are often isolated from colleagues).

Key points under the findings are illustrated with de-identified quotes from the social research interviews conducted with representatives from federal, state and local government, water utilities, local community and Indigenous organisations. This section concludes with a discussion on how these conditions could be implemented.

4. Water quality and quantity

Interviewees within the social research described a range of issues associated with supplying water of adequate quality and quantity that meet the drinking water guidelines as well as the needs of remote Indigenous communities. These included source water quality issues related to microbial and chemical contamination, and challenges for water service providers in building understanding of water supply sources and water use patterns that limit the ability to maintain water security. The respondents also documented how long-term water security issues are exacerbated in a changing climate due to unreliability

of seasonal rainfall and increasing intensity and frequency of extreme weather events (Jackson et al. 2019b; Hall and Crosby 2020).

4.1. Water contaminaion

Drinking water supplies in remote Indigenous communities are at risk of both microbial contamination and chemical contamination by naturally occurring elements in deep artesian (bore) sources (Hall et al. 2017). The naturally occurring chemical contaminants found in the drinking water, including arsenic, cadmium, nitrates, uranium and barium which tend to increase towards inland Australia, can require the installation of advanced water treatment technologies due to the health risks from high concentrations (Hall et al. 2017). Poorly maintained drinking water infrastructure was linked to heightened risk of water contamination, described as:

> "It's quite chronic in cases . . . [because] storage tanks [are] . . . rarely replaced . . . They're going to rust; they're going to corrode . . . Water supplies are 100% a [health] problem" (Indigenous organisation representative).

4.2. Water palatability

Issues of palatability and aesthetics were also noted in communities reliant on bore (ground) water, a key water source in remote Australia, and desalinated water. There are implications for infrastructure maintenance as well, both at the household level and the water system (Anda and Dallas 2005), described by an interviewee as:

> "Hardness and total dissolved solids . . . generally salinity . . . pH is actually slightly too low . . . iron, a little bit of manganese . . . the consequences [on the water are a lack of lather] in terms of washing, [a build-up of scale] in terms of appliances"

> (Water utility representative).

In response to palatability issues, many Indigenous community members prefer to drink rainwater from household tanks rather than 'town' water supplied by service providers. Indeed, a study of drinking water preferences in four remote communities indicated that rainwater was the primary drinking water source for over a third of participating households (Beal et al. 2019). The reasons for this preference ranged from unacceptable odour and taste of treated (chlorinated) water, concern regarding chemicals being added for treatment, and a lack of trust that town water was potable- due in part to a high number of boil water alerts in some communities. The majority of people whose primary drinking water

source was rainwater did not treat their water; of those who did, boiling was the preferred method (Beal et al. 2019). Although rainwater can be a preferred source for taste, the associated health risks from long-term tank storage and lack of treatment was a concern raised especially by the government and local service providers (Hall, Selvey, and Go Sam 2018; Aldirawi, Souter, and Beal 2019). Additional implications for health arise in cases where soft drinks are consumed in preference to water (Hall et al. 2017).

4.3. Water consumption patterns

There is documentation of high household and community-level water use in remote communities, yet limited analysis of actual patterns of water use to distinguish between behaviours and infrastructural issues, including leaks (Beal et al. 2018). Up to 75 percent of consumption has been identified as used for outdoor purposes (Beal, Stewart, and Larsen 2014; Beal et al. 2019). This is in contrast to water use outdoors constituting 25 percent of total household water consumption in urban areas such as Sydney (Sydney Water 2019). The key drivers of high outdoor water use beyond leaks include dust control from roads and yards in areas with large unvegetated areas, cooling of the roof, yard and driveway to create an evaporative effect during hot weather, washing down boats and fishing or hunting equipment, physical amenity such as gardening, and social amenity including sorry camps (funerals) and extended family gatherings (Beal 2017).

Efforts to monitor and understand water consumption- especially to identify leaks- are often constrained by available baseline consumption data across seasons and populations. These data are required to effectively target water management strategies at the community level (Beal, Gurung, and Stewart 2016; SACOSS 2020). Interviewees observed that most communities do not have automated disaggregated metres and rely on manual metre reads. These are often conducted in an *ad hoc* manner, and high-level assessments based on the community supply metre are used instead to estimate average per capita use (Christie 2010; Beal, Gurung, and Stewart 2016). This average can vary significantly from actual consumption values as communities and households are diverse in the number of permanent and visiting occupants.

A lack of understanding of drivers of water consumption can lead to inaccurate targeting of water use (Ross et al. 2014b; Beal et al. 2018). In the social research, interviewees identified the value of improved technologies for metering and monitoring household

water use to inform infrastructure planning and strategies for engaging communities in water conservation activities. One stated:

> "Smart meter or near real-time data allows us to identify leaks, we notify housing, housing is able to get work orders out and leaks are fixed"
>
> (Water utility representative).

Reliance solely on quantitative water consumption and quality data may not provide the required understanding of the context of household and community water use. Ross et al. (2014b) detailed how smart metering complemented by social engagement and qualitative data can enable demand management programmes to be targeted more effectively to the local context rather than a standard promotion of lower water consumption practices.

5. Management, governance and financing

Arrangements for accountability, planning, financing, administering, regulating and monitoring were identified in the interviews and literature as key aspects for enabling long term sustainable outcomes (Ross et al. 2014a; Jackson, Stewart, and Beal 2019a; Jackson et al. 2019b). These detailed how the complexity of roles and responsibilities, government funding priorities, water service provisions to public housing residents and land tenure arrangements have contributed to confusion and inefficiencies that undermine sustainable water services. Key issues raised by interviewees related to this complexity and confusion in standards for essential water services and in the cost of remote water services.

5.1. Essential service standards

Under the Australian Constitution, state and territory governments are required to provide residents with municipal and essential services (Australian Government 2010). The legacy of forced removal from traditional lands to missions (reserves) resulted in many Indigenous communities now being located on the outskirts of townships. This has meant that Indigenous communities can be excluded from service provision through state or local government oversight or provided with different essential services to those provided to non-Indigenous communities (Wensing 2015; SACOSS 2020). One interviewee said:

> "Whereas any other [non-Indigenous] town in the state has the capacity to get a question answered or has access to their data on water quality as a citizen of the state, Aboriginal people in Aboriginal communities do not"
>
> (Water utility representative).

The inconsistencies in service provision for Indigenous communities were described in a review by the Australian Government (2010). The review identified arrangements for water and sanitation services in Indigenous communities in Australia as 'complex and inconsistent', with some funding arrangements '(equating to) lower standards of service than that provided to non-Indigenous Australians living in communities of similar size and location' (Australian Government 2010, 210). These arrangements create ambiguity for Indigenous communities regarding which agency is responsible for delivering services within their community. One interviewee stated:

> " ... It is amazing how many different agencies can say 'this isn't my problem, it's the (Department of Housing)', then the (Department of Housing) says 'it's not my problem, it's the (Department of Water)' ... and it just leads to confusion and inaction. It's not clear"
>
> (Water utility representative).

5.2. Cost of remote water services

Many remote Indigenous communities are almost completely dependent upon government for services and local economic activity, including employment and development opportunities (Moran 2016; Ross et al. 2014b). A majority of the community population live in public or social housing managed by government or community housing providers (Productivity commission 2016). Water services are typically included as part of rental agreements with no consumption charges for water use or individual water metres installed on public housing (Ross et al. 2014b; NOUS Group 2017; Beal et al. 2018).

Provision of housing services in remote Indigenous communities involve a significant and unavoidable revenue-cost shortfall by the service providers, driven predominantly by the significantly higher costs for servicing remote communities (SACOSS 2020). Maintenance and repair activities in remote Indigenous housing often ranges between 1.4 and 4.5 times the cost of equivalent activity in 'mainstream' or urban public housing, and can be reportedly up to 47 times higher for specific items (NOUS Group 2017). Cross-subsidisation is enabled in some jurisdictions for state-wide sustainable outcomes to compensate for the higher costs (NOUS Group 2017).

Complex reporting and maintenance processes can result in long lead times for repairs and fixing leaks, and also create confusion around responsibilities (Hoffmann 2001). A 'siloed' approach to management across agencies without integrated place-based solutions risks issues being overlooked (Jackson et al. 2019b). Funding for appropriate levels of public housing maintenance was raised as

a key issue and barrier to effective household water management in the interviews. One interviewee stated:

> "The public housing maintenance budget per household is very small given the relative costs of labour and providing maintenance services in remote communities"

(Indigenous organisation representative).

In response, improved coordination in property management and tenancy management was identified by interviewees as providing the greatest potential for positive gains.

At a community-scale, land tenure is important for sustainable outcomes, including for water services. Under current Australian law, any permanent fixtures on land are the property of the landholder (QPC 2017). Service providers require clear tenure arrangements in place to provide certainty for their ongoing investments and activities relating to service provision (Creamer and Hall 2019). However, land is usually held collectively by residents of remote Indigenous communities, with an Indigenous organisation or Traditional Owner acting as trustee (QPC 2017). This can lead to diverse processes for service providers to secure tenure, compared to processes in non-Indigenous communities, resulting in a complexity of tenure arrangements that vary between and within the various jurisdictions (Wensing 2015). Separate native title interests overlay tenure across many remote Indigenous communities, potentially adding further confusion (QPC 2017).

6. Technology and operations

Sustainable water services are reliant on functional technologies – namely technological infrastructure that is designed, installed and operated to meet water quality and quantity requirements (Ross et al. 2014a). Challenges described by the interviewees and in the literature related to the selection of technologies appropriate to people, place and purpose, ensuring adequate skills and capacity for operation and maintenance, and compliance with the Australian Drinking Water Guidelines (Hall et al. 2021b).

A positive example of these considerations is seen in the 'Safe and Healthy Drinking Water' pilot programme in some of the outer Torres Straits islands. It was co-designed and managed by state government agencies with responsibility for health, infrastructure, water and Indigenous partnerships, the local Indigenous council and the island-based, Indigenous water operators (TPHS 2017). Existing water treatment infrastructure was reviewed then improved for suitability for the location and purpose;

minor infrastructure improvements were implemented; and water operators were supported through tailored training and long-term mentoring. The outcomes of the pilot included reduced drinking water contamination and increased operator skills and knowledge (Hall et al. 2021a). The importance of such technologies that are fit-for-purpose, people and place was repeatedly raised by the interviewees, such as:

> "A lot of the communities have good quality drinking water, at least initially . . . we often quickly see a lack of maintenance, meaning that everybody goes back to using their old water source– because the big fancy system doesn't work"

(Research representative).

This focus on a bespoke water and sanitation system has been more recently recognised by Infrastructure Australia's 2021 plan that calls for utilities to:

> "genuinely commit to delivering fit-for-purpose, fit-for-place and fit-for-people water services to Australians living in remote and isolated communities . . . through approaches that recognise and respond to the unique conditions in these parts of the country"

(Infrastructure Australia 2021, 11).

The current lack of tailored approaches was described in the interviews as potentially having arisen from system designers from urban water treatment and supply options not considering the whole-of-community perspective and setting that includes remotely located staff and fluctuating population size during cultural gatherings. This can lead to water technologies and practices being introduced in remote Indigenous communities which may not be ideally suited. One interviewee stated:

> "We need to come up with a much more tailored approach. If we're going to put infrastructure in, we really need to think about what capacity is there to operate and maintain it? And if there's a shortfall, how do we help to meet that?"

(Federal Government representative).

The social research highlighted that decisions regarding water infrastructure can often made by engineering and technical officers who may be constrained by a funding environment that preferences capital expenditure and large infrastructure projects. This is in contrast to small-scale, locally relevant and collaborative water management activities that can also build capacity within communities (Jackson, Stewart, and Beal 2019a).

Without close engagement with community members, the resulting infrastructure was noted at times to be inappropriate for cultural norms, dignity and social practices that were not identified by the implementers or service providers in advance. This was described as:

" … They [utility providers] spoke to people about them, then put them in. But people didn't use them because they felt really conspicuous because they were outdoors, and everyone could see when they were going to the toilet and this was culturally uncomfortable … You need to talk it through properly with everyone"

(Federal Government representative).

Gaining a clear and deep understanding of the local context was detailed by interviewees as essential for service infrastructure, including monitoring technologies. They detailed that this required concerted and culturally appropriate consultation to ensure the technologies are desired, understood and used by residents with the capacity to maintain systems with long-term relevance, described as:

"[A] very important lesson in the context of what I observe … is that you can develop your own view of what the problem and what the solution is. But if you don't take the time to listen and unpack it all you can find that you have your own way of thinking and it's not necessarily taking the whole situation into account"

(Project management representative).

7. Mutual learning

Water service provision and management in remote Indigenous communities typically operates from a non-Indigenous, technocratic perspective. This has limited appreciation of Indigenous perspectives of water that connect people integrally to their environment (Jackson et al. 2019b). This was described by one interviewee as:

"You can't ignore the fact that you can provide the hardware, you can teach people to wash their hands and all of that, but at the end of the day it's a Western practice in a Western model that's been inflicted on Indigenous people, and they've been forced to accept it. It kind of assumes that there is no place for Indigenous ways"

(Indigenous organisation representative).

In recent years, there appears to be a growing appreciation by non-Indigenous Australians regarding Indigenous ways of managing water (Jackson and Moggridge 2019; Berry et al. 2018). Literature describes opportunities for mutual learning and sharing of Indigenous and non-Indigenous worldviews relating to the management of water resources, cultural values and water services, potentially resulting in different but more appropriate outcomes (Nelson, Godden, and Lindsay 2018).

Aligned with this growing respect and consideration for Indigenous ways of knowing and doing is an appreciation of and the cultural competency to respond to Indigenous history, cultures and contemporary social dynamics. This is identified in the literature as key to achieving alternative and sustainable arrangements for essential services delivery (Hunt 2013). Interviewees reiterated that where minimal training of non-Indigenous staff in cultural awareness occurred, community engagement was often conducted in culturally insensitive ways. The importance of comprehensive cultural training and ongoing learning was outlined by an interviewee:

" … you're well-meaning, maybe, but not necessarily conscious of where your thinking is coming from. Or where your prejudice is coming from which might just be not being aware of people's systems and their strengths"

(State/Territory government representative).

Partnership-building in improving sustainable outcomes for essential services in remote Indigenous communities was identified as critically important, yet strict project timelines and high rates of staff turnover can limit or inhibit partnership building (Jackson et al. 2019b). Interviewees suggested that remote outcomes were often compared to urban delivery, rather than the higher costs and other aspects reflecting unique and expected differences to urban customers. This comparison with 'city costing' was reflected by an interviewee as:

"Engaging with a number of individual customers is expensive and complex … Partnering with other organisations who want to achieve other benefits in communities, like adult education etc., where the activities are complementary. Building a relationship with customers is one of the benefits for us"

(Water utility representative).

Despite the intention for authentic dialogue and collaboration regarding water management, the outcomes can be limited where local communities are cognisant that governments have the power to influence the flow of funds and opportunities into the community (Jackson et al. 2019b). This was described by an interviewee as:

"Don't underestimate the fear within remote communities, of the 'State/outsiders' wanting to take-over control. It took us a long time to get over it with the (Indigenous) councils we have been dealing with. Some initially refused our support because they feared the State wanted to take over their services"

(Government agency representative).

In contrast, literature documenting initiatives that built sector capacity for locally controlled collaboration and partnership through 'learning by doing' can contribute to mutual learning over time (Jackson et al. 2019b; Beal et al. 2018; Hall et al. 2021b).

8. Implementation of these conditions

These documented conditions highlight possible opportunities for water services utilities and state and Territory governments to initiate a range of engagement values and approaches with Indigenous communities. Utilities working with Indigenous communities could ensure that initiatives are based on trust, integrity, collaboration and partnership- as outlined within the discussion of mutual learning. These can be supported through the relevant state or Territory government agencies through initiatives including regulatory changes and subsidy design and introduction. A long-term perspective should be taken to ensure a legacy in the community of strengthened capacity to achieve strengthened water service outcomes – including under the renewed National Water Initiative. Remote Indigenous communities must be recognised and respected as key client-partners with agency, and utilities and government agencies should approach initiatives with an orientation for mutual learning.

The approaches to implement these values could be through advocacy, research and knowledge support, and direct engagement for on-the-ground initiatives. Initial starting points could include building relationships and opening dialogue with key stakeholders, including Federal Government departments delivering the UN Sustainable Development Goals and Closing the Gap initiatives, and state and territory governments that are responsible for water and sanitation delivery. Acquiring a mandate and legitimacy to be involved in remote Indigenous community services beyond utility core business is recommended, as well as identifying and securing long-term funding. Through cultural competency, utilities could build the necessary capacities and organisational attributes for making a positive contribution towards safe water and sanitation outcomes in remote Indigenous communities.

9. Conclusions

Safe drinking water and effective sanitation is not provided equitably to all Australian households and does not always meet basic human rights or regulatory standards. For those living in remote communities, this lack of essential services contributes to the gap in health outcomes between Indigenous and non-Indigenous Australians. To contribute to closing this gap, this research identified four key conditions (themes) to support consistent and sustainable delivery of safe water and sanitation in remote Indigenous communities of Australia. The themes emerged from employing the STEEP tool to effectively enable

findings from four relevant projects to be synthesised and presented together- thus providing a richer set of data including from projects that were published as commercial in confidence.

The first condition was that water potability and palatability needs to be ensured. Currently, water quality can be affected by microbial and chemical contamination, water can be unpalatable, and the security of water sources can be compromised by changing climatic conditions. Secondly, adequate funding for water and sanitation services is required to cover the higher costs of remote water services and ensure appropriate and prompt response rates for maintenance and repair. Furthermore, the differences in land tenure and essential service governance structures that result in complex, conflicting or overlooked provision leading to siloed government services and potentially unclear responsibilities between agencies must be addressed. Thirdly, technology for water and sanitation that is fit for purpose, people and place is crucial to effective and sustainable outcomes in combination with appropriate skills and capacities for local service operation and maintenance. Finally, the above aspects can be better facilitated through a respect for and understanding of cultural and historical aspects of the communities' competency to respond to Indigenous history, cultures and contemporary social dynamics, an appreciation and adoption of Indigenous ways of managing water, and authentic partnership development of sufficient duration and collaboration.

These above aspects are relevant to Australia's commitment to attaining the SDGs, particularly SDG 6, and towards the refreshed efforts for meeting the Closing the Gap targets in Indigenous equity and a renewed National Water Initiative. The findings are relevant to inform policy and practice to enable decision-makers and utilities to allocate adequate resources and design appropriate processes to more rapidly close the gap in Indigenous equity and meet Australia's international commitments and contribute to building safer, healthier communities in remote Australia.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Dr Nina Lansbury is a researcher on environmental health within The University of Queensland's School of Public Health. Her current research examines the implementation challenges and opportunities for the UN Sustainable Development Goals, and sustainable provision and evaluation of water, sanitation and hygiene in development, including in remote Indigenous communities on both mainland Australia and in the Torres Strait.

Dr Kumi Abeysuriya is a sustainability researcher providing applied research and specialist advice relating to distributed and decentralised water, wastewater and water-energy nexus in Australian and international development sector contexts. Her work contributes to strengthening policy and practice to achieve more equitable water and sanitation service outcomes, including in remote Indigenous communities.

Dr Melissa Jackson is a researcher with the Griffith University Climate Action Beacon, Cities Research Institute and School of Engineering and Built Environment. Since 2004, Melissa has worked across government, utilities and research, in policy and strategy, applied and collaborative research with a focus on sustainable energy and water systems, climate change adaptation and social change. More recently, undertaking doctoral research on transformative and innovation in governance of small-scale community water systems in remote Aboriginal and Torres Strait Islander communities.

Charles Agnew is a scientist working in the water industry. He is passionate about diversity and inclusion in particular improving outcomes and recognition for Australia's First Nation Peoples. His experience spans the full range of water functions including strategy and planning for water, wastewater and stormwater services.

Associate Professor Cara D Beal is an Associate Professor in Environmental Health at the School of Medicine, Griffith University and a Principal Research Fellow at the Cities Research Institute. Cara has active research interests in the field of environmental health and WASH (water, sanitation, hygiene), community water management in rural Pacific and remote Indigenous communities in Australia; socio-technical & smart metering/big data driven behaviour change.

Samuel K Barnes is a public health researcher within The University of Queensland's School of Public Health. His areas of research interest include Aboriginal and Torres Strait Islander health as well as infectious diseases.

Simone Soeters is a social researcher and local government social planner with a background in international community development, gender and social inclusion, and population studies. Simone's current research interests focuses on community wide liveability, social cohesion and understanding the social issues impacting vulnerable or hard to reach communities.

Professor Pierre Mukheibir is a professionally registered civil engineer with over 25 years' experience in the water and sanitation sector. His work in developing countries has primarily focused on water security, affordability and equitable access to water and sanitation services, especially under a changing environment. Pierre's PhD examined the impact of climate change on water resource management in small towns – "Water, climate change and small towns". The thesis demonstrated an approach that could be adopted by small towns to develop their water adaptation response to climate change impacts that includes an assessment of existing climate variability responses, thereby ensuring equitable access.

Suzanne Brown has over 25 years' in the water sector, with time in industry, consulting and academia both in Australia and the UK. She has a first degree in civil engineering and a Masters in environmental science. Her Drainage for Liveability Program, which repurposes urban drains and basins into living streams and wetlands has won multiple awards. Prior to her current role she was the WA Water Corporation's Manager, Environment and Aboriginal Affairs for 7 years. Recently she was a finalist in the Australian Water Association's Water Professional of the year awards and in 2019 became a Fellow of the Peter Cullen Trust for Water and Environment. She represents the WA Water Corporation on the Water Services Association of Australia's national Liveable Communities Committee.

Associate Professor Bradley Moggridge is a proud Murri from the Kamilaroi Nation with over 20 years' experience in Aboriginal engagement, water and environmental science, working in applied research, policy development, regulation and project management. Bradley is currently Associate Professor in Indigenous Water Science and P/T PhD candidate at University of Canberra. Bradley hopes to encourage future Indigenous generations to pursue interests in Science, promote his ancestors' knowledge of water and mentor emerging Indigenous scientists.

ORCID

Cara D. Beal http://orcid.org/0000-0002-9219-2120
Pierre Mukheibir http://orcid.org/0000-0001-7876-1705
Bradley Moggridge http://orcid.org/0000-0003-4735-5661

References

Abeysuriya, K., S. Soeters, M. Jackson, N. Hall, P. Mukheibir, and C. Beal 2019. Safe water and sanitation for all in remote Indigenous Communities: Exploring the roles and opportunities for the water industry. Melbourne: Prepared for the Water Services Association of Australia (unpublished).

ABS. 2007. "*4710.0- Housing and Infrastructure in Aboriginal and Torres Strait Islander Communities 2006*." https://www.abs.gov.au/ausstats/abs@.nsf/mf/4710.0 (*accessed* 27 August 21) [Online]. Canberra: Australian Bureau of Statistics. Available: https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4710.02006?OpenDocument [Accessed].

ABS. 2016. *2016 Census: Aboriginal and/or Torres Strait Islander Peoples QuickStats*. Online]. Canberra: Australia Bureau of Statistics. Available: https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/IQS036 [Accessed].

AECOM. 2010. *Review of Regional Water Quality & Security: Review & Reform Strategy*. Canberra: Prepared for Infrastructure Australia.

Aldirawi, S., R. Souter, and C. D. Beal. 2019. "Barriers and Opportunities for Behavior Change in Managing High Water Demand in Water Scarce Indigenous Communities: An Australian Perspective." *Journal of Water, Sanitation and Hygiene for Development* 9: 765–773. doi:10.2166/washdev.2019.091.

Ali, S., T. Foster, and N. Hall. 2018. "The Relationship between Infectious Diseases and Housing Maintenance in Indigenous Australian Households." *International Journal of Environmental Research and Public Health* 15: 2827. doi:10.3390/ijerph15122827.

Anda, M., and S. Dallas 2005. "Delivering Essential Services in Desert Indigenous Settlements."

Australian Government 2010. "Strategic Review of Indigenous Expenditure Report to the Australian Government. Prepared by Department of Finance and Released under the Freedom of Information Act."

Australian Government 2018. "Report on the Implementation of the Sustainable Development Goals." *Australia's First Voluntary National Review on Progress with the Sustainable Development Goals.*

Australian Governments and the Coalition of Peaks. 2020. *National Agreement on Closing the Gap*. Canberra: Australian Governments and the Coalition of Peaks.

Bailie, R., M. Stevens, E. MCDonald, D. Brewster, and S. Guthridge. 2010. "Exploring cross-sectional Associations between Common Childhood Illness, Housing and Social Conditions in Remote Australian Aboriginal Communities." *BMC Public Health* 10. doi:10.1186/1471-2458-10-147.

Beal, C. D., R. A. Stewart, and S. Larsen. 2014. "Exploring the Residential Water-Energy Nexus in Remote Regions - Results from a Far North Queensland Water end-use Pilot Study." *Water* 41 (3): 78–82.

Beal, C., T. Gurung, and R. Stewart. 2016. "Modelling the Impacts of Water Efficient Technologies on Energy Intensive Water Systems in Remote and Isolated Communities." *Clean Technologies and Environmental Policy* 18: 1713–1723. doi:10.1007/s10098-016-1241-9.

Beal, C. 2017. "Some Remote Australian Communities Have Drinking Water for Only Nine Hours a Day." https://theconversation.com/some-remote-australian-communities-have-drinking-water-for-only-nine-hours-a-day-86933

Beal, C., M. Jackson, R. Stewart, C. Rayment, and A. Miller. 2018. "Identifying and Understanding the Drivers of High Water Consumption in Remote Australian Aboriginal and Torres Strait Island Communities." *Journal of Cleaner Production* 172: 2425–2434. doi:10.1016/j.jclepro.2017.11.168.

Beal, C. D., M. Jackson, R. A. Stewart, K. Fielding, A. Miller, and P. L. Tan 2019. "Exploring community-based Water Management Options for Remote Australia. Final Report for the Remote and Isolated Communities Essential Services Project." Brisbane: Griffith University.

Beal, C. D., B. Dorante, P. Pearson, S. Aldirawi, and N. Abdallah. 2020. "Working with Community and Council: The Kirirri Story Trialling Water Demand Management Strategies in the Torres Straits." *Water e-journal* 4 (5).

Berry, K. A., S. Jackson, L. Saito, and L. Forline 2018. "Reconceptualising Water Quality Governance to Incorporate Knowledge and Values: Case Studies from Australian and Brazilian Indigenous Communities."

Christie, M. 2010. "Milingimbi Water: A Report to the Power and Water Corporation from the Yolŋu Consultancy Initiative." Darwin: Charles Darwin University.

Commonwealth of Australia 2017. "Introducing Competition and Informed User Choice into Human Services: Reforms to Human Services: Productivity Commission Inquiry Report." Canberra: Productivity Commission.

Creamer, S., and N. L. Hall. 2019. "Receiving Essential Health Services on Country: Indigenous Australians, Native Title and the United Nations Declaration." *Public Health* 176: 15–20. doi:10.1016/j.puhe.2019.08.024.

Green, D., and L. Minchin. 2014. "Living on Climate-Changed Country: Indigenous Health, Well-Being and Climate Change in Remote Australian Communities." *Ecohealth* 11: 263–272. doi:10.1007/s10393-013-0892-9.

Hall, N. L., M. Barbosa, D. Currie, A. Dean, B. Head, P. Hill, S. Naylor, S. Reid, L. Selvey, and J. Willis 2017. "Water, Sanitation and Hygiene in Remote Indigenous Australia: A Scan of Priorities." https://drupal-gci-op.uat.drupal.uq.edu.au/filething/get/13903/UQ_WASH%20scan%20in%20Indig%20Communities-FINAL-LR-2.pdf (accessed 12 September 17). Brisbane: University of Queensland and Wateraid Australia.

Hall, N. L., L. Selvey, and C. Go Sam 2018. "Evaluation Report: Safe and Healthy Drinking Water in Indigenous Local Government Areas Pilot – Torres Strait Region (Phase 2) (Commerical in Confidence)." Brisbane: Prepared for Health Protection Branch (Water Unit), Queensland Health.

Hall, N. L., and L. Crosby. 2020. "Climate Change Impacts on Health in Remote Indigenous Communities in Australia." *International Journal of Environmental Health Research* 32 (3): 487–502.

Hall, N. L., H. Grodecki, G. Jackson, C. Go Sam, B. Milligan, B. Blake, T. Veronese, and L. Selvey. 2021a. "Drinking Water Delivery in the Outer Torres Strait Islands: A Case Study Addressing Sustainable Water Issues in Remote Indigenous Communities." *Australasian Journal of Water Resources* 25: 80–89. doi:10.1080/13241583.2021.1932280.

Hall, N. L., A. Lee, W. Hoy, and S. Creamer. 2021b. "Five Enablers to Deliver Safe Water and Effective Sewage Treatment to Remote Indigenous Communities in Australia." *Rural and Remote Health* 21: 6565–6572.

Hoffmann, B. 2001. *Health-related Housing and Infrastructure: Relative Need of Communities and ATSIC Regions in the Northern Territory/Ben Hoffmann & Ross Bailie*. [Darwin]: Cooperative Research Centre for Aboriginal and Tropical Health.

Hoverman, S., and M. Ayre. 2012. "Methods and Approaches to Support Indigenous Water Planning: An Example from the Tiwi Islands, Northern Territory, Australia." *Journal of Hydrology (Amsterdam)* 474: 47–56. doi:10.1016/j.jhydrol.2012.03.005.

Hunt, J. 2013. "Engaging with Indigenous Australia-exploring the Conditions for Effective Relationships with Aboriginal and Torres Strait Islander Communities."

Infrastructure Australia. 2021. *Reforms to Meet Australia's Future Infrastructure Needs: 2021 Australian Infrastructure Plan*. Canberra: Infrastructure Australia.

ISF-UTS & QUU 2017. "Discussion Paper for Working with Remote Aboriginal and Torres Strait Islander Communities to Improve Water Service Outcomes."

Brisbane and Sydney: Prepared for Queensland Water Utilities by the Institute for Sustainable Futures, University of Technology Sydney.

Jackson, S., and B. Moggridge. 2019. "Indigenous Water Management." *Australasian Journal of Environmental Management* 26: 193–196. doi:10.1080/14486563.2019.1661645.

Jackson, M., R. Stewart, and C. Beal. 2019a. "Identifying and Overcoming Barriers to Collaborative Sustainable Water Governance in Remote Australian Indigenous Communities." *Water* 11 (10): 3390.

Jackson, M., R. Stewart, K. Fielding, J. Cochrane, and C. Beal. 2019b. "Collaborating for Sustainable Water and Energy Management: Assessment and Categorisation of Indigenous Involvement in Remote Australian Communities." *Sustainability* 11: 427. doi:10.3390/su11020427.

Lyons, I., and M. Barber. 2021. "Relatedness and co-existence in Water Resource Assessments: Indigenous Water Values, Rights and Interests in the Mitchell Catchment, North Queensland." *Australasian Journal of Water Resources* 25: 57–69. doi:10.1080/13241583.2021.1921331.

Moran, M. 2016. *Serious Whitefella Stuff: When Solutions Became the Problem in Indigenous Affairs*. Carlton, Victoria: Melbourne University Press.

Morrison, J. 1992. "Environmental Scanning." In *A Primer for New Institutional Researchers*, edited by M. Whitely, J. Porter, and R. Fenske, 86–99. Tallahassee, Florida: Association for Institutional Research.

Nelson, R., L. Godden, and B. Lindsay. 2018. "A Pathway to Cultural Flows in Australia." In *The National Cultural Flows Research Project*. Melbourne: Murray Lower Darling Rivers Indigenous Nations (MLDRIN). http://www.culturalflows.com.au/ .

NIAA. 2021. *Closing the Gap*, https://www.niaa.gov.au/indigenous-affairs/closing-gap%26 (Accessed%2 22/8/21). Online]. Canberra: National Indigenous Australians Agency. [Accessed]

NOUS Group. 2017. *Efficient System Costs of Remote Indigenous Housing: Input into the Review of the National Partnership Agreement on Remote Indigenous Housing*. Brisbane: Nous Group Consulting.

Pholeros, P., S. Rainow, and P. Torzillo 1993. "Housing for Health: Towards a Health Living Environment for Aboriginal Australia." http://www.healthabitat.com/the-healthy-living-practices (accessed 8 May 17). Sydney: Healthabitat.

Productivity commission. 2016. *Overcoming Indigenous Disadvantage: Key Indicators 2016*. Canberra: Productivity Commission.

Productivity commission 2021a. "National Water Reform 2020 Draft Report." https://www.pc.gov.au/inquiries/completed/water-reform-2020/draft/water-reform-2020-draft.pdf Canberra: Productivity Commission.

Productivity commission 2021b. "National Water Reform 2020." Inquiry Report No. 96, 28 May 2021. Canberra: Productivity Commission.

QPC. 2017. *Service Delivery in Remote and Discrete Aboriginal and Torres Strait Islander Communities*. Brisbane: Queensland Productivity Commission.

Rigby, C., A. Rosen, H. Berry, and C. Hart. 2011. "If the Land's Sick,we're Sick:* the Impact of Prolonged Drought on the Social and Emotional well-being of Aboriginal Communities in Rural New South Wales." *Australian Journal of Rural Health* 19: 249–254. doi:10.1111/j.1440-1584.2011.01223.x.

Ross, K., K. Abeysuriya, C. Mitchell, and N. Mikhailovich 2014a. "Governance for Decentralized Sanitation: Global Practice Scan. A Working Document."

Ross, K., C. Delaney, N. Beard, K. Fuller, S. Mohr, and C. Mitchell. 2014b. "Smart Metering Enables Effective Demand Management Design: A Case Study to Demonstrate that an Early mixed-method Baseline Analysis Is Essential to Designing Robust, cost-effective Demand Management Programs in Remote Communities." *Water* 41 (5): 81–88.

SACOSS. 2020. *Scoping Study on Water Issues in Remote Aboriginal Communities*. Adelaide: South Australian Council of Social Service. https://www.sacoss.org.au/sites/default/files/public/200630_SACOSS%20Scoping%20Study%20Remote%20Communities_FINAL_0.pdf

SYDNEY WATER 2019. "Water Conservation Report 2018-2019." https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq3/~edisp/dd_047419.pdf (accessed 15/10/21). Sydney: Sydney Water.

TPHS. 2017. *Project Plan: Phase 2- Safe and Healthy Drinking Water in Indigenous Local Government Areas Pilot – Torres Strait Region*. Cairns: Tropical Public Health Services, Cairns and Hinterland Hospital and Health Service, Queensland Health.

United Nations. 2015. *Transforming our World: the 2030 Agenda for Sustainable Development* [Online]. Available: https://sustainabledevelopment.un.org/post2015/transformingourworld [Accessed].

Wensing, E. 2015. "In Denial and Disarray: Recent History of Funding for Municipal and Essential Services in discrete/remote Aboriginal Communities." Working Paper, https://researchers.anu.edu.au/publications/118973. Canberra: Australian National University.