

The Original Water Industry

Establishing an Indigenous Voice in the Modern Water Industry

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ABSTRACT

This paper examines the notion of the original water industry, presenting the argument that there was in fact an original water industry of which Indigenous Australians were the custodians.

The second finding is that this original water industry existed across all sectors including the way water was managed and used for drinking, how water was interacted with to harvest plants and animals sustainably, and the way in which waterways and the water cycle more broadly were integrated with the Indigenous lifestyle.

The paper then highlights the value of this industry and puts forth that this knowledge has contemporary application, particularly in a commercial setting.

The authors found that Indigenous Australians face many of the same issues the water industry faces more broadly, such as water quality and water scarcity, however these key water issues affect Indigenous Australians at a disproportionate rate.

The paper suggests that there is potential value in the application of principles from the original water industry to contemporary Indigenous water issues, and puts forward that this knowledge and these practices, should also be considered as a part of the solution to mainstream water issues and more specifically with issues presented by climate change.

The paper concludes that the best avenue for incorporating Indigenous practices and knowledge into the water industry is the one that has been proposed by Indigenous leaders, experts and academics alike. This is to establish an Indigenous voice to water, a voice advising on specific water issues and on the direction of the industry at a local, community, state and national level.

ORIGINAL WATER INDUSTRY

The original water industry is the water industry that existed in Australia for millennia. It operated across the many sectors that the contemporary water industry stretches e.g. wastewater, drinking water and water resource management, as well as more broadly in industries such as agriculture and aquaculture.

This industry's operators and managers are Indigenous Australians who have managed water, dependant and associated activities, in many ways prior to and post European settlement. The nature of the original water industry reflects Indigenous culture, practice and knowledge.

This industry had a broad reach, consisting of many different sectors including fisheries, which sustained Aboriginal and Torres Strait populations, aquaculture practices or businesses that also acted as sustainable food and material sources, the management of water resources for drinking and other uses, and a wastewater sector that utilised and managed waterways and the broader environment as a waste removal system (*Webb, 2019*) (*Arthur & Morphy, 2019*) (*Pascoe, 2018*).

All of these sectors were managed in an integrated manner and the interconnections between sectors were deeply understood, as were the connections between these activities and local water sources (*Arthur & Morphy, 2019*) (*Pascoe, 2018*).

These connections influenced all human activity and water management, as sectors were interlocked with biological indicators or communications of the local environment, which the authors suggest is nature's "biophysical" control system. Indigenous Australians were the master engineers of this ancient control system (*Arthur & Morphy, 2019*).

'Dreaming tracks' reinforce the premise of an original water industry and are almost a historical artefact. There is contention around whether dreaming tracks should be considered metaphorical, which is a colonial assumption, and whether the format of these largely verbal records should be documented. However, through printing, the

original owners lose the intellectual property to their own stories.

Looking past these points of contention, they should be considered an extremely valid and reliable source. They are evidence of early activities, environmental changes and the geographical formation of Australia. There are countless creation stories across Australia and these yarns explain how rivers and waterways came about (*Lama-Lama, 1977*) (*Nuwarra, 2014*) (*Reed, 1967*). They also illustrate how water resources were managed in the past (*Arthur & Morphy, 2019*).

Early historical records, including explorer diaries, reinforce the fact that there was indeed an original water industry, and there was significant ingenuity and innovation in many of the practices that were employed, all of which were customised around the particular environment they were situated in (*Pascoe, 2018*).

These examples are an early take on the emerging trends of place-based solutions or appropriate technologies, and hold value for application today (*The Royal Children's Hospital, 2011*).

WATER FLOW MANAGEMENT FOR AQUACULTURE AND FISHERIES

A prime example of an applicable practice in the fisheries and aquaculture sector of the original water industry, is the use of fish traps.

Fish traps are known by many different names depending on which 'country' they are situated on. They are a structure created in streams, rivers and along coastal waters.

Fish traps adjust the way in which water flows through, over or around a particularly waterway or body of water, and in doing so divert fish either to openings where they can be caught, or to holding pools where they can be caught or stored, or farmed and bred (*Pascoe, 2018*) (*Arthur & Morphy, 2019*) (*Rowland & Ulm, 2011*).

They can vary from "slight modifications to natural features of the landscape, to special purpose-built structures" (*Rowland & Ulm, 2011*).

Generally, a rock wall that utilises a locking system is built across an inland water way, or in a coastal setting. They can be constructed in a variety of shapes, as observed in **Figure 1** with one side or part of the structure being the coastline.

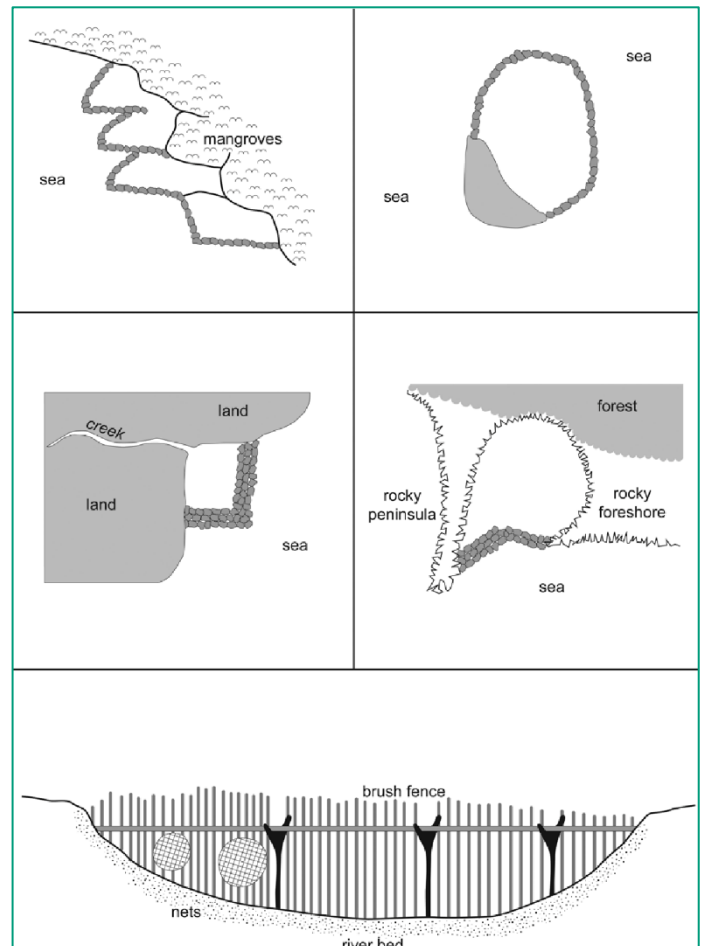


Figure 1: Common Coastal Fishtrap Configurations (Rowland & Ulm, 2011)

WATER SUPPLY

Another sector in the original Australian water industry was the water supply. Indigenous Australians have been managing drinking water resources for 65,000 years, ensuring that water is distributed or used in a highly efficient and equitable manner (*Gammage, 2012*) (*Pascoe, 2018*). This often included areas classified as arid or desert regions, with very low drinking water resources (*Water Wise Queensland, 2018*).

The main way that water sources were found was through generational knowledge and again, through the interconnection between Indigenous Australians and the natural environment (*Water Wise Queensland, 2018*).

The most significant way that this original water sector (as in the water supply sector) differs from the modern one is via the connection to environmental indicators.

Indigenous Australians essentially established an ecological control system using local data inputs including the movement and activities of a variety of plants and animals. Signals from this control system led to adjustments in the way water was consumed and where it was extracted from (Arthur & Morphy, 2019) (Moggridge B., 2006).

A good example was the tracking of birds such as the Zebra Finch, Striated Pardalote, and the Red-browed Pardalote (Water Wise Queensland, 2018). These birds were excellent at identifying water sources in desert regions and their activity was closely followed by Indigenous Australians.

Other examples include dingoes, a variety of birds, ants and trees. (Moggridge B., 2006). Dingoes were followed to rock pools and ants led to subterranean water sources. Large ghost gums indicated the presence of groundwater in dry country, and frogs that retained water underground were dug up, harvested of their water, and then put back underground so they continued to collect water and could be harvested again and again (Water Wise Queensland, 2018) (Moggridge B., 2006), (Jackson & Moggridge, 2019).

After water resources were identified, supplies were rotated in different seasons, and water was taken sustainably, with very little waste (Arthur & Morphy, 2019).

WASTEWATER MANAGEMENT

While this sector had to exist in the original water industry there is little primary research or literature on the practices and knowledge sets that it consisted of.

A hypothesis was constructed from existing data and literature, as well as informal interviews with community members and anecdotes. It is estimated that the most common disposal methods were discharge to the environment, and that this practice did not overload the environment, because of the real-time connection to biological indicators, as well as the population densities and the nature of waste (no industrial or commercial).

It is also hypothesised that whatever method/s were employed were distributed and sustainable, which is supported by data on Indigenous Australian culture and practices, particularly relating to the disposal of solid organic waste, as well as data and literature on disposal methods employed by non- Australian Indigenous peoples such those from Papua New Guinea (Total Environment Centre) (Aringa Panta, 2014) (Arthur & Morphy, 2019)

(CSIRO, 2016) (Gettelman & Rood, 2016) (Prober, O'Connor, & Walsh, 2011) (Pascoe, 2018) (Terri Janke and Company: Lawyers and Consultants, 2018).

One confirmed example coming from an interview highlighted the fact that waste-to-resource is a traditional technique in the Torres Strait, with paw paw trees being cultivated using biosolids (Webb, 2019). This indicates that the hypothesised approach to wastewater management is directionally correct.

To verify or validate this hypothesis, more research is required.

INDIGENOUS SCIENCE

The Value of Indigenous Knowledge, Practices and Beliefs around Water

Indigenous science and economics presents value to contemporary industry at a technical level as well as at strategic level (Nursey-Bray, Palmer, Smith, & Rist, 2019). There are several industry trends or general approaches that were employed by Indigenous Australians that have application in current industry.

It was found that there are likely practices and knowledge, such as those discussed above, that are directly translatable; however, this operational application requires more investigation.

It was also found that there were number of key concepts that offered value in a strategic or conceptual sense, if applied in current industry. All would need further investigation and demonstration to quantify the potential value and inform the breadth of application.

These key value elements are listed below:

- **Custodianship** – Indigenous Australians are renowned for their custodianship and care for country (Green, Billy, & Tapim, 2011). This obligation of custodianship produces excellent environmental outcomes in nearly all activities undertaken.
As a result of this organic environmentalism, Indigenous solutions are naturally sustainable, without any particular adjustment (Moggridge B., 2006) (Arthur & Morphy, 2019).
- **Natural control system** – A result of the custodian nature of Indigenous culture and the connection to country is the ability to integrate human activity within a local ecosystem; interlocking natural indicators or signals to the way human activity is managed within the original water industry (Arthur & Morphy, 2019) (Green, Billy, & Tapim, 2011) (Australian Institute of Aboriginal and Torres Strait Islander Studies) (Terri Janke and Company: Lawyers and Consultants, 2018).

The use of a natural control system to adjust the way humans interact with an environment offers significant value to the contemporary water industry. Application can be both operational and conceptual.

- **Distribution and decentralisation** – Indigenous Australians were far more evenly dispersed throughout the country than Australia's population is today. This dispersion meant that a decentralised or distributed economy was a necessity (Arthur & Morphy, 2019). There were still large settlements (Arthur & Morphy, 2019) (Pascoe, 2018), but none contributed as disproportionately to the economy as capital cities do in contemporary Australia.

The dispersion and low population densities meant that specialisation and trade or collaboration between nations was a necessity, and a common part of culture (Arthur & Morphy, 2019) (Pascoe, 2018).

A majority of the goods and services procured were locally sourced, however specialisation played an important role in this economy, which was not, as perceived, purely autarkic (Pascoe, 2018). Similarities could be drawn between the 'Nations' of Indigenous Australia and the co-operatives of Europe in the mid-1800's.

The learnings and value offered by this element of the original water industry are broad and high level, and align very well to the industry direction towards locally sourced goods and services.

This trend holds much economic, social and environmental value like reductions in transport distance, and therefore in cost and emissions, as well as an improvement energy return on energy invested (EROEI).

The 'nomadic' nature often associated with Indigenous culture offers value in adjusting a lifestyle around the environmental conditions. Indigenous groups were known to have two or three settlements which they would alternate between depending on the availability of food, water, and other conditions affecting liveability (Pascoe, 2018).

- **Shared economy** – Indigenous culture is known as one where sharing is deeply rooted (Pascoe, 2018). Concepts of ownership brought about by economic theory are far less prevalent, or even alien to traditional Indigenous culture. The sharing nature of Indigenous culture meant that there was a great deal of equity amongst, and between discrete groups. This also meant that resources were efficiently distributed.

There are examples of regions working together to ensure that all clans within the region both are supported, and provide support, based mainly on environmental conditions (Sandgate State School, 2014). This shared approach is a reason that Indigenous culture is criticised, however provides significant learnings for contemporary industry.

Ancillary Benefits Applicable to the Water Sector Today

There is significant value offered by the original water industry, both operationally and strategically to today's water industry. Directly, this value can be achieved by the above elements, however there are several ancillary benefits to the incorporation of these concepts to mainstream industry, outlined below.

- **Cross cultural training** – By applying Indigenous concepts throughout the water industry a better understanding will be achieved across cultures (Indigenous Energy Australia, 2019).
- **Capacity building** – An approach that leverages traditional knowledge places the community in a more critical position and increases their input. This added involvement and responsibility naturally leads to better capacity being built across the Indigenous Australian community (Indigenous Energy Australia, 2019).
- **Employment** – Further responsibility and involvement in the water industry means that Indigenous Australians become the experts working with businesses and communities to ingrain Indigenous wisdom into the industry (Indigenous Energy Australia, 2019). These experts would obviously be employed in some capacity, thus increasing employment and Indigenous outcomes (Indigenous Energy Australia, 2019).
- **Education** – A better interaction between the Indigenous Australian community and the water industry, founded on the incorporation of traditional knowledge to the industry, will create a bi-directional knowledge flow and would be far more efficient.
Once parties have learnt how to communicate with one another, and adjust communication depending on context, relationships are formed, allowing knowledge and skills to be more easily transferred. This value is particularly relevant to technical concepts such as Indigenous water resource management, water literacy and demand/supply side management principles (Indigenous Energy Australia, 2019).
- **Genuine equity** – There is a consensus that many Indigenous Australians are disenfranchised. A primary driver of this is the lack of value placed on Indigenous knowledge. By integrating cultural values into business as usual practices of the water industry, all knowledge is valued as equal and therefore, all people are genuinely considered equal (Indigenous Energy Australia, 2019).

APPLYING INDIGENOUS KNOWLEDGE IN THE CONTEMPORARY INDUSTRY

There are many environmental and social challenges, and emerging technologies and trends that threaten to disrupt the water industry.

Droughts and the decline of native fish and plant stocks threaten regional communities, and soon possibly urban centres. Aging assets and climate change cause much concern for most water operators. Emerging challenges such as microplastics, PFAS, rapid declines in biodiversity, and zero-discharge treatment are at the doorsteps of many members of the water industry.

Progressing technologies such as smart meters and industry trends such as distributed services and waste-to-energy offer significant advantage to those able to capitalise on these industry movements, but present a potential existential risk to those that don't.

Through our investigations, it became evident that there is applicability from the original water industry to many of these critical contemporary risks and opportunities.

There is precedent of Indigenous knowledge and practices being integrated with western approaches, and it is strongly recommended that this integration is once again considered by industry (Pascoe, 2018). It is proposed that the points of alignment are with the key elements of value of the original water industry that are highlighted above.

An expansion on the synergies between contemporary issues and original solutions is explored below:

The most directly applicable Indigenous value is sustainability and sustainable practice.

The intrinsic sustainability of Indigenous culture, and the environmental awareness that is consistent throughout the original water industry, holds significant value to modern industry, particularly with the rise of sustainable approaches.

The integration of human activity with the natural environment was found to be of particular interest, the authors encourage industry to consider the potential ways in which contemporary operations could integrate this approach.

There is and can be direct application of the natural control system to many segments of the water industry (Aringa Panta, 2014). Some operational examples of where a natural control system may have direct application are highlighted below.

Fisheries and Aquaculture

A common issue that plagues fisheries and aquaculture businesses alike is the issue of sustainable sourcing of plant and fish stock. Sustainably sourced catch has become increasingly important to fisheries and aquaculture operators due to the rise of the conscious consumer (Australian Marine Conservation Society, 2012).

Indigenous fisheries have existed for millennia, all the while being sustainable (Pascoe, 2018) (Arthur & Morphy, 2019). Fish and other stock are and were sourced locally, and only the amount needed was taken, so there was near zero wastage (Australian Institute of Aboriginal and Torres Strait Islander Studies) (Smyth, Egan, & Kennett, 2018).

Many fisheries had holding ponds where fish were kept to brood. A safe environment for fishlings was created, increasing the amount of fish in a waterway; the harvesting of which kept numbers to a sustainable level for that particular waterway (Australian Institute of Aboriginal and Torres Strait Islander Studies) (Pascoe, 2018) (The Department of the Environment and Energy, 2004).

There is opportunity for niche operations to employ these Indigenous aquaculture techniques directly combining them with western technologies and practices to improve efficiency of the operation. There is also significant opportunity for existing fisheries to utilise individual components of this original industry. One prime example would be the use of local environmental indicators to adjust an operation to reduce detrimental impacts on ecology, and improve environmental and economic sustainability of the operation (The Department of the Environment and Energy, 2004) (Australian Institute of Aboriginal and Torres Strait Islander Studies).

Drinking Water Management

Drinking water management is another significant industry where there is obvious knowledge and practices that can be applied directly to contemporary industry (Arthur & Morphy, 2019) (Jackson & Moggridge, 2019) (Poelina, Taylor, & Perdrisat, 2019).

Indigenous Australians are recognised for their ability to identify water sources and for their sustainable water use. This is directly related to water body health, as well as water scarcity seen in the current industry.

Early explorers and settlers relied on Indigenous knowledge to identify where water was, and to access this water (Moggridge B., 2006). Unfortunately, the sustainable way in which Indigenous people used water was not adopted so enthusiastically (Pascoe, 2018).

Water was managed through inter-generational knowledge transfer and a natural control system. The authors believe there is clear benefit offered by employing both the

knowledge sharing and natural control systems concepts, however more investigation is required to quantify these benefits.

Wastewater

The last area of the water industry that was identified as potentially benefiting from the application of nature's control systems is the wastewater sector, particularly effluent discharge into waterways.

Regulators' and utilities' understanding of waterways are evolving rapidly with a likely scenario being that utilities adjust their processes based on a real-time understanding of their impact on the environment (*Water NSW, 2020*) (*Howard B Glasgow, 2004*).

Whilst this would be achieved through the implementation of smart meters, telemetry and control systems to improve the understanding of environmental capacity, and to control the quantity and quality of effluent, there is opportunity to couple this somewhat predetermined approach with biological and ecological indicators. This concept is not at all alien in this context, as bio-indicators and indicator organisms are currently used to measure the environmental impact of effluent.

Other Industries

This natural control system may also provide benefit to many other industries like urban developments, mining and resources, and tourism. It can help to understand the environmental effect of these industries, the ongoing health of the local biosphere, impacts on human health and impacts of human activity.

Using tourism as an example, the natural control system could be used to predict ideal times for customer experiences, particularly for eco-tourism, whereby a tour operator using natural indicators could determine when more crocodiles will be present in a specific waterway.

Sustainability

The sustainable approach and nature's control system also offer conceptual value to the contemporary water industry. The industry and society more broadly would benefit from taking a more sustainable approach, as is evidenced by the emphasis on sustainability in many industries.

There is also a high level of opportunity for human activity in general to become more integrated with the biosphere. Many proponents are touting the benefit of biosphere consciousness/integration; the approach of the original water industry could be the way to act on this promising, but novel concept (*Rifkin, 2011*).

Distributed and Shared

The distributed and shared nature of the original water industry also offers value at a higher or conceptual level. Industry in general is moving from hierarchical and centralised to shared and distributed. This is observed with the decentralisation of the energy market in renewable energy, of communications in the internet, the finance system in Blockchain, and across many other industries. (*Rifkin, 2014*).

Whilst this transformation may not be across all industries, it will impact the water industry given its reach and touch points. Water will at least intersect with an industry that is impacted, and therefore will be required to adjust in some way.

Other Opportunities

Other opportunities that should be explored are the general distribution of services and localisation of specialties. There is a strong connection between water, waste and agriculture which could open the opportunity for a distributed and shared local operation.

Biosolids supplying local agriculture businesses and sharing the profits is one of the many potential applications that the authors believe warrant further investigation. Sharing recycled water amongst regions based on water scarcity and climatic conditions is also another potential future application that involves a shared approach. All these approaches have commonalities to the concept of a circular economy.

Interestingly many native plant species require far less irrigation to produce a productive crop; the business models still require refinement (*Pascoe, 2020*).

Less direct is the shared approach that could be taken by industry operators. Where there are industry wide issues, the burden of solution development could be shared amongst a number of parties. The multiple solutions to PFAS contamination, for example, could be explored by many water utilities with each utility investigating and developing the potential solution that are best suited to their strengths.

It is suggested that the improvement of the water industry across all segments is made by integrating Indigenous knowledge into current practice, not by replacing the current water industry. This way, knowledge sets complement one another, improving benefits where there is alignment between elements of both practices, and negating weaknesses where one system outperforms the other.

Whilst all solutions will likely be a combination of Indigenous and non-Indigenous knowledge it is evident that Indigenous knowledge is underutilised (Jackson &

Moggridge, 2019) (Poelina, Taylor, & Perdrisat, 2019) (Pascoe, 2018) (Australian Institute of Aboriginal and Torres Strait Islander Studies) (Arthur & Morphy, 2019) (Prober, O'Connor, & Walsh, 2011) (Green, Billy, & Tapim, 2011) (Smyth, Egan, & Kennett, 2018).

One way to integrate these knowledge sets might be in line with founding scientific principles. Where these scientific principles and technical concepts are built on or adapted to add value in a modern context. Many of these pioneering concepts still form the basis of several fields of science, guiding those fields at a high level.

The authors suggest that Indigenous knowledge could be viewed in the same light. An open, but critical mindset that recognises the complementary nature of Indigenous knowledge is required to take full advantage at the value offered.

The original water industry holds much value in the contemporary. Whilst the exact application requires further development, the sustainable nature, the integration of human activity with ecological signs, and a shared and distributed approach all hold value.

This "natural control system" possibly holds the most value, and it is of great interest to see how these concepts might be incorporated into a commercial operation (Prober, O'Connor, & Walsh, 2011) (Arthur & Morphy, 2019) (Pascoe, 2018).

One hurdle may stem from the fact that this practice is an outcome of the higher level of custodianship that is fundamental to all Indigenous Australian cultures (Green, Billy, & Tapim, 2011). It may be difficult to replicate this cultural-based connection to country.

It is forecasted that the water industry and economy in general are moving towards a form that mirrors the established Indigenous economy. Therefore, there is opportunity to apply learnings from the millennia old Indigenous economy in the mainstream.

THE DISPROPORTIONATE EFFECT OF WATER ISSUES ON INDIGENOUS AUSTRALIANS

A significant benefit that the water industry provides to our communities is clean drinking water and effective wastewater services, which are basic human rights and are fundamental to maintaining community health and economic development (Arthur & Morphy, 2019).

Provisions of these services are managed by utilities and other organisations. Many issues the water industry face

either stem from or result in inadequate or vulnerable water and wastewater services (Robertson, 2019).

Unfortunately, these services are not equally delivered across Australia. Indigenous communities are one group that disproportionately receive sub-standard water services (Hall, 2018).

There are many examples of water-based issues affecting Aboriginal and Torres Strait Communities.

Water, Sanitation and Hygiene (WASH)

There are significant issues with WASH in Indigenous communities across the nation (Hall, 2018). The most pressing examples are in those communities where poor WASH outcomes have caused endemic proportions of trachoma (National Trachoma Surveillance and Reporting Unit, 2018), an eye disease that if left untreated causes blindness. Trachoma is a disease that has essentially been eradicated from the developed world (Taylor, Lange, & Stanford, 2016).

Despite a focussed effort from the federal government to eradicate the disease in 2009, trachoma still exists in some communities at hyper-endemic rates of >20% in five to nine year old children (National Trachoma Surveillance and Reporting Unit, 2018). This disease has not been present in mainstream Australia for one hundred years, primarily due to WASH practices (Taylor, Lange, & Stanford, 2016).

Water Scarcity

An example of water scarcity issues affecting Indigenous communities is the Torres Strait Island of Masig (York Island). These communities and others in the Torres Strait are under highly stringent water restrictions. These water restrictions include the water being shut off for sixteen hours a day (Jackson M., 2019).

Another example of extreme water scarcity that is greatly affecting Aboriginal communities is in Central Australia. Many water sources are vulnerable to climatic variability and stress, and may be at risk of failure due to extended dry conditions with little or no aquifer recharge. After several years of extended dry conditions, a number of remote communities in central Australia are now facing extreme risks of water scarcity (Vanweydevelde, 2020).

A broader water issue that is affecting non-Indigenous and Indigenous Australians is the water management issues facing the Lower Murray Darling catchment (Arthur & Morphy, 2019). This community is in a drought that is exacerbated by the effects of climate change, compounded by the poor water management practices that have been occurring in this basin for decades (Natural Resources Commission, 2019).

These types of issues can be found across the country and are highlighted by a multitude of academic papers and other publications (Arthur & Morphy, 2019) (First Peoples' Water Engagement Council (FPWEC), 2012) (Jackson & Moggridge, 2019) (Moggridge, Betteridge, & Thompson, 2019) (Nursey-Bray, Palmer, Smith, & Rist, 2019) (Poelina, Taylor, & Perdrisat, 2019) (Water Wise Queensland, 2018).

Water Quality Issues

Possibly the most alarming example of a water issue affecting an Indigenous community is the lack of access to drinking water in the Palm Island community. The community has been having intermittent issues with drinking water since late 2018 and has had no or low drinking water being produced from April 2019 to late 2019 (australianmap.net, 2019).

While there is an asset solution currently being delivered to this community, an operational and social component is required to ensure that the asset-based solution provides long term value, and achieves the intended benefits in the medium and long term. This is reinforced by another water quality issue arising in February 2020, albeit less severe than the issues faced in 2019.

There are also many examples of wastewater treatment operations consistently operating at not only a sub-optimal level, but non-compliant levels for months and in some cases years (Morris, 2017).

A prime example of a community that experienced wastewater issues that caused public health and environmental risks was Cherbourg. This community had an ageing asset that was leaking wastewater into the local creek (Collins, 2018). It took ten years of community campaigning and negotiating to remedy (Morris, 2017).

USING INDIGENOUS SCIENCE TO SOLVE INDIGENOUS PROBLEMS

Given the disproportionate number of Indigenous communities that are affected by water issues, and the under-utilisation of Indigenous knowledge, there is significant opportunity for Indigenous solutions to be applied to Indigenous challenges. More investigation would be needed to quantify the potential benefit of this approach; however, there is strong evidence that Indigenous knowledge is valuable in addition to the current knowledge base.

The application of Indigenous knowledge to issues in Indigenous communities is fit for purpose, and is in line

with leading design principles such as place-based, user-based and strengths-based design as well as customer centricity.

The way in which Indigenous knowledge could be executed and implemented across the contemporary water industry is a complex conversation, however there is consensus among many leading Indigenous academics and experts that an 'Indigenous voice' should be the primary approach considered.

An Indigenous Voice in the Water Industry

There are many examples of these core and ancillary value elements being implemented throughout the water industry. The most powerful way, and that which will have the farthest reaching effect is hypothesised to be through the establishment of an Indigenous voice in water (Moggridge, Betteridge, & Thompson, 2019) (Poelina, Taylor, & Perdrisat, 2019) (Terri Janke and Company: Lawyers and Consultants, 2018).

Communities of Victoria, the Kimberley and Lower Murray Darling catchment are at varying degrees of establishing an Indigenous water voice (Moggridge, Betteridge, & Thompson, 2019) (Poelina, Taylor, & Perdrisat, 2019).

Establishing an Indigenous voice to water has been repeatedly raised and endorsed by the majority of Indigenous water professionals, academics and leaders. To date, this has gone largely unheard, despite encouraging developments in pockets around the country.

This preferred approach to governance is shared in the broader social and political realms with an advisory function or voice that is able to input into decision making; a priority for Indigenous Australians (*The Uluru Statement, 2017*). This is seen in the Voice to Parliament and Makarrata Commission recommended in the Uluru Statement from the Heart.

Establishment of this voice is not only an important step in the national reconciliation conversation, but can also be viewed as the best way to fundamentally adjust mindsets and behaviours throughout the water industry (*Department of Education and Training, 2011*) (First Peoples' Water Engagement Council (FPWEC), 2012).

Creating this environment or culture is the root step to ensuring Indigenous science becomes business as usual for the water industry, and the cornerstone to the coming together of the contemporary and the original water industry (Jackson & Moggridge, 2019) (Poelina, Taylor, & Perdrisat, 2019) (Moggridge, Betteridge, & Thompson, 2019) (First Peoples' Water Engagement Council (FPWEC), 2012).

The authors strongly suggest that an Indigenous voice to water be considered at all levels including catchment, utility, regional, state and national.

CONCLUSION

This paper highlights and reinforces that an original water industry has existed in Australia. Aboriginal and Torres Strait Islanders managed this original water industry across numerous sectors, many of which still exist today.

The original water industry holds value that is directly and indirectly applicable to contemporary industry. The main value points being:

- The ingrained sustainability of Indigenous solutions and lifestyle;
- The natural control system – where Indigenous Australians interact with a local environment based on biophysical indicators or natural signals; and
- How a distributed economy or industry could operate in an equitable and efficient manner.

The paper also highlights that Indigenous Australians encounter water issues at disproportionately higher frequencies and magnitudes than non-Indigenous Australians.

It is recommended that when challenges within the water industry are being addressed at any level, Indigenous knowledge should be considered as a part of the potential solution, particularly in Indigenous settings.

Lastly, it was confirmed that the preferred way to integrate the original and contemporary water industries is by establishing an Indigenous voice for water. It is highly recommended that this be investigated at numerous levels.

REFERENCES

Land and Sea Management Unit, Torres Strait Regional Authority. (2014). **TORRES STRAIT: CLIMATE CHANGE STRATEGY 2014 to 2018**. Land and Sea Management Unit, Torres Strait Regional Authority.

Aringa Panta, D. (2014). **THE ROLE OF INDIGENOUS SOLID WASTE MANAGEMENT PRACTICES (ISWMP) IN MANAGEMENT OF SOLID WASTE IN URBAN CENTRES IN PNG**. Flinders University.

Arthur, B., & Morphy, F. (2019). **Atlas of Indigenous Australia (2nd ed.)**. Sydney: Macquarie.

Australian Institute of Aboriginal and Torres Strait Islander Studies. (n.d.). **A brief history of Indigenous fishing**. Retrieved October 04, 2019, from AIATSIS: <https://aiatsis.gov.au/exhibitions/brief-history-indigenous-fishing>

australianmap.net. (2019). **1979 + 2015/19: Palm Island (Queensland) – Cylindrospermopsis, Colour, Turbidity, Do Not Drink Water**. Retrieved July 20, 2019, from Australian

Drinking Water Map: <https://water.australianmap.net/1979-palm-island-queensland-cylindrospermopsis/>

Austrlain Marine Conservation Society. (2012). **Be Informed**. Retrieved October 04, 2019, from Australia's Sustainable Seafood Guide: <https://www.sustainableseafood.org.au/pages/be-informed.html>

Cohen, T., Nanson, G., Jansen, J., & Larsen, J. (2015, February 26). **Drying inland seas probably helped kill Australia's megafauna**. Retrieved September 12, 2019, from The Conversation: <https://theconversation.com/drying-inland-seas-probably-helped-kill-australias-megafauna-37527>

Collins, M. (2018, December 17). **South Burnett Council prepared for sewage break out**. Retrieved September 02, 2019, from South Burnett Times: <https://www.byronnews.com.au/news/south-burnett-council-prepared-for-sewage-break-ou/3603558/>

CSIRO. (2016). **Water**. Sydney: CSIRO.

Department of Education and Training. (2011). **Embedding Aboriginal and Torres Strait**. Brisbane: Queensland Government.

Duncan, P. (2012). **Options for an Indigenous Economic Water Fund (IEWF)**. Sydney: First Peoples' Water Engagement Council (FPWEC).

Gammage, B. (2012). **The Biggest Estate on Earth: How Aborigines Made Australia**. Crow Nest, NSW: Unwin and Allen.

Gettelman, A., & Rood, R. B. (2016). **Climate Change and Global Warming**. In A. Gettelman, & R. B. Rood, *Demystifying Climate Models* (pp. 22-35). Berlin: Springer Open.

Green, D., Billy, J., & Tapim, A. (2011). **Indigenous Australians' knowledge of weather and climate**. *Climatic Change*, 337-354.

Hall, N. L. (2018). **Australian Indigenous remote communities and water, sanitation and hygiene**. *Australian Water Association Water e-Journal*.

Howard B Glasgow, J. M. (2004). **Real-time remote monitoring of water quality: a review of current applications, and advancements in sensor, telemetry, and computing technologies**. *Journal of Experimental Marine Biology and Ecology*, 409-448.

Indigenous Energy Australia. (2019). **Indigenous Energy Australia**. Brisbane: Indigenous Energy Australia.

Jackson, M. (2019). **Appropriate Technology Workshop - Renewable Energy Indigenous Communities**. Brisbane: Engineers Without Borders.

- Jackson, S., & Moggridge, B. (2019). Indigenous water management. *Australasian Journal of Environmental Management*, 193-196.
- Lama-Lama, I. (1977). The River Which was Made From Tears. In R. Gummul, S. Marrawakamirr, & D. Merrkuyawuy, Kwork Kwork the Green Frog and other tales from the Spirit Time (p. 43). Canberra.: Australian National University Press.
- Moggridge, B. (2006, March 15). Aboriginal people built water tunnels. (J. Skatssoon, Interviewer)
- Moggridge, B. J., Betteridge, L., & Thompson, R. M. (2019). Integrating Aboriginal cultural values into water planning: a case study from New South Wales, Australia. *Australasian Journal of Environmental Management*.
- Morris, K. (2017, October 20). Ten year fight for facility. Retrieved September 02, 2019, from QT News: <https://www.qt.com.au/news/ten-year-fight-for-facility/3243504/>
- National Trachoma Surveillance and Reporting Unit . (2018). *Australian Trachoma Surveillance Report 2017* . Sydney: The Kirby Institute, UNSW.
- Natural Resources Commission. (2019). *Final Report: Review of the Water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources 2012*. Sydney: NSW Government.
- Nina, L. H., Shannon, C., & Jagals, P. (2016, July 11). It's a fallacy that all Australians have access to clean water, sanitation and hygiene. Retrieved April 11, 2019, from The Conversation: <https://theconversation.com/its-a-fallacy-that-all-australians-have-access-to-clean-water-sanitation-and-hygiene-61436>
- Nurse-Bray, M., Palmer, R., Smith, T., & Rist, P. (2019). Old ways for new days: Australian Indigenous peoples and climate change. *Local Environment*, 473-486.
- Nuwarra. (2014, February 25). *Aboriginal Dreamtime Water Stories*. Retrieved October 03, 2019, from Nuwarra: <https://nuwarra.weebly.com/dreamtime-water-stories.html>
- Pascoe, B. (2018). *Dark Emu: Aboriginal Australia and the Birth of Agriculture*. Broome, Western Australia: Magabala.
- Pascoe, B. (2020, May 13). How Bruce Pascoe Rebounded from a Summer of Trauma. (L. Allam, Interviewer).
- Poelinaa, A., Taylor, K. S., & Perdrisat, I. (2019). Martuwarra Fitzroy River Council: an Indigenous cultural. *AUSTRALASIAN JOURNAL OF ENVIRONMENTAL MANAGEMENT*, 26(3), 236-254.
- Prober, S. M., O'Connor, M. H., & Walsh, F. J. (2011). Australian Aboriginal peoples' seasonal knowledge: a potential basis for shared understanding in environmental management. *Ecology and Society*, 16(2), Article 12.
- Reed, A. W. (1967). *Aboriginal Fables and Legendary Tales*. Sydney: Halstead Press.
- Rifkin, J. (2011). *The Third Industrial Revolution*. New York: St. Martin's Press.
- Rifkin, J. (2014). *The Zero Marginal Cost Society*. New York: St Martin's Press.
- Robertson, B. (2019, March 21). PNG-Australian border villages adapting to climate change: Making smart toilets a microbusiness. Retrieved 10 04, 2019, from Reef and Rainforest Research Centre: <https://www.rrrc.org.au/png-australian-border-villages-adapting-to-climate-change-making-smart-toilets-a-microbusiness/>
- Rosling, H. (2018). *Factfulness*. London: Hodder & Stoughton Ltd .
- Rowland, M. J., & Ulm, S. (2011). Indigenous Fish Traps and Weirs of Queensland. *Queensland Archaeological Research*, 14, 1-58.
- Sandgate State School. (2014). *Brisbane's Local Aborigines: The Turrbal People*. Brisbane: Queensland Department of Education.
- Smyth, L., Egan, H., & Kennett, R. (2018). *Livelihood values of Indigenous customary fishing: Final report to the Fisheries Research and Development*. Canberra: Australian Institute of Aboriginal and Torres Strait Islander Studies.
- Sydney Water. (n.d.). *History of Sydney Water*. Retrieved October 5, 2019, from Sydney Water: <http://www.sydneywater.com.au/SW/education/water-management/HistoryofSydneywater/index.htm>
- Taylor, H., Lange, F., & Stanford, E. (2016, September 14). Why is trachoma blinding Aboriginal children when mainstream Australia eliminated it 100 years ago? Retrieved October 5, 2019, from The Conversation: <https://theconversation.com/why-is-trachoma-blinding-aboriginal-children-when-mainstream-australia-eliminated-it-100-years-ago-63526>
- Terri Janke and Company: Lawyers and Consultants. (2018). *Indigenous Knowledge: Issues for protection and management*. Sydney: IP Australia.
- The Department of the Environment and Energy. (2004, July 20). *National Heritage Places - Budj Bim National Heritage Landscape*. Retrieved 09 16, 2019, from The Department of the Environment and Energy: <http://www.environment.gov.au/heritage/places/national/budj-bim/>

The Royal Children's Hospital, Melbourne: Centre for Community Child Health. (2011). Policy Brief - Issue 23. Melbourne: The Royal Children's Hospital.

The Uluru Statement. (2017). The Uluru Statement form the Heart. Retrieved June 11, 2020, from The Uluru Statement: <https://ulurustatement.org/the-statement>

Total Environment Centre. (n.d.). History of Waste. Retrieved August 20, 2019, from Waste Not: <https://www.wastenot.org.au/history-of-waste/>

Water NSW. (2020). REAL-TIME DATA. Retrieved June 11, 2020, from Water NSW: <https://www.waternsw.com.au/waterinsights/real-time-data>

Water Wise Queensland. (2018). How did Aboriginal Peoples manage their water resources. Brisbane: Queensland Government.

Webb, T. (2019, October 17). Torres Strait Waste Disposal. (M. Frangos, Interviewer).

THE AUTHORS



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Michael is the CEO of Indigenous Energy Australia, is a renewable energy engineers and has spent much of his career at operational, tactical and strategic levels of energy, water and waste industries.

Michael is an organisational transformation specialist, and share's Indigenous Energy Australia's aim to evaluate and implement alternative knowledge bases, to deliver contemporary commercial value.



Brad Moggridge

Brad is a hydrogeologist and PHD Candidate at the University of Canberra, and a leading expert in Indigenous water knowledge, history and practice.

Brad has an ambition of leading in his area of expertise and also promoting Aboriginal

Traditional Knowledge and finding commonalities between Traditional Science and Western Science so this can influence policy and the way we manage the Australian landscape.



Phil Duncan

Phil Duncan is from Moree New South Wales and is a member of the Gomeri Nation and an elected representative of the Gomeri Nation Native Title Claimant Group. His homelands are Moree and Terry Hie Hie. Phil has over 35 + years' experience working with Aboriginal people and government to improve the lives of Aboriginal people through recognition of our rich cultural history, the return of our lands, the improvement of our living conditions and education of our next generation through both his employment and active volunteer community work.



Troyson Bassani

Troyson is a lower-coastal Yindinji and a Lama Lama man. Troyson spent most of his childhood life in Yarrabah Aboriginal Community. Troyson has worked alongside Noel Pearson as a Strategic Designer. Troyson has worked across, tourism, finance, real estate and development

Troyson is passionate about empowering Indigenous people through power and renewable energy opportunities, many of which sit with the Indigenous estate.



Torres Webb

A proud Indigenous man from the Torres Strait. Torres is an environmental scientist, published author and associate of Indigenous Energy Australia. As a staunch advocate for Aboriginal and Torres Strait Islander wellbeing through culture, education, sustainability and economic development opportunities. Most recently Torres's work has been focused around supporting school communities to embed traditional Indigenous Science Knowledges and Wisdoms within the schooling curriculum and education system, developing A "Whole School Community Approach" to educating our youth for the challenges of the future.