The socio-technology of indirect potable water reuse
Sarah Bell and Victoria Aitken

ABSTRACT
Public acceptability is widely acknowledged as a key factor in the success of indirect potable water reuse (IPR) schemes. Social research has provided useful insights into the factors that influence public attitudes to IPR and guidelines for engaging the public. Recent IPR developments in Australia demonstrate that clear democratic processes for decision making are yet to be devised. The distinction between technology and society which underpins work in this field does not adequately reflect the nature of IPR and limits possibilities for more robust decision making processes. IPR is not simply a technology to be accepted or rejected by society. IPR is a complex socio-technology which cannot exist unless its technologies become embedded in social, institutional, infrastructural and ecological networks. Reconsidering IPR as a complex socio-technology provides a new grounding for devising processes and institutions for decision making. Based on the formulations of Bruno Latour for bringing the sciences into democracy such processes will include four main tasks: 1) Perplexity—identifying propositions to be taken into account; 2) Consultation—evaluating the strength of the propositions; 3) Hierarchy—ordering the propositions into relative merit and importance; and 4) Institution—stabilising the outcomes through appropriate institutions.

Key words | public acceptance, social research, water reuse

INTRODUCTION
Planned indirect potable water reuse (IPR) is a controversial technology. More precisely, it is a relatively uncontentious set of technologies seeking application in a highly controversial context. The technologies which lie at the heart (or kidneys?) of IPR systems, such as ultra-violet irradiation (UV), ultra-filtration (UF), micro-filtration (MF) and reverse osmosis (RO), have been under development since the 1950s and applied without controversy to treat water and wastewater in situations including ultra-purification for the electronics industry, managing process liquor in mining, food and chemical industries, and for potable supply from conventional sources. Controversy arises when these otherwise innocuous technologies are implicated in the reconfiguration of urban water systems as an intermediary purification step between treated municipal wastewater and supplies for drinking water treatment. Technologies such as UV, MF and RO make the otherwise inconceivable proposition of humans deliberately drinking water that has been contaminated with their own waste technically possible and politically considerable. On their own, however, these technologies do not make the proposition of IPR socially acceptable.

Social acceptability is widely recognised as a key factor in the successful implementation of IPR proposals (Hartley 2006). Early potable reuse schemes implemented in Namibia and the US remain in place today having been commissioned in the seemingly peaceful era when water treatment technologies were invisible to all but a select group of engineering experts, utility managers and their financiers. More recent IPR proposals have been met with and often defeated by public opposition campaigns (DeSena 1999; Po et al. 2003). Social research about water reuse,
particularly IPR, has flourished in recent years and formed the basis of more sophisticated public participation and engagement programmes. These efforts to come to grips with the phenomenon of social rejection of IPR are of vital importance in moving towards more sustainable urban water systems. However, a focus on the social acceptance of IPR as an isolated technology misses some of the more fundamental issues that this contested application of a set of otherwise uncontested technologies raises.

This paper reviews current literature on social acceptability of IPR and recent developments in the implementation, or not, of IPR in Australia. We aim to demonstrate the limitations of an approach to IPR which maintains a strict distinction between technology and society. Instead we argue for a reconsideration of IPR as a hybrid socio-technology, a complex network of relationships between people and things that cannot be adequately described, deliberated and decided upon using terms defined by the conventional technology: society division. Working from this position we then consider how democratic decision making frameworks can be reformed to allow for more reasoned debate and a higher quality of decision making regarding IPR than has so far been seen.

**IPR IN URBAN WATER SYSTEMS**

Political, ecological, economic and social changes across the globe in recent decades mean that urban water suppliers no longer enjoy privileged isolation from social conflict over technology choice. The 1980s and 90s witnessed the ‘unbundling’ of infrastructure networks introducing new privatised actors into networks of water provision, revealing to the public the relationships between cost, capital and the consumption of water (Marvin & Graham 2001). Continued growth of city populations coupled with the insatiable cultural expectations of green gardens, endless showering and countless changes of freshly laundered clothes have placed increasing demand on limited supplies (Shove 2003). Recognised decline of river systems has led to increasing requirements to manage water for natural as well as social systems, requiring water to be dedicated to maintaining environmental flows. Public health scares have led to increased suspicion of water companies and experts, in the wider context of a general decline in trust of experts and institutions (Po et al. 2003; Marks 2003a). Droughts in all regions of the world have placed added stress on the capacity to supply water to cities and provide ominous warnings of the difficulty of managing water systems under increasingly erratic weather conditions. All of these issues present fundamental challenges to the expert-led institutional arrangements for governing water (Colebatch 2006). Managing urban water systems is no longer simply a matter of experts predicting demand and providing resources and technologies to meet it. The social, institutional, technological, economic, political and ecological arrangements for delivering clean water to citizens can no longer be taken for granted (Gandy 2004; Stenekes et al. 2006).

**SOCIAL ACCEPTABILITY**

Within the water reuse literature IPR is commonly assumed to be a good technical solution and public opposition is presented as an obstacle to implementation which must be overcome in order to ensure sustainable urban water supply (USEPA 2004; Hartley 2006). Some form of public outreach or public participation in IPR programmes is generally accepted as being important but is usually recommended in order to overcome the barrier of public acceptance rather than to help decide whether or not IPR is a good idea (Hartley 2003; USEPA 2004).

Surveys of public attitudes to water recycling have been undertaken since the early 1970s. Bruvold (1985, 1988, 1992) pioneered public acceptability studies, starting a trend to examine how the public perceive different uses for recycled water, particularly concerning the degrees of contact. More recent studies have continued this research, consistently reproducing the pattern of acceptability whereby support declines as the level of contact increases. For example, high contact uses such as laundering and drinking, elicits responses of low support, whereas low contact uses such as irrigation of public gardens are generally highly acceptable. This effect has been observed in USA, Australia, and Israel, and is usually found to be independent of basic demographic factors such as gender, age, and income.
Public rejection of IPR has been assumed to be based on misunderstanding of the technologies of water treatment and misconceptions of health risks. This ‘deficit’ model of the public understanding of IPR provides the basis for public education campaigns as a means of improving the acceptability of proposed schemes. The underlying assumption of ‘if only the public knew what we knew, they would agree with us’ is a common mistake made by engineers and utility managers. Despite being discredited by social scientists the ‘deficit model’ persists as the basis for public participation and outreach in IPR proposals (Irwin & Michael 2003; Stenekes et al. 2006).

Where public attitudes are acknowledged to be more complicated that simply resulting from technical ignorance, a new deficit model based on public misconceptions of risk emerges (Wynne 2005). Public concerns about health risks due to contaminants, particularly hormones and drugs, consistently appear as elements in public attitudes towards IPR proposals (ACTEW 2007; Hurlimann 2007; National Water Commission 2007). Marks (2003a) makes the important connection between concerns about new risks associated with water reuse and the decline in trust of institutions such as water utilities and their regulators as explained by Ulrich Beck’s (1992) *Risk Society* thesis. Unfortunately institutional and industry responses to a public discourse of risk has not engendered Beck’s reflexive modernisation, whereby experts, industries and governments acknowledge the essentially risky nature of late modern industrial developments and build new partnerships across sectors of society. Instead, analysis of public concerns about risk is usually based on psychological models with the aim of devising better risk communication strategies (Leviston et al. 2006; National Water Commission 2007). Where the IPR literature has moved on from a belief that better public understanding of the technology will improve public acceptability of IPR, the deficit model reappears as a belief that better public understanding of the risks of IPR is needed.

The ‘yuck factor’ is another widely reported element of public rejection of IPR (Po et al. 2003; Marks 2003b; National Water Commission 2007). Even when an individual has an understanding of the technology and the health risks which is consistent with the expert view, they may simply reject IPR. This is usually explained as an irrational ‘emotional response’ linked to disgust, which can be explained in terms of psychological theories such as the theory of contagion. Whilst psychological theories are undoubtedly useful in explaining individual responses to ideas such as IPR, reliance on psychological models in understanding wider social phenomena sidelines the importance of collective cultural understandings of what is normal or acceptable.

Analyses of both the ‘yuck factor’ and ‘risk perception’ based on psychological models of the individual as the basic unit of society sit well with engineering models based on the analysis of individual components as the foundation of bigger technological systems. Psychological theories such Ajzens theory of predicted behaviour have been used to develop sophisticated models for predicting social responses to water reuse proposals (Leviston et al. 2006). Better understanding of individual responses to IPR will undoubtedly be of value to proponents of schemes. However, in denying the importance of culture as the basis for defining what is ‘acceptable’ and ‘normal’ in society it is unlikely to lead to more robust engagement about the role of IPR in sustainable urban water systems (Shove 2003; Wynne 2005).

Trust is another consistently mentioned variable in explaining public responses to IPR (Marks 2003a; Hartley 2003). Much of the literature takes an instrumentalist approach to addressing the problem of trust. Po et al. (2003) draw on research showing high levels of trust in universities and government research organisations to advise that experts speaking in favour of IPR should be drawn from these institutions rather than from water authorities or companies. Hartley’s (2005) five principles for guiding water professionals in designing their public outreach an participation activities aim to help the water industry to ‘build and maintain public confidence’ in water reuse.

The importance of trust in public acceptance of IPR highlights the role of public institutions in water system management. Hatton MacDonald & Dyack’s (2004) analysis of institutional impediments to water reuse and conservation in Australia includes consumer perceptions and addresses issues of property rights and governance, but does not connect consumers of recycled water to the
institutions that govern it. Stenekes et al. (2006) present a coherent review of the question of public acceptance of water recycling in the context of an institutional framework for governing water which is ill equipped to address the challenge of sustainable water provision. They point out that the discourse of ‘public acceptance’ reflects an expert-led institutional framework which is struggling for legitimacy given the fundamental changes that are taking place water systems. They argue for new institutional arrangements which allow for much greater public deliberation over the full set of options for sustainable urban water systems, rather than a continuation of a model in which the public are positioned as either accepting or rejecting expert defined systems such as IPR.

AUSTRALIAN DEVELOPMENTS

Despite the state of the art in social research and public participation recent developments in Australia point to some serious shortcomings in public involvement in decision making about IPR. The prolonged drought recently experienced by Australia’s largest cities has turned attention towards IPR as a possible new supply. Continued growth of urban populations in Australia also presents challenges for water system managers, particularly given high per capita consumption levels in comparison to other countries (Colebatch 2006). Managing the current drought and planning for future urban growth in Australia within the context of a highly variable climate reflect many of the challenges facing water system managers around the world. Recent debates and decisions demonstrate that Australia, like most countries, is yet to devise robust processes and frameworks for decision making about IPR.

In 2006 the city of Toowoomba in South-East Queensland held a referendum on a proposed IPR scheme. 38% of residents voted in favour of the proposal, in line with long term public attitude surveys in Australia and the US (National Water Commission 2007). The referendum was the culmination of an intensely fought, adversarial campaign in which voters were required to choose between ‘yes’ or ‘no’ for a specific proposal, rather than provided with the opportunity to deliberate over the advantages, disadvantages, risks and alternatives.

In response to the Toowoomba result and the prospect of a worsening resource situation Queensland State Premier Peter Beattie cancelled a promised referendum on IPR in the south east region. IPR as a response to water shortages in South-East Queensland is seen as too important to risk democratic rejection. Conventional expert-led models of water provision and decision making have been reinforced, moving back from more recent interest in public participation and democratic decision making about controversial technologies. The people of Toowoomba will effectively drink recycled water which will be delivered to the town via a pipeline connected to the regional IPR scheme, despite the referendum result, further undermining the role of the public in decision making about water in Queensland.

The implementation of IPR as a crisis measure is of particular interest in examining water planning and decision making. The drought that prompted the water shortages in South-East Queensland has been prolonged an unexpected. None-the-less such extreme water shortages represent a failure of the conventional predict-and-provide models of expert-led water planning. That efforts towards greater public involvement in water decision making, with all their limitations, have been dismissed in a return to a technocratic mode of decision making is testament to the power of this form of governing water. Whilst crisis supply-side measure may be justified, such powerful reinstatement of expert-led decision making, the dismissal of public concerns as irrational and dangerous, and the implication that greater public involvement in water governance is an optional luxury, point to a general regression in understanding relationships between water, society, technology and politics at the time when new approaches to these vexing issues are most needed.

In contrast to Queensland, the governments of New South Wales and Victoria have announced that IPR will not be implemented in their jurisdictions in the immediate future. In these states it seems that the democratic support for the government is too important to risk authoritarian implementation of this particular controversial technology.

Proposals in Western Australia and the ACT have so far taken a less overtly political pathway, with organised strategies to inform and support decisions to implement IPR (Leviston et al. 2006; ACTEW 2007). Both proposals essentially maintain expert-led decision making, although supported by efforts to understand and improve public acceptability.
That such different processes and different decision exist across Australia may be a function of context, but more likely demonstrates that there is not as yet any adequate mechanism for effective public decision making on IPR. In this regard IPR is far from lonely as one of many controversial technologies which modern democratic systems struggle to account for (Beck 1992; Irwin & Michael 2003). The muddle over IPR points to fundamental institutional limitations in urban water management which reflect broader problems with modern institutional structures and the conventional settlement between technology, politics and society.

Australia is not unique in struggling with public decision making about water systems. IPR proposals in the US have followed a range of different pathways, with mixed outcomes (Hartley 2003). Regulators in the UK are beginning to insist that water companies consult on their 25 year resource plans, without clear guidance as to how this should be done and how the outcome should be taken into account. Changes in technologies, ownership, governance, climate, population and public expectations in recent decades mean that conventional understandings of the relationships between technology and society in water systems are no longer adequate. The fundamental divisions which underpin the division of labour which leaves engineers to manage water supplies based on technological rationality and society free to use water without the need to know about its source of distribution needs to be reassessed.

**IPR THE SOCIO-TECHNOLOGY**

Debates about IPR are usually defined in terms that make a clear distinction between technology and society. The technology of IPR is assumed to be stable and reliable, while the social world into which it must be launched is less predictable. The representation of technology and society as if they were two distinct realms ignores the complex relationships that flow between the two and promotes an adversarial approach in dealing with controversial issues such as IPR.

The writings of Bruno Latour and others working under the label of ‘actor-network theory’ allow us move through the technology: society divide to see IPR as fundamentally ‘hybrid’, neither purely technological nor purely social (Latour 1993, 2005). Reconsidering IPR as a socio-technology looking to be stabilised within urban water systems, rather than a technology looking to be accepted by society or politics, provides openings for moving beyond the expert: public log jam. It does not guarantee that IPR will achieve stability, but provides the possibility that it will achieve a fair hearing, rather than being rejected unfairly or forced to rely on the power of politicians to justify its existence.

IPR is not merely a technological solution. It consists of a set of technologies, such as RO and UF, looking to be embedded in a set of social, ecological and institutional relationships. It is not merely the technologies of IPR which society is being asked to accept but a complex network of relationships between filters, pumps, rivers, reservoirs, experts, viruses, chemicals, managers, bodies and water that need to built. IPR as a solution to water shortages does not exist unless it can be embedded into the hydrological networks of the city, which includes citizens and their concerns, governments, households, water distribution networks, rivers and regulators.

Reconsidering IPR in this light provides new openings for considering how to think through the complex decision making about whether or not to proceed with recycling wastewater for human consumption. Social acceptability cannot be separated from the IPR as a technological entity, to be considered as a distinct realm of activity. It is not simply a matter of devising a perfectly rational technological system and waiting for it to be accepted or rejected by society. If IPR is to be anything more than a proposed array of water filters water managers and engineers need to acknowledge that the range and importance of human actors in the networks which will transform a set of uncontroversial technologies into a new source of water.

Considering IPR as a socio-technology that has not yet been stabilised leads to a new set of challenges for decision making. As a proposition for reconfiguring technologies and water flows through the city, there is no clear pathway for obtaining a well reasoned answer to the questions ‘is IPR a good proposition?’ and ‘is IPR the best proposition?’. Where differing answers to these questions persist there no clear means for deliberating in order to arrive at a robust decision to proceed or not. Further, there are not yet clear institutional frameworks within which to stabilise or authorise the outcomes of any such deliberation.
ECOLOGICAL POLITICS

In his book *Politics of Nature* Bruno Latour (2004) outlines the case for a new settlement between ‘Science’ and ‘Politics’ and proposes strategies to ‘bring the sciences into politics’. Subverting the usual division between fact and value Latour introduces an alternate division between the ‘power to take into account’ and the ‘power to arrange in rank order’. Democratic processes follow four main tasks through these two domains. ‘Perplexity’ and ‘consultation’ constitute the power to take into account, and ‘hierarchy’ and ‘institution’ constitute the power to rank and order. The four stages move from identifying propositions to be taken into account, evaluating the strength of the propositions, ordering the propositions into relative merit and importance, and stabilising the outcomes through appropriate institutions. Politicians, scientists, economists and moralists, as broad categories of professional skill sets, each have a part to play in all of four realms, though each fulfilling a different role.

As the basis for democratic decision making about IPR the four stages of Latour’s politics might include the following.

1. **Perplexity**: active awareness of new entities and propositions to be considered.
   - the proposition of IPR as an arrangement of filtration and purification technologies to provide a new source of drinking water.
   - the proposition that the technologies of IPR may not remove all known and unknown contaminants, leading to increased health risk to water users.
   - the proposition that drinking recycled water is culturally unacceptable.
   - the proposition that IPR is required to solve water shortages.
   - the proposition that other measures are required to solve water shortages.

2. **Consultation**: participation by appropriate witnesses and stakeholders who can answer questions and make the case for the existence, importance or relevance of these propositions and entities.
   - engineers, community members and leaders, politicians, scientists, cultural researchers, social scientists, economists and others make various representations and participate in deliberation about each of the propositions.

3. **Hierarchy**: arranging various propositions into a collectively agreed order
   - the propositions are arranged in order based on the consultation outcomes, not on the predominance of ‘facts’ from scientists and engineers or ‘values’ from politicians and the public.
   - IPR as a proposition for new water supply is ranked in relation to propositions relating to health risks, cultural considerations and propositions for alternative solutions.

4. **Institution**: achieving closure on the process of consideration and ordering, stabilising the outcomes
   - having been fairly represented, IPR may be confirmed as an water supply option, relegated as a package of technology without the necessary social relationships to ensure its viability, or defined in relation to other options for water management under particular circumstances.

IN PRACTICE

Operationalising Latour’s vision of political ecology as a blueprint for completely new decision making procedures is unlikely to be feasible. However, it does provide impetus for existing calls for more deliberation on IPR, at all stages of development, rather than approaches which take the technical proposition of IPR for granted and seek to manipulate publics to achieve acceptance. It also points to the need for structure and institutional authority to stabilise these processes, rather than leaving consultation and public engagement to a case-by-case ad hoc basis.

In terms of practical guidance for water system managers a recognition of the socio-technical reality of IPR means that:

- IPR is not a supply-side option unless it can be embedded in social, political and institutional networks. These issues need to be considered from the very outset consideration of any IPR scheme and not left until technological development is considered robust and ready for public scrutiny.
• Expression of public concern are important propositions in themselves and should be included in decision making rather than reduced to emotional ‘yuck factor’, a deficit of technical understanding, or misconceptions of risk.
• Contrary to the advice of some marketing professionals, engineers and technical staff with appropriate training should be involved in deliberative activity with these various publics rather than isolated or sidelined.
• PR may not in fact be a good idea, even if well proven technologies can be arranged to completely purify wastewater.

For governments and regulators this analysis means that:
• Open, trustworthy and democratic forums for discussing and deciding about the possibility of IPR are needed in which water suppliers can participate along with other interested parties.
• The wider question of the value of IPR amongst other alternative supplies and strategies for managing future water shortages needs to be addressed as part of integrated water planning, involving meaningful processes for dialogue between experts, politicians, managers and publics, at all stages.
• Such engagement needs to be part of recognised democratic processes which move beyond simply requiring proponents to ‘consult the public’ without clear public institutional frameworks and processes in place.

CONCLUSIONS
In a discussion of the institutional context for water reuse Colebatch (2006) defines the work of governing as complex and ambiguous, an assembling of a pattern of order from a range of bodies of knowledge, problematizations, and technologies of rule (p. 25).

The work of governing IPR and deciding on whether or not it has a role in sustainable urban water systems is indeed complex and ambiguous. Existing institutions are struggling to deal with these issues. However, greater awareness of the importance of social issues and public concerns, and early efforts towards greater inclusion of these considerations in decision making provide the basis for more effective and robust democratic processes for moving towards sustainability. Moving beyond the conventional technology: society divide to consider IPR as a socio-technology provides a new conceptual grounding from which to move forward.

Whether or not IPR has a role to play in sustainable urban water systems will be determined by whether or not the technologies that are central to this proposition can be stabilised within the existing and emerging networks of social, technical, ecological and political actors. Technical representation of these technologies will be an important part of this process, but technological rationality alone will not be sufficient to ensure a stable future for IPR. The relationships needed for IPR to exist will not be built by trying to convince the public of the rightness of the technical proposition. IPR may never exist in any more than a few cities. Whether or not IPR exists is less important than building robust democratic processes to allow it to be judged fairly as one among many propositions for achieving sustainable water systems.

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