

Transforming
Biosolids

Biosolids and the Public

Rethinking Community Engagement in a Time of Change

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The ARC Training Centre for the Transformation of Australia's Biosolids Resource has a primary goal of delivering world-class and innovative technological solutions and knowledge, to train the next generation of biosolids practitioners in cutting-edge, transformational approaches, and to guide best practice in the biosolids sector.

A key project delivered by the Centre is Stakeholder Engagement and Acceptance (Project 3D), which seeks to examine the wider social complexities and dynamics shaping ongoing transitions in the Australian wastewater industry, with a particular focus on opportunities for improving the industry's customer and community engagement strategies and practices.

For further information visit: www.transformingbiosolids.com.au

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Executive summary

As the biosolids sector in Australia adapts and innovates, so too must its approach to customer and community engagement. It will no longer be viable to treat engagement as an afterthought or box to be “checked”. To succeed in the coming decades, it must become a core strategic imperative.

This report presents findings from a social science research project, *Stakeholder Engagement and Acceptance*, undertaken with the ARC Training Centre for the Transformation of Australia’s Biosolids Resource. The primary aim of this project was to examine the social and organisational factors shaping ongoing transitions in the Australian biosolids sector, with a focus on deriving lessons for water authorities regarding their customer and community engagement efforts.

The present study maps the diversity of community engagement strategies and approaches within the biosolids sector based on a global review of academic literature and industry documentation. This review was complemented by key informant interviews with biosolids professionals across Australia to better understand challenges to existing management practices, future management trajectories and their implications for community engagement strategy.

Key findings:

- **Engagement strategies in the biosolids sector have gradually evolved over time, reflecting broader shifts in societal attitudes and approaches to public participation.** This journey has been marked by pivotal shifts, from an era of intentional obscurity to strategic messaging campaigns, and ultimately, an emerging recognition of the need to build genuine relationships with publics through dialogue and deliberative engagement.
- **Members of the public are already involved in biosolids and wastewater issues in ways that go beyond formal institution-led processes.** Our global review of engagement practices suggests that public participation in biosolids and wastewater issues and actions includes both formal institution-led processes and more spontaneous, grassroots initiatives. This spectrum of engagement reveals the diversity of engagement possibilities and the multiple, sometimes competing practices that might otherwise be overlooked.
- **Methods of engagement relying on one-way communication of “facts” are insufficient to build public trust and support.** Decades of social science research finds that that public acceptance of science and technology is not solely based on deficiencies in knowledge or understanding. Rather, acceptance dynamics are far more nuanced, shaped by a complex interplay of values, cultural contexts, personal experiences, and societal trust in institutions. Recognising this complexity is crucial for the industry to move beyond simplistic information campaigns and towards more meaningful, two-way dialogues that address the multifaceted nature of public concerns and aspirations.
- **The biosolids sector faces a critical juncture as it grapples with major infrastructural decisions and their societal implications.** Expert interviews revealed this decision-making to be largely driven by regulatory pressures, climate change imperatives, and circular economy opportunities. However, these drivers have left little room for meaningful public inclusion in decision-making processes. This disconnect is exacerbated by a distinct lack of social science research on public perceptions of emerging wastewater

technologies, which could leave the industry inadequately prepared to navigate the complex social terrain of wastewater transitions.

- **Engagement in the biosolids sector is evolving, but significant challenges remain.** Industry professionals report grappling with an expanding scope of management issues, from local concerns to global impacts. There is a growing recognition of social responsibility, yet uncertainty persists about effectively communicating alternatives to stakeholders. Internal alignment and capacity building for engagement emerged as critical, yet often overlooked, component of meaningful engagement. These insights underscore the need for a more nuanced, adaptive approach to public engagement that can keep pace with the sector's rapidly evolving technological and social landscape.

Building on this empirical data, we identify current gaps and limitations in current engagement strategies, and present set of best practice principles to guide future initiatives. We then conclude with five recommendations for the biosolids sector to enhance its customer and community engagement efforts, including to:

1. Embed public engagement as a core organisational priority that is practised across the entire lifecycle of biosolids initiatives, ensuring its integration into strategic planning, decision-making processes and operational practices.
2. Invest in building the skills of capacity of organisational staff to improve their ability to engage effectively with the public, while also fostering internal alignment across organisational units to ensure a consistent and coordinated approach to engagement.
3. Develop and incorporate new modes of communication and collaboration with members of the public, including initiating programmes of deliberative engagement mechanisms and upstream social analysis of potential technological developments.
4. Undertake further research to build an empirical base of effective community engagement with biosolids management, particularly focuses on developing a more nuanced understanding of the complex factors that shape public responses towards biosolids management beyond technical considerations and economic efficiencies.
5. Develop a comprehensive framework for evaluating the effectiveness of public engagement initiatives, including documenting and analysing case studies to extract valuable lessons and best practices for the broader wastewater industry.

Introduction

The wastewater industry in Australia is approaching a critical turning point. More extreme weather, increasing urbanisation, ageing infrastructure and rapidly evolving community expectations are driving the sector to adapt and innovate^{1,2}. At the same time, the once-reliable practice of applying biosolids in agricultural applications is coming under intense scrutiny, as societal concerns about emerging contaminants and tightening regulations cast doubt on its long-term viability^{3,4}.

Against this backdrop of change, many water authorities – both in Australia and internationally – are actively exploring the potential of novel technologies and practices to address these complex, intersecting pressures⁵. Although these efforts present exciting opportunities for meeting growing climate change responsibilities, promoting energy self-sufficiency and delivering on promises of the circular economy^{6,7}, they also present a number of risks, challenges and uncertainties.

Crucially, the successful implementation of new biosolids solutions will depend, in large part, on the extent and level of public support for these initiatives, as has been highlighted by decades of social science research in adjacent policy areas⁸⁻¹¹. What this underscores is the urgent need for robust and evidence-based public engagement strategies. However, the current rapid pace of social and technological change in the wastewater industry has left little room to assess the current state of engagement or anticipate its future development.

At the same time, research conducted for this project has highlighted both the need for, and opportunities to, better align developments in biosolids management with existing capabilities in community and stakeholder engagement. While many water utilities have developed sophisticated approaches to both stakeholder and community engagement, precipitating the establishments of dedicated engagements teams with utilities, much of this institutional capability is focused primarily on customer and public relations in the context of drinking water.

In comparison, our research has found that wastewater management – and biosolids management in particular – have formed a more limited component of water utilities' engagement efforts. For this reason, this report points to a key opportunity that is likely to become apparent in the short to medium term. As water utilities seek to transition their biosolids management strategies – and capitalise on opportunities for resource recovery and regional organic waste processing – there will likely be a greater need to align capabilities within utilities around community and stakeholder engagement.

The need for more systematic approaches to community engagement around biosolids management, is in part demonstrated by past experiences which have demonstrated the ways in which public concerns and opposition to water industry practices can not only delay individual projects but disrupt entire management pathways (see Box 1). It is therefore crucial for the wastewater industry to appreciate the foundational importance of public engagement to its operations, developing strategies that inform, involve, and empower stakeholders across the entire biosolids value chain.

Purpose of this report

The purpose of this report is to review public engagement strategies and practices in the wastewater sector, with a particular focus on Australia's evolving biosolids management landscape. We identify current challenges and opportunities for Australia's water authorities in the current period of change and uncertainty. In doing so, we develop a set of principles and evidence-based recommendations for the design of long-term and ongoing engagement initiatives.

Our approach

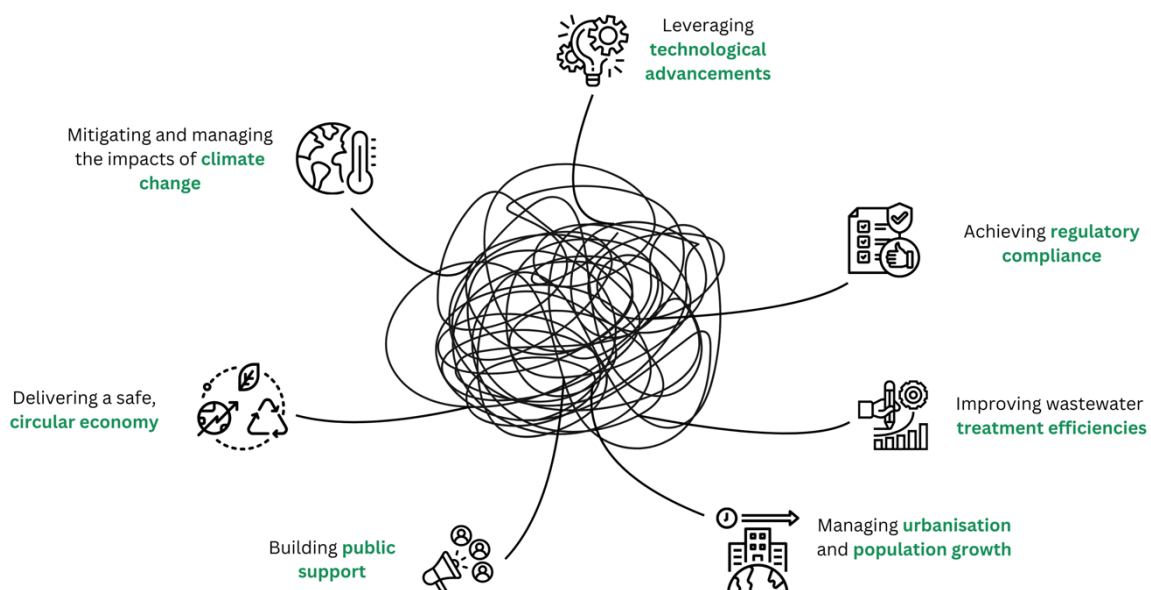
The research presented in this report is underpinned by a comprehensive social science methodology aimed at exploring the social dimensions of ongoing transitions in wastewater management and public engagement strategies, capturing diverse perspectives and experiences across the Australian wastewater sector.

Key components included:

- **Literature review and document analysis:** We completed an extensive review of international academic literature on public engagement and acceptance of biosolids. This included peer-reviewed articles, industry reports, and policy documents, allowing us to situate Australian practices within a global context and identify emerging trends and best practices.
- **Expert interviews:** We conducted in-depth interviews with 26 wastewater and biosolids professionals across all states and territories across Australia to explore the social factors shaping current and future management practices and their implications for existing customer and community engagement initiatives.
- **Site visits:** The research team visited several wastewater treatment plants across Australia, representing a diverse range of scales, technologies, and regional contexts. These visits provided firsthand observations of operational practices and challenges.
- **Stakeholder workshop:** We piloted a novel workshop methodology with an urban water authority, which brought together professionals from different departments to discuss stakeholder engagement strategies. These interactive sessions helped identify internal challenges and opportunities for improving internal and external stakeholder communication and alignment.

Scope of the report

In addition to the empirical data, the report draws on global examples of public engagement with biosolids management, with a particular focus in the Australian context. This review of engagement strategies and practices is not intended to be exhaustive, but to highlight the diversity of public involvement with biosolids. Where relevant, we include case studies and insights from academic literature on public engagement with wastewater and sewage management, including with potable reuse initiatives and technologies.



The new context of public engagement. The intersecting demands on and objectives of Australia's biosolids sector.

Box 1: From Pollution to Protest – Turn Back the Tide, Sydney, 1989

In March 1989, Sydney's Bondi Beach became the stage for a landmark event in Australian wastewater management history: the "Turn Back the Tide" concert. Organised by activist groups People Opposed to Ocean Outfalls (POOO) and Stop the Ocean Pollution (STOP) and drawing a crowd 250,000 people, the event sought to raise awareness of the declining health of Sydney's iconic beaches revealed to be polluted with raw sewage and industrial waste.

Dubbed the "Aussie Woodstock of Poo," the concert represented a powerful public response to the perceived mismanagement of urban wastewater. While the event did not lead to major changes to the ocean outfall plans, it did result in some modifications and heightened public scrutiny of wastewater practices.

The Turn Back the Tide concert and its associated media discourse provides an important lesson in how members of the public can significantly influence wastewater management practices and government policy, which can emerge in complex and contested ways. It is also an example that remains relevant today as water authorities grapple with the challenges of treating and disposing of biosolids where public perception and involvement will continue to play a crucial role.

The Death of Bondi

by Carlotta McIntosh

If only it were just shit. There's muck, sludge, grease balls, effluent and toxic waste. Shit is the stuff we flush down the toilet. Our sewerage system was designed for just that.

Faeces produce micro-organisms that breed in the system and eat the crap - a free clean-up service. Dumped off beaches, it does change the ecology and can spread disease, but the huge problems really arise when industrial waste gets into the system.

Micro-organisms won't eat it. And who can blame them? First there's mercury. That's the stuff that causes Minamata disease, diagnosed first in Japan. A link was established between excessive levels of mercury in fish and the destruction of the central nervous system.

The range of heavy metals include cadmium, mercury, copper and lead. The main sources of these chemicals in Sydney are industrial although some, like copper, come from residential copper pipes.

Then there are the organochlorine chemicals, like pesticides, which are more dangerous than heavy metals because they are not biodegradable. They accumulate in the food chain, causing death, lesions and mutations in fish.

Sydney beach pollution denied

SYDNEY: A Water and Sewage Employees' Union statement that three of Sydney's most popular beaches were regularly polluted with raw sewage was denied yesterday by the Sydney Water Board.

According to the union, overflooded treatment plants at Bondi, Malabar and North Head prevented full treatment of sewage.

The general manager of the board, Mr Peter Crawford, said the statement was not correct. It was a union protest against a board decision to reduce sludge levels on night and weekend shifts at the plants. There was a dispute now before the State Industrial Commission.

The secretary of the union, Mr Joe Fisher, countered by saying a board statement that regular pollution was not a problem was a "misleading statement".



Sewage pollution moves

SYDNEY: The Sydney Water Board is investigating two alternative methods of disposing of sewage sludge, rather than dumping it in the ocean, as part of a multi-pronged attack on beach pollution.

A Water Board spokesman said one process, which had been under trial at Shellharbour, used a micro-wave type treatment to kill all viruses and bacteria in the sludge before converting it into fertilizer.

A second process, which was about to undergo a pilot study at the Malabar outfall, involved dewatering the sludge to form a low-grade diesel oil.

The spokesman said the board was looking at the costs, effectiveness and environmental impacts of the processes.

The pilot studies were initiated after it was discovered that sewage sludge being dumped in the ocean contained the bulk of dangerous viruses, bacteria, and toxic waste from industry.

encourage industries to deal with their waste on their own.

Environment group Greenpeace dismissed the new measures as a public-relations exercise. "Over 80 per cent of sludge still goes out through North Head and the two plants they have given no undertaking on, Bondi and Malabar," said spokesman Richard Godden.

● Fishing bans are to remain around Sydney sewage outfalls despite yesterday's issue of a report which concluded that mercury levels in the red morwong species were not a health risk.

The NSW Minister for the Environment, Tim Moore, said the Water Board study found there was no present toxicological threat to humans from heavy metals discharged in effluent from ocean outfalls.

But Mr Moore said he would not recommend that the ban on fishing be lifted.

Young surfers lead POOO's Bondi march

SYDNEY: Young surfers from Sydney's northern and southern beaches yesterday joined eastern suburbs residents in a vocal anti-sewage march to Bondi Pavilion which was attended by nearly 2000 people.

The marchers, chanting anti-pollution slogans and carrying scores of banners, walked from Waverley Park to nearby Bondi Beach for the rally.

People Opposed to Ocean Outfall (POOO) spokesman Ben Brown said the organisers were surprised at a larger-than-

Draft anti-pollution plan may force higher rates

SYDNEY: Sydney ratepayers may be charged another \$200 a year from 1994 if a proposed new pollution-treatment program is introduced.

If implemented, the 15- to 20-year program, unveiled in Sydney yesterday, would cost about \$4.5 billion, adding about another \$300 a year to each rate bill.

However, the first five years of the Sydney Wastewater Action Program could be paid for by money raised under the new \$80 environmental levy.

The recommendation comes from US consultants Camp, Dresser and McKee and their Australian associates Camp, Scott, Farphy, following a six-month study into Sydney's new deep-water ocean outfalls.

Issued by the NSW Premier, Nick Greiner, and the Minister for the Environment, Tim Moore, the consultants' draft study judges the previous Labor Government's decision

to construct deep-water outfalls at North Head, Bondi and Malabar

"This just doesn't mean simply the ocean, it means Sydney Harbour, it means the river system, it basically means the area from the Blue Mountains to Palm Beach and Gerringong south of Wollongong," Mr Greiner said.

Later, Mr Moore outlined two of the ways the clean-up could be implemented.

"We could see two major sewage systems in Sydney and pull the peak flow from Bondi to Malabar," Mr Moore said.

Mr Greiner earlier said the study "vindicated completely" the Government's environmental levy.

"The long-term answer and the expensive part of the answer is about \$2.5 billion which essentially duplicates the main sewage lines," he said.

The consultants said secondary treatment was not necessary, but upgraded equipment and new techniques should be used.

to construct deep-water outfalls at North Head, Bondi and Malabar "appropriate".

However, the consultants said treatment was inadequate at each of the major plants and measures to remove grease and suspended solids should be stepped up.

Problems associated with pollution from sewage overflows and stormwater drains also needed to be overcome.

The review was critical of the Water Board's development programs, describing them as unfocused and fragmented.

Mr Greiner said that if the Sydney Wastewater Action Program recommendation was accepted, he expected the state of NSW waters to be vastly improved in five years, with visible improvements in every summer after the forthcoming season. He said that while the report was only in draft form, the Government was committed to cleaning up Sydney's water.

Water Board plans to clean up beaches

SYDNEY: The Water Board has unveiled a \$400 million plan to take its clean-up of Sydney's beaches beyond the introduction of the controversial ocean outfalls.

In a statement yesterday, a spokesman for the Water Board said the world's most advanced sewage-treatment technology would be used to remove more than 80 per cent of the solid material now discharged through ocean outfalls.

The new strategy was issued yesterday by the NSW Premier, Nick Greiner, the Minister for the Environment, Tim Moore, and the Water Board chairman, David Hatley.

Mr Greiner said the Government had indicated that the use of the ocean outfalls "could not simply be a case of out of sight, out of mind".

"We are committed to maintaining the

of the sewage from enhancement systems. Public meetings would be held in March in Cronulla, Bondi, and Manly to explain the proposals.

The proposed works included:

● further sewerage of houses in the Palm Beach and White Beach areas of Sydney's northern beaches.

● \$16.4 million to be spent on a sludge-treatment plant at Warriewood and possibly extending the outfall further out to sea.

● a further \$75 million to be spent on upgrading facilities at the major North Head treatment plant.

● Water Board plans to connect houses in the Vaucluse area to the Bondi treatment plant by the mid-1990s, ending the three-million-litre-a-day discharge of untreated sewage at three South Head outfalls.

● More than \$60 million to be spent on upgrading the Bondi treatment plant, full implementation expected by 1997.

Understanding engagement

Far from being a marginal activity, community engagement is now an integral part of how governments and private industries approach complex environmental issues. In this section, we explore the concept of engagement, its various forms, and its critical role in shaping wastewater and biosolids planning and management.

What do we mean by “engagement”?

The term “engagement” refers to the various ways in which government authorities interact with stakeholders and members of the public. Engagement can be used to improve understanding, facilitate dialogue, and promote collaborative decision-making about issues that affect these stakeholders and these goals are now established as key principles of effective water planning and governance both in Australia and internationally¹².

For these reasons the terminology of ‘engagement’ encompasses a range of practices, increasingly commonplace across wide-ranging areas of public administration. In broad terms commitments to ‘community engagement’ or ‘public participation’ mark a shift from older models characterised by more linear communications strategies (for example the so-called “decide-announce-defend” – or DAD – model), to models based in dialogue, inclusion and transparency¹³.

Practices of community engagement also draw from major international conventions. Principle 10 of the 1992 Rio Declaration speaks of the right for communities to “participate in decision-making processes” on environmental matters, while the 1998 *Convention on Access to Information, Public Participation In Decision-Making And Access To Justice In Environmental Matters* (otherwise known as the “Aarhus Convention”), articulated a range provisions for “early public participation, when all options are open and effective public participation can take place” (Art 6.4).

In this way, public participation and community engagement have come to be regarded as hallmarks of sustainable development, addressing in particular the social sustainability of decision-making processes. For this reason, in many countries, water authorities are now required to consult with the public on their water resources management plans, recognising the critical role of public opinion in shaping the success of alternative water sources, including desalination and wastewater recycling¹¹. This growth and institutionalisation of engagement reflects the awareness that effective water governance and decision-making requires not just technical expertise, but also an understanding of societal perceptions, values, and concerns¹⁴.

At the same time, it is worth noting that as notions of sustainable development are increasingly augmented with notions of circularity and resource recovery – captured in notions of a circular economy – commitments to meaningful public and community engagement have begun to take on different meanings. For example, in a recent volume, anthropologists, Patrick O’Hare and Dagna Rams argue that in contrast to the concept of sustainable development, current framings of “the circular economy have thus far remained oblivious to wider social concerns”¹⁵. Furthermore, Mark Dyer and colleagues argue that the “concept of a circular economy is at a crossroads” and has been “largely driven by top down national or trans-national legislation” that conceives of circularity largely as a technological accomplishment, while recommending strategies for creating shared public narratives that may enhance circular economy policy efforts¹⁶.

Frameworks for Community Engagement

Various approaches and models have been developed over time to better understand and facilitate citizen participation in governance processes^{17–19}. Perhaps the most famous framework for understanding public and community engagement is the “ladder of participation”, developed in the late 1960s by Sherry Arnstein. Arnstein’s framework was defined a typology of “eight rungs on a ladder of citizen participation”²⁰.

In a recent review of her work, Lauria and Slotterback (2020) outline that Arnstein’s framework was written “at the height of the civil rights movement and implementation of massive urban renewal and social support programs in the US”, and further that “her ladder offered inspiration for a new practice of participation that centred people, communities, and power” and “contributed further momentum to a fundamental shift in the role of the planner from rational technician, to values-driven advocate, mediator, facilitator, organizer, and communicator”²¹. It is notable therefore, that after 50 years these concerns remain vital and continue to animate efforts to engage publics and communities in decision making processes, whilst also capturing something of the methodological diversity that has been taken up across this field.

Acknowledging this diversity, the International Association for Public Participation (IAP2) has developed a framework for understanding different “levels” of engagement through their spectrum of public participation (Figure 1). This spectrum has been taken up by many government authorities, assisting them in clarifying the level of stakeholder involvement they are seeking while ensuring that activities are aligned with their intended outcomes. It includes the following categories of engagement:

- Inform: Providing balanced and objective information
- Consult: Obtaining public feedback on analysis, alternatives, or decisions
- Involve: Working directly with the public throughout the decision-making process
- Collaborate: Partnering with the public in each aspect of decision-making
- Empower: Placing final decision-making power in the hands of the public

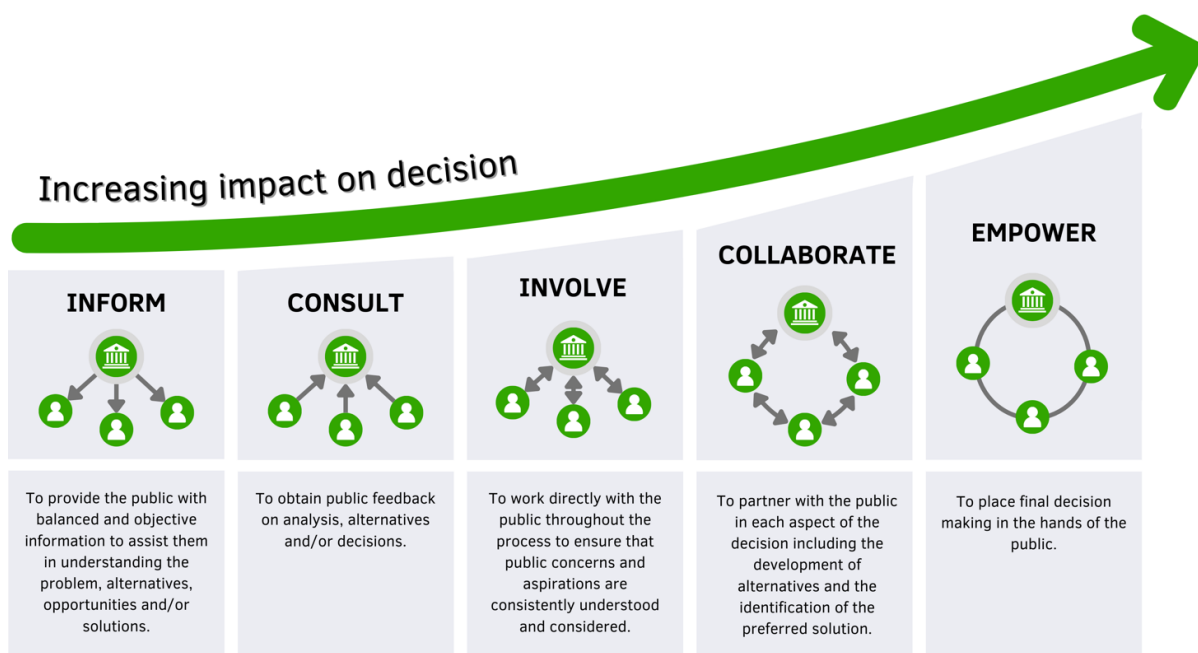


Figure 2. Public Participation Spectrum – as adapted from International Association for Public Participation (IAP2). See <https://iap2.org.au/resources/spectrum/>.

While common approaches to public engagement, such as those outlined in the IAP2 spectrum, provide a framework for institution-led initiatives, it's important to recognise that public engagement in the water sector, like in other sectors, often extends far beyond these formal processes¹⁹ (See Section 5 below). It is also notable that public participation is a lively area of contemporary scholarly debate and considered critique.

For example, writing specifically about the IAP2 engagement spectrum, Legacy (2024) analyses commitments to community engagement as a “paradox”, characterised by an embrace “of participatory practices that showcases a commitment to quality, inclusivity and just-based planning” and a commitment to “strengthening planning’s connection to the wider democratic project” on the one hand whilst also being “used to manipulate the community’s relationship with the state in ways that protect the interests of the more powerful, elite actors” on the other. Reflecting on, and responding to these critical appraisals of institutional community engagement efforts, has been a key dynamic in the intellectual and methodological development of the field.

Drawing on leading insights from social science research on public engagement, we therefore consider public engagement to encompass the various ways in which people relate to wastewater-related issues in general and biosolids management in particular²². By mapping these various forms of engagement, it is possible to uncover a more comprehensive understanding of how different publics think and what they do in relation to water management issues, revealing multiple contending visions and practices that might otherwise be overlooked.

Who is “the public”?

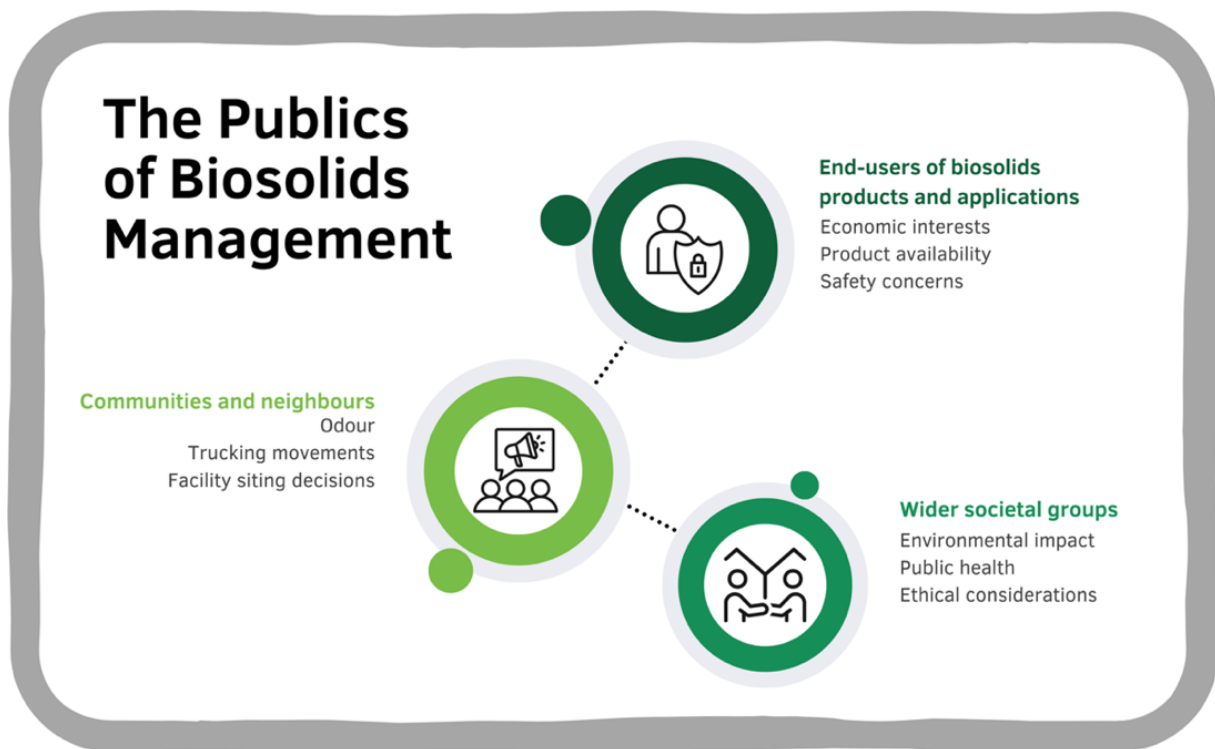
When thinking about public engagement in biosolids management, it is important to clarify who we are referring to when we say “the public”. In reality, there isn't a single, homogeneous “public”, but rather a diverse “publics” each with varying interests and concerns²³. These groups and individuals may include:

- **Communities** or neighbouring communities living in close proximity to wastewater treatment plants or biosolids application sites. These groups and individuals are often the most directly impacted by issues such as odour, trucking movements, and facility siting decisions.
- **End-users** of biosolids products and applications (e.g. land-applied biosolids) who may have a direct economic interest in the continued availability and safety of biosolids, with their perspectives being important in shaping the future of land application practices.
- **Wider societal groups** who may have concerns or opinions about the risks, sustainability, and ethics of biosolids management practices, even if they are not directly impacted. This includes environmental organisations, public health advocates, media outlets and the general citizenry who may or may not support the initiatives of the water sector.

In this report, we deliberately use the term 'publics' to recognise this diversity. This distinction acknowledges that different segments of society may have varying levels of interest, concern, and knowledge regarding biosolids management. These differences can significantly impact how each group engages with a particular issue, whether at the early stages or later in the research and development process.

When engaging with these publics, consider:

- Who is the public I am addressing?
- What concerns and issues matter most to this group?
- How can I effectively gauge their expectations of our engagement?
- What knowledge or insights might I gain from this public?
- What strategies can I employ to ensure I meet their needs and expectations?



Moving engagement upstream

Traditionally, public engagement in the water sector has occurred *downstream*, involving communication and consultation about technologies or management practices after they have already been developed or implemented. While this can be useful for explaining benefits and addressing concerns, this engagement may come too late to be able to meaningfully influence the direction of biosolids management strategies.

There is now broad consensus on the necessity of incorporating public values and interests into the governance of emerging technologies. This approach is deemed especially pertinent in contexts characterised by high stakes, conflicting values, and significant uncertainties (Chilvers and Kearnes 2020; Kearnes, *et al.* 2014; Macnaghten 2010; Macnaghten, *et al.* 2019).

Such *upstream engagement* involves involving stakeholders and the public in discussions at an early stage, before key management strategies and technologies have been determined²⁴. This involves public dialogue about research priorities, potential environmental implications, or desired community outcomes of biosolids use.

Upstream engagement encourages asking fundamental questions such as²⁴:

- Why are we considering this approach?
- What are the alternatives?
- Who benefits from it?
- How will it affect our community and environment?
- What are the long-term implications?

In the context of biosolids management the goal of upstream engagement is to bring these questions into the decision-making process early, when they can still influence the direction of management strategies. This approach can help align management practices with community values and needs, identify potential concerns early, and build public trust through transparency.

Beyond acceptance

The biosolids sector has typically used the language of "acceptance" when discussing public attitudes towards biosolids technologies and products²⁵⁻²⁸. Acceptance (or lack thereof) is often seen as a key reason why wastewater recycling initiatives fail to be realised. Based on this view, public engagement practices have sought to ensure communities accept the use of biosolids in their area, often through education and outreach campaigns which target the benefits and safety of biosolids (see section 4 below)²⁹. Thus, the core underlying assumption has been that if people better understand biosolids, they will be more likely accept their use without resistance.

This perspective on engagement has been termed by social science researchers as the "deficit model" of public knowledge, as it considers a knowledge-deficit public can be rectified by the delivery of abundant scientific and technical information³⁰. However, several decades of social science research has shown that conceiving the public as "misinformed" or "uneducated" fails to consider the range of other factors that contribute to an individuals' response to emerging technologies beyond access to scientific information.

Additionally, the public's reluctance to accept wastewater recycling has often been attributed to a visceral aversion, commonly known as the 'yuck' factor. Many studies have suggested that this instinctive, emotional response is a primary reason for the failure of recycled water projects. Such studies typically rely on attitude models and psychometric methods, often using quantitative approaches like surveys and polls.

However, this explanation has been challenged by some researchers. Some authors argue that this approach reinforces a technocratic mindset, which assumes that public opposition to expert risk assessments must be irrational and emotionally driven. Others have proposed that other factors also play crucial roles in the success or failure of wastewater recycling initiatives, including cost structures, institutional resistance to change, fragmented administration, and insufficient community involvement in planning stages.

As such, various other factors have been shown to influence social acceptability of emerging technologies, including:

- Benefits and repercussions for local communities
- Direct, indirect and cumulative impacts of the environment
- Real or perceived risks and uncertainty
Values, beliefs and expectations
- Local expertise and knowledge
- Social, economic, and geographic contexts
- Trust in promoters, advocates and institutions
- Equitable participation in decision-making processes

By considering these broader factors that influence social acceptability, biosolids managers can better integrate their initiatives into their particular context and be supported by the community in a more harmonious manner.

Key research and publications

Over the years, various organisations and researchers have contributed to developing strategies, frameworks, and best practices for effective community engagement with biosolids. This body of work underscores the water industry's ongoing commitment to improving public engagement practices.

Table 1. A timeline of water industry research, strategies and frameworks on public engagement with biosolids.

| Year | Publication | Author |
|-------------|--|--|
| 1981 | Institutional Constraints and Public Acceptance Barriers to Utilization of Municipal Wastewater and Sludge for Land Reclamation and Biomass Production | United States Environmental Protection Authority |
| 1993 | Powell Tate Communications Plan on Biosolids | Water Environment Federation |
| 1994 | Biosolids Recycling: Beneficial Technology for a Better Environment | United States Environmental Protection Authority |
| 2000 | Dealing with Outrage: A Key Communication Tool for Biosolids Professionals | Water Environment Federation |
| 2002 | Survival Guide: Public Communications for Water Professionals | Water Environment Federation |
| 2004 | Biosolids Community Engagement Framework for the Victorian Water Industry | Australian and New Zealand Biosolids Partnership |
| 2004 | Public Perceptions of Biosolids: Developing Public Participation and Earning Trust | Beecher / Water Environment Research Foundation |
| 2005 | Communication and Public Consultation for Biosolids Management | Federation of Canadian Municipalities and National Research Council |
| 2011 | Conducting Effective Community Outreach and Dialogue on Biosolids Land Application: A Primer for Biosolids Professionals | Water Environment Research Foundation |
| 2011 | A Strategic Risk Communications Process for Outreach and Dialogue on Biosolids Land Application | Water Environment Research Foundation |
| 2011 | National Manual of Good Practice for Biosolids | National Biosolids Partnership |
| 2016 | Community Engagement Framework for Biowastes – New Zealand | Centre for Integrated Biowaste Research and Low Environmental Impact |
| 2021 | Biosolids Communication Toolkit | Water Environment Federation |
| 2010-2021 | Community Attitudes to Biosolids Survey | Australian and New Zealand Biosolids Partnership |

Engagement strategies and practices

Engagement strategies in the biosolids sector have gradually evolved over time, reflecting broader shifts in societal attitudes and approaches to public participation. This section explores what we refer to as four co-existing yet distinct generations of community engagement with biosolids. We then explore diverse approaches and methods to engagement, recognising a spectrum from formal processes to grassroots initiatives.

Table 2. Engagement strategies in the biosolids sector distinguishing between four “generations”

| | “Keeping the public in the dark” | “Controlling the message” | “Public relationships, not public relations!” | “Social dialogue” |
|------------------------------------|--|---|---|--|
| Emergence | Pre-1990s | Early-1990s | Late-1990s | Mid-2000s |
| IAP2 spectrum of engagement | | Inform | Consult | Collaborate |
| What the focus is | Intentional obscurity Defending biosolids against criticism | Informing publics on benefits and safety of biosolids Promoting predetermined strategies | Communicating risks Building relationships Understanding factors that drive public acceptance | ‘Opening up’ the problem for deliberation Acknowledging areas of uncertainty Recognising the productive contribution of other knowledges |
| How the public is viewed | They are inconsequential to management decisions | They are uninformed or disengaged They can be persuaded They can be hostile | We understand their knowledge and concerns They talk back and share views | Together we understand the problem Together we set the agenda Together we negotiate solutions |
| Engagement methods | Limited reactive engagement | Public relations campaigns Proactive communication of “the facts” | Public education and outreach Relationship building Monitoring public perceptions | Participatory decision-making Scenario planning workshops Consensus building |

Four generations of community engagement with biosolids

“Keeping the public in the dark”.

Early approaches to community engagement were characterised by minimal disclosure and limited public awareness of biosolids management practices. So long as the flows and workings of the sewerage system remained intact, the view was that there was little need to engage with members of the public.

This generation is mostly clearly outlined in a 1981 United States EPA report which states that there is “little effort to reach out to particular segments or constituents of the public. Rather, information about the project [is only] made available for individuals and groups which made the effort to obtain it”. Behind this reactive approach is a fear that public disclosure of management practices could “harden” public attitudes about biosolids and create difficulties going forward.

“Controlling the message”

In the early 1990s, the shift towards land application of wastewater solids as a preferred management strategy brought the wastewater industry into closer contact with communities, especially in rural and agricultural areas. As a result, public awareness of biosolids and their potential impacts grew, leading to increased scrutiny and concern. Public frustration also mounted due to the industry's initial lack of transparency and tendency to dismiss these concerns²⁹.

As part of an effort to place the industry ‘on the front foot’, the industry adopted an engagement strategy aiming to bolster community understanding of biosolids allowing the industry to “control the message”³¹. Engagement practices included the use of targeted messaging, education campaigns, and demonstration projects to shape public perceptions and make assurances about its relatively low risks to human and environmental health.

Deeply embedded in this generation of public engagement is a conception of the public as “not very well informed scientifically” about wastewater treatment processes, and biosolids management in particular. However, this strategy, while more engaged than previous approaches, still often failed to address the root causes of public concern or fully acknowledge the legitimacy of community perspectives on biosolids management.

“Public relationships, not public relations”

Beginning in the early 2000s, the wastewater sector in the United State began to re-evaluate its approach to public engagement. The Water Environment Research Federation (WERF) commissioned a study that resulted in the 2004 report, *Public Perception of Biosolids Recycling: Developing Public Participation and Earning Trust*²⁹. This pivotal report ultimately highlighted a gap between industry practices and expert recommendations on risk communication. It called for the sector to move from a strategy of “public relations” to one of “public relationships,” recognising that people were “rightly concerned” about biosolids reuse and that simple PR tactics were largely insufficient.

Alongside this move towards “public relationships,” the industry also began to focus more on monitoring public perceptions. The move has been exemplified by the Australian & New Zealand Biosolids Partnership's (ANZBP) who have undertaken two major surveys of public responses to biosolids.

“Towards social dialogue”

The most recent shift in biosolids engagement strategy involves a move towards participatory and deliberative approaches. This shift has occurred mostly in academic circles as social scientists became involved in critiquing existing engagement strategies to advocate for more deliberative and participatory approaches with biosolids management.

This generation moves passed the previous generation primarily by viewing the public not as barriers to be 'overcome', but as valuable partners in developing sustainable management strategies. It aimed to involve the public earlier in decision-making processes, aiming for collaborative problem-solving and recognising the public as co-creators of solutions, not just recipients of information (See case study below).

It is important to recognise that these different strategies for public engagement in biosolids management do not exist in isolation, nor have they followed a strict linear progression. Instead, they often coexist and overlap, with various actors and organisations employing different approaches simultaneously.

Even as wastewater industry has moved towards more participatory and consensus-building practices, elements of the earlier strategies of "silence" and "controlling the message" are still present in some contexts. This can lead to a complex and sometimes contradictory landscape of public engagement, where genuine efforts to build trust and collaboration may be undermined by lingering habits of secrecy or tokenistic engagement.

Box 2. Building Stakeholder Consensus in New Zealand – The Kaikoura Case Study

In New Zealand, biosolids management has largely relied on limited forms of public consultation, such as information provision and public meetings, typically after decisions have been made. Recognising a need for more robust community engagement, the study by the Centre for Integrated Biowaste Research (CIBR) conducted a multi-stage engagement process spanning 2009-2012.

The process included an initial community meetings, personal interviews with key stakeholders, and multiple community forums to present research findings and gather input. Scientists then presented research on biosolids characteristics, environmental impacts, and economic analyses in ways that were accessible to all stakeholders. Community members were actively involved in discussions and decision-making throughout the process, which culminated in voting on preferred options that integrates social, cultural, environmental, economic and technical factors.

The engagement resulted in strong community support for three main reuse options: application to exotic forest plantations, application for rehabilitation with native plants, and composting (both open-air and vermicomposting) for public sale. The case study demonstrated how collaborative community engagement can lead to more robust and sustainable biosolids management solutions that involve broad stakeholder support, providing a valuable model for other communities facing similar waste management challenges.

Engagement in practice

Public engagement in biosolids and wastewater management encompasses a broad spectrum of activities, ranging from formal, organised processes to spontaneous, grassroots initiatives. Drawing on a global review of public engagement with wastewater and biosolids management, in this section we seek to provide a more complete picture of complex ways in which different publics interact with and shape wastewater and biosolids management practices beyond institution-led forms.

A spectrum of engagement: 'invited' and 'uninvited' participation

Institution-led engagement is otherwise referred to as 'invited' participation: forms of public engagement that are initiated and orchestrated by institutions or authorities and typically involving formal, structured processes like public consultations, surveys, and deliberative workshops.

Invited participation allows utilities and authorities to gather targeted feedback on specific proposals or issues, often ensuring representativeness and clear channels for public input. A recent example of such participation is the Fraser Coast Regional Council's community feedback initiative. The council sought community input to inform the development of a future biosolids treatment and reuse strategy through a multi-channel approach including an online engagement hub, fact sheets, media releases, and targeted communications. This structured approach allowed the council to gather specific feedback on their proposed strategies while providing information to the public.

However, not all public engagement in wastewater and biosolids management issues are initiated or sanctioned by government authorities. *Uninvited participation* captures more citizen-led or grassroots forms of engagement that are not formally organised by institutions. Examples include activism, protests, community science initiatives, and other "bottom-up" actions.

The Australian PFAS Chemicals Map developed by Friends of the Earth Melbourne is a good example of uninvited participation in biosolids issues. This online resource provides an interactive map and information about the locations, sources, and environmental impact of per- and polyfluoroalkyl substances (PFAS) across Australia, including their presence in biosolids. This citizen-led initiative seeks to mobilise scientific data to raise public awareness about PFAS contamination, potentially influencing public and media discourse and policy considerations surrounding wastewater management and water and soil quality.

Such forms of uninvited participation can bring attention to overlooked issues or perspectives that may challenge existing paradigms or push for social change. It can often arise from community concerns or dissatisfaction with current institutional practices, and may inform the development of radical or innovative solutions. However, at the same time, they may struggle to gain official recognition or influence formal decision-making processes.

Engaging in issues versus actions

Many forms of participation primarily involve the expression of views or concerns about wastewater and biosolids management. This includes public debates about emerging contaminants in biosolids, participation in forums discussing wastewater treatment options and technologies, or social media discussions about water and biosolids reuse policies. This type of engagement emphasises the discursive aspects of wastewater and biosolids issues rather than public involvement in direct actions.

The "Chemical Concoctions" initiative led by the Queensland Water Directorate is a good example of issues-based engagement. The project developed an online platform to educate the public about contaminants of emerging concern (CECs) found in household environments. The website provides information on six classes of chemicals

through an interactive "open home" website to encourage public understanding about common contaminants found in the home and what people can do to minimise their exposure.

There is also participation and engagement in *actions*, which involves tangible practices or behavioural changes related to wastewater and biosolids management. Examples include household practices to reduce contaminants in wastewater, community composting initiatives that use biosolids as a fertiliser, or the involvement of people in wastewater monitoring efforts, such as through citizen science initiatives. This type of engagement focuses on practical, hands-on involvement in wastewater and biosolids-related activities and may not necessarily be organised and led by water authorities.

An example of this type of action-based engagement is from the United States and involves a partnership between the Metropolitan Water Reclamation District of Greater Chicago and ChicaGRO Intergenerational Growing Projects. This initiative provided composted biosolids for 72 community gardens to support sustainable urban farming and food security issues in Chicago neighbourhoods. The project encouraged public connections to biosolids in practical applications in order to deliver tangible community benefits and increased understanding of biosolids reuse.

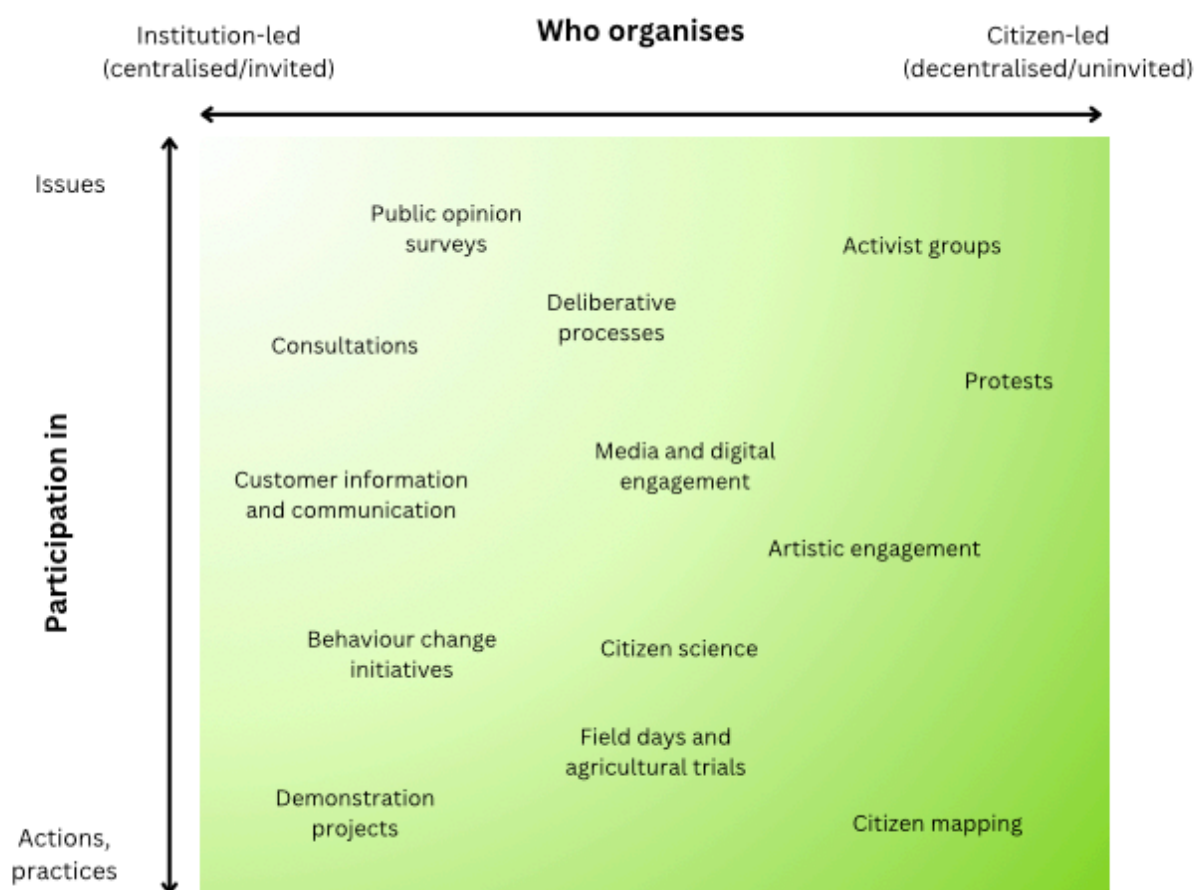


Figure 3. The diversity of public engagement with wastewater and biosolids management. Adapted from Chilvers et al. 2021. See Appendix for more detail on types of engagement practices.

Emerging issues in Australia

Expert interviews with wastewater professionals across Australia revealed key insights into current and emerging stakeholder engagement challenges within the biosolids sector. As the industry explores alternative treatment and reuse pathways, we highlight several key issues and complexities of engaging diverse stakeholders amid evolving practices and public expectations.

Scaling challenges: From local issues to global concerns

Our findings suggests that many water authorities are actively exploring alternative management options as doubts grow about the long-term viability of land application methods. Such shifts in technology and practices are likely have significant implications for their public engagement strategies.

Whereas traditional local concerns such as trucking movements, facility siting, and odour management have remained the focus under a land application paradigm, new issues are emerging under alternative management strategies, including the circular economy agenda, emerging contaminants (e.g., PFAS) and climate change mitigation responsibilities. It is these broader, global concerns which will have significant implications how the sector engages with its customers and communities, as one industry professional explains:

"The way that everything's moving, and with the regulatory reforms, we're talking about a much more mature discussion with community that's an ongoing thing. You don't just do it just before your next big bunch of projects. You're doing it all the time and you're involving community all the time." – Biosolids planner – urban water authority

Enhancing responsiveness and accountability

Respondents recognised their responsibility to society at-large, and many expressed a desire for greater oversight and ownership of the entire biosolids value chain. This view stems from a belief that more direct engagement with communities and farms can help build productive relationships and address concerns more effectively. As one respondent conveyed:

"We want to stand by our product and push the benefits more, take more ownership of it and hold more of the interaction with the communities and the farms that are involved. Because it's hard having a layer of contracting between you to be able to actually address their concerns." – Biosolids manager, urban water authority

Communicating the value of alternatives

The thermal treatment of biosolids through technologies, such as pyrolysis and gasification, were considered by some respondents as the most viable solution to meet current drivers and challenges. However, communicating these major infrastructural decisions to the public was viewed as a looming challenge for the sector, as one respondent explained:

"If land application becomes a problem or becomes unviable, I think the challenge might be how to announce the value of the alternatives, and how to ensure we can still recycle or reuse the biosolids in a sustainable way. I think that will be the challenge." –Biosolids manager – regional water authority

Strengthening internal capacity and organisational alignment

The importance of internal stakeholder alignment was identified as a critical issue for the future of biosolids management in Australia. Ensuring coherence and consistency in messaging and engagement practices across strategic, customer engagement, and operational teams was viewed as an essential component of effective engagement. As the industry navigates complex challenges such as the introduction of new treatment technologies or the siting of new facilities, internal coordination will be vital for anticipating and responding to community concerns in a clear and cohesive manner.

“We have a communications team, but they are not usually employed in biosolids management...We do need to work a bit more with our communications team to achieve a more consistent message” – Biosolids manager – regional water authority

“Moving forward we’re going to have tighter regulatory environment...and we want to be really clear that we’re communicating consistently with our customers as not to kill pathways for other utilities while also understanding our own way forward.” – Biosolids planner – urban water authority

Box 3. Building capacity and internal stakeholder alignment for effective stakeholder engagement

In August 2024, a collaborative workshop brought together biosolids producers from across Southeast Queensland in partnership with Project 3D to address increasingly crucial issue of stakeholder engagement in the biosolids management sector. Through knowledge sharing sessions and interactive exercises, participants worked to foster a shared understanding of engagement challenges and opportunities, responding directly to an identified need for better coordination of stakeholder engagement approaches in current and emerging biosolids management pathways.

The workshop served as a catalyst for transforming how biosolids producers approach stakeholder engagement, moving from isolated efforts to a more unified, strategic approach across their region. It also sought to establish a foundation for ongoing collaboration between biosolids producers in Southeast Queensland, in view of establishing more coordinated engagement with stakeholders across the region.

By bringing together diverse perspectives and expertise, the workshop further exemplified the constructive role of the social sciences in building internal capability and cross-organisational alignment for more effective stakeholder engagement strategies.



Rethinking engagement

In this final section, we propose a set of guiding principles and recommendations for the Australian biosolids sector in its efforts to involve customers and communities in the journey towards a safe, circular economy.

Revising key principles and assumptions

The following principles are drawn from our empirical data and an established body of social science research on engagement, seeking to provide evidence-based guidance for future engagement initiatives.

- **Commit to early, inclusive and sustained engagement.** Effective engagement begins at the earliest stages of biosolids planning and continues throughout the entire lifecycle of a given project. Various approaches are available and have been validated in existing social science literature, such as scenario workshops, citizen juries and participatory mapping. Such methods can help to ensure that public input can meaningfully shape outcomes rather than just reinforcing predetermined decisions.
- **Acknowledging and communicating uncertainty.** The biosolids sector often deals with complex scientific and technological issues where certainty is not always possible. It is crucial to be transparent about what is known, what is unknown, and what is uncertain. This involves clearly communicating the current state of scientific knowledge, including areas of consensus and debate within the biosolids community, being upfront about the limitations of current and ongoing research and explaining the potential risks and benefits associated with different management options, including the long-term and cumulative effects that may not be fully understood.
- **Recognise that expertise comes in many forms.** While technical knowledge is crucial, local knowledge, lived experiences, and diverse perspectives all contribute to make better decisions. Broaden the range of voices involved in decision-making processes, including independent experts, community representatives and Traditional Owner groups. This approach enhances transparency and accountability and helps ensure that decisions reflect a wider range of considerations and values.
- **All engagement efforts have their blind spots and constraints.** Water authorities will need to critically examine the assumptions, limitations, and potential biases inherent in public participation processes, including in the choices of engagement methods. For example, survey and opinions polling, while important and well-intentioned, can provide only partial insights into the complex factors shaping public understanding and responses to biosolids management. Choosing a range of engagement methods can help to overcome the limitations and biases to methodological choices.

Diversity of opinion is not just inevitable but valuable. It brings to light different perspectives and concerns that might otherwise be overlooked. Engaging constructively with disagreement involves actively listening to and addressing concerns, being willing to modify plans in response to feedback, and viewing conflicts as opportunities for learning and improvement.

To implement these principles effectively the industry should also reconsider some common assumptions about the role and value of public engagement. The table below outlines some required shifts in thinking:

| Common assumptions | Revised assumptions |
|--|---|
| Publics are barriers or threats to the beneficial use of biosolids | Publics have the potential to play a constructive role in shaping socially responsible management practices, but engagement may also surface value conflicts that will require negotiation |
| Public concerns are largely irrational and can be reduced to emotional responses to localised disturbances (e.g., NIMBY, “Yuck” factor). | Public responses to biosolids are shaped by a complex interplay of contextual factors, including local histories, cultures, social relationships and trust. |
| Effective engagement involved positive messaging, a supportive media environment and clever marketing | Effective engagement involves an openness to multiple viewpoints, a commitment to dialogue and shared learning, and a recognition of the diversity of engagement with wastewater and biosolids issues |
| Public opinion polls on public attitudes can help to overcome barriers to public acceptance | Context-sensitive research can help uncover complex social, cultural and place-based factors that shape acceptance dynamics. |
| Wastewater and biosolids infrastructure exist independently of social factors | Biosolids management transcends economic and technical specifications to include complex social factors that must be integrated into the design, development and appraisals of management options |

Opportunities for action

Making engagement a core strategic imperative

Water authorities should consider making public engagement with biosolids a core organisational priority, embedding it in strategic planning, decision-making, and operational practices, from project conception to implementation. Our findings indicate that integrating public engagement throughout the entire lifecycle water policy could lead to more successful outcomes and mutual benefits for both communities and water authorities.

This could be achieved by:

- Developing a comprehensive customer and community engagement strategy relevant to specific local contexts that spans all stages of the biosolids lifecycle;
- Integrating engagement milestones into project timelines, research proposals and operational plans;
- Establishing clear processes for how public input will be incorporated into decision-making processes.

Strengthening organisational capacity and alignment

Water authorities should invest in training programs to equip organisational staff across their business with the necessary knowledge and skills to engage effectively with the public. Efforts should also be made to foster internal alignment across organisational units, to ensure a consistent and coordinated approach to engagement.

This could include:

- Developing tailored training programs on public engagement techniques for staff at various levels.
- Creating working groups to ensure consistent and aligned messaging and approaches.
- Establishing clear roles and responsibilities for engagement activities across the organisation.

Experimenting with new modes of engagement

Water authorities should consider developing and implementing new communication and collaboration methods with the public. This recommendation builds on an established body of social science literature indicating the highlights the potential of innovative engagement techniques in water and resource management.

Possible approaches include:

- Initiating deliberative engagement programs, such as citizens' juries or consensus conferences on biosolids management options.
- Conducting upstream social analysis of potential technological developments to anticipate and address public concerns early in the pre-trial phase.
- Utilising digital platforms and social media for more interactive and accessible engagement.

Expanding research inquiry

Current research often focuses narrowly on public understanding and knowledge of biosolids, typically achieved through the delivery of opinion polling and quantitative surveys. A more comprehensive approach is required to fully grasp the complexities and dynamics of public acceptance. This broader scope of research inquiry allows for a more nuanced understanding of the complex factors that shape public responses towards biosolids management beyond technical considerations and economic efficiencies.

Research projects could involve:

- Qualitative studies on the cultural and social meanings associated with biosolids in different communities.
- Investigations into how local context (e.g., history, economics, environmental conditions) influences acceptance dynamics of biosolids management practices.
- The development and implementation of a robust framework of Social Licence to Operate (SLO) for water authorities, including key indicators of community trust and approval.

Evaluating engagement effectiveness

To improve biosolids engagement practices, it will be important to document real-world examples of public engagement across Australia. Presently, case studies demonstrated effective modes of community and customer engagement are rare and engagement has not been evaluated in an in-depth or systematic manner.

Possible actions include:

- Developing standardised evaluation tools that can be used across different engagement initiatives.
- Creating a national database of case studies and make this accessible to all water authorities and biosolids producers.
- Collaborating with academic institutions, especially social science researchers, to systematically document and analyse engagement initiatives.

BIOSOLIDS ENGAGEMENT JOURNEY

ENGAGEMENT OPPORTUNITIES AND ROADMAP

MAKE ENGAGEMENT A CORE STRATEGIC PRIORITY

Embed public involvement in planning, decision-making, and operations. Develop engagement strategies that span the entire biosolids lifecycle.

IMPLEMENT INNOVATIVE ENGAGEMENT APPROACHES

Explore deliberative programs, upstream social analysis, and digital platforms. Develop new ways to collaborate and communicate with communities.

EXPAND SCOPE OF RESEARCH INQUIRY

Study cultural, social, and contextual factors influencing acceptance. Move beyond knowledge surveys to understand complex public responses.

MONITORING AND EVALUATION

Analyse and document engagement experiences in a process of continual learning and adaptation.

STRENGTHEN ORGANISATIONAL CAPACITY AND ALIGNMENT

Invest in staff training and foster cross-departmental alignment. Establish clear roles and processes for consistent public communication.

Online materials for further reading

- Australian Government Department of Industry, Innovation and Science. **A Guide to The Right Engagement** ([Link](#))
- National Co-ordinating Centre for Public Engagement. **A Quick Guide to Developing High Quality Public Engagement** ([Link](#))
- International Association for Public Participation Australasia. **Valuing Better Engagement: An Economic Framework to Quantify the Value of Stakeholder Engagement for Infrastructure Delivery** ([Link](#))

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Appendix – The diversity of public engagement initiatives with wastewater and biosolids management

| TYPE OF ENGAGEMENT | EXAMPLE | LINK |
|--|--|---|
| PUBLIC OPINION SURVEYS | The Australian and New Zealand Biosolids Partnership (ANZBP) has delivered its Community Attitudinal Survey since 2010 to identify community attitudes towards biosolids management in Australia and New Zealand to inform effective communication strategies and decision-making processes in the biosolids industry. | https://www.biosolids.com.au/wp-content/uploads/NGR-1906009-Community-Attitudes-Survey-PUBLIC-REPORT.pdf |
| COMMUNICATION AND INFORMATION PROVISION | Led by the Queensland Water Directorate, Chemical Concoctions is an online website that aims to educate the public about contaminants of emerging concern (CECs) found in household environments by providing information on six classes of chemicals through an interactive "open home" website that explores different rooms and spaces. | https://chemicalconcoctions.org |
| CONSULTATIONS | The Fraser Coast Regional Council sought community feedback to inform the development of a future biosolids treatment and reuse options through a multi-channel approach including an online engagement hub, community survey, fact sheets, media releases, and targeted communications. | https://www.frasercoast.qld.gov.au/news/article/886/council-reviewing-how-biosolids-are-reused |
| MEDIA AND DIGITAL ENGAGEMENT | The Western Treatment Plant Community Hub is an online platform that provides updates, news, and engagement opportunities for the community regarding Melbourne Water's Western Treatment Plant. | https://letstalk.melbournwater.com.au/wtp |
| FOCUS GROUPS | Led by the University of New South Wales, this three-year study examined public understandings of and responses to drinking water produced from recycling schemes in Australia, utilising qualitative research methods to explore how potable reuse is framed in policy and media and how the public makes sense of and respond to recycled water initiatives. | Kearnes et al. (2014) |
| SCENARIO WORKSHOPS | A study in New Zealand explored the use of novel public engagement methods, particularly scenario workshops, to develop more sustainable biosolids management policies by involving citizens in the decision-making process and addressing environmental, economic, social, and cultural factors alongside technical considerations. | https://pubmed.ncbi.nlm.nih.gov/18486303/ |
| CITIZENS' FORUMS | The Triple Carbon Reduction project and researchers from the University of East Anglia in the United Kingdom mapped the diverse forms of public engagement with wastewater management and hydrogen technologies in the UK and explored citizen perspectives through a deliberative "Citizens' Forum". | https://waterinnovation.challenges.org/winners/triple-carbon-reduction/ |
| BEHAVIOUR CHANGE INITIATIVES | Northumbrian Water's Bin the Wipe campaign in the United Kingdom sought to influence customer behaviour to reduce sewer blockages and flooding caused by the improper disposal of wet wipes. | https://www.nwl.co.uk/binthewipe |
| DEMONSTRATION PLANTS AND FIELD TRIALS | Singapore's national water agency, PUB, operates an the NEWater Visitor Centre that combines interactive educational exhibits with tours of an | https://www.pub.gov.sg/Public/WaterLoo |

| | | |
|----------------------------------|--|---|
| | operational recycled water plant aimed at promoting public understanding of water reuse as part of the country's water supply strategy. | p/OurWaterStory/NE Water |
| COMMUNITY GARDENS | The Metropolitan Water Reclamation District of Greater Chicago (MWRD) partnered with ChicaGRO Intergenerational Growing Projects to provide composted biosolids for 72 community gardens to support sustainable urban farming and addressing food security issues in local neighbourhoods. | https://www.wwdmag.com/home/news/10934254/mwrdenriches-south-side-community-gardens-with-biosolids |
| ARTISTIC ENGAGEMENTS | Treatment III was a public art project featuring works by twelve artists across multiple sites in Melbourne's western suburbs, celebrating the history, technology, and community surrounding the city's wastewater infrastructure, with a focus on the Western Treatment Plant in Werribee. | https://www.treatment3.org.au |
| CITIZEN SCIENCE | The D-NOSES (Distributed Network for Odour Sensing Empowerment and Sustainability) project is a European initiative that aims to empower citizens and involve them in civic actions to combat odour pollution and promoting participatory strategies at all levels. | https://www.ideasforchange.com/en/archive-case-studies/d-noses-en |
| CITIZEN MAPPING | The Australian PFAS Chemicals Map is an online resource developed by Friends of the Earth Melbourne that provides an interactive map and information about the locations, sources, and environmental impact of per- and polyfluoroalkyl substances (PFAS) across Australia. | https://pfas.australianmap.net |
| COMMUNITY ACTIVIST GROUPS | The Sierra Club in the United States, in collaboration with the Ecology Center of Michigan, published a report titled "Sludge in the Garden," which reported results from a scientific study on nine home fertiliser products made from sewage sludge and found concerning levels of toxic PFAS chemicals, raising questions about the safety of using biosolids-based fertilisers in gardens and agriculture. | https://www.sierraclub.org/sludge-garden-toxic-pfas-home-fertilizers-made-sewage-sludge |
| PROTESTS | The Turn Back the Tide concert was a large protest event held on Bondi Beach in Sydney, Australia in March 1989, where 240,000 people gathered to demonstrate against ocean pollution and sewage contamination of Sydney's beaches. | http://www.herinst.org/sbeder/Books/toxicfish/introduction.html |