

Community management of onsite wastewater treatment systems- what they want in Mount Gambier, South Australia

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Abstract: Effective management of onsite wastewater treatment systems (OWTS) is important in preventing contamination of ecologically sensitive receiving environments, such as surface water and groundwater used for human consumption or contact. Householders play a key role in OWTS management, therefore inadequate householder knowledge of system function, inability to recognise signs of system failures and lack of understanding of maintenance requirements can increase the risk of system failure. A householder survey and community consultation process have been undertaken in conjunction with a biophysical effluent sampling program to reveal community understanding of OWTS, opinions on preferred management strategies, institutional arrangements and possible reactions to future financial costs to householders. Opinions from workshop participants and other stakeholders suggested their community wanted knowledge regarding OWTS functioning and maintenance, in particular, information on the use of suitable household chemicals to maintain treatment performance and continued research into contamination of groundwater sources by wastewater systems to better inform wastewater management strategies. Community participants were divided on the preferred administration and cost of maintenance, with some wanting to retain responsibility for maintenance arrangements by contracting specialised personnel and others suggesting local authorities should take responsibility.

Keywords: community engagement; groundwater contamination; onsite wastewater systems, karstic aquifer, wastewater management.

INTRODUCTION

To ensure long-term environmental and public health protection, it is essential that onsite wastewater treatment systems (OWTS) are properly managed to prevent discharge of inadequately treated wastewater (Gardner *et al.*, 1997). The householder plays a key role in the management of OWTS, through chemical usage, hydraulic load management and maintenance regimes. This is important, as regular maintenance is a vital component of OWTS management and has been reported to minimise potential environmental contamination (Johansson *et al.*, 2002). While maintenance is generally undertaken by service agents and desludgers, householders play a significant role in ensuring an appropriate frequency of maintenance.

Mandatory intervention through regulatory bodies can be used to ensure adherence to regulations. There have been several programs established by Australian states to assist local authorities to monitor, regulate and report on the operations and impact of OWTS (Johansson *et al.*, 2002). However, traditionally the effectiveness of local authorities' initiatives to improve wastewater management has been hampered by lack of financial and legislative support by government, land development pressures, management of non-compliance, costs to owners for onsite maintenance and inadequate information on system function and maintenance (Victorian Water, 2007).

Currently, the South Australian government requires local authorities to analyse the appropriateness of wastewater treatment regimes and to develop policies regarding wastewater treatment within their jurisdiction. These local policies need to account for specific soil type and coverage, depth to watertable and proximity to valued water resources. In order to better manage wastewater systems, local authorities in Mount Gambier are engaging in community consultation, to understand community concerns and to develop a communication and consultation framework for the implementation and ongoing processes involved in the development of long term wastewater treatment plans.

Several studies have been conducted in the United States, in upstate New York (Schwartz *et al.* 1998), and in northeast North Carolina (McKee & McNulty 2003), on the general management of onsite wastewater treatment by owners and their response to local authorities' management and maintenance initiatives. Of the few studies conducted in Australia, Cooper *et al.* (2006) interviewed community members in northeast Victoria on preferred choices of

wastewater systems. Nunn and Ross (2006) surveyed a rural community in Victoria to ascertain compliance with permit requirements of effluent quality of aerobic wastewater treatment systems. The Colac Otway Shire in Victoria instigated wastewater management programs in response to aerobic systems discharging effluent off-site (Colac Otway 2002). Arnold and Gallasch (2001) investigated the effectiveness of domestic onsite wastewater treatment systems in the Mount Lofty Ranges, South Australia, one of the sources of the capital city of Adelaide's drinking water. The Australian studies found local authorities were concerned about compliance with state regulations and waste management procedural arrangements i.e., determination of the performance and condition of OWTS, data management of OWTS information and the implementation of regular inspection and management programs (Arnold and Gallasch, 2001; Colac Otway, 2002; Nunn and Ross, 2006).

Conversely, residents were mainly concerned about their limited knowledge of system function and maintenance requirements, financial costs, environmental impact and influence on property values. Nunn and Ross (2006) report a general lack of householder understanding of the system's function and maintenance requirements as a major factor leading to regulatory non-compliance. Studies by Arnold and Gallasch (2001) and Colac Otway (2002) are two examples where Australian local government authorities have used community awareness programs and educational information to improve the level of householder knowledge regarding OWTS operation, maintenance, and identification of system failures. However, to date the programs have not been evaluated.

The rural city of Mount Gambier in the south-east of South Australia provides a case study where onsite wastewater treatment is used in peri-urban and rural areas. While the majority of Mount Gambier residents have been serviced by a sewer system since the 1970s, around 75 residential properties within the city bounds and 3000 in the surrounding peri-urban and rural areas rely on OWTS for wastewater management (Levett *et al.*, 2009). Conventional septic systems and aerobic systems are two OWTS that are in use in the Mount Gambier area. Aerobic systems in the area mainly employ a suspended-growth system in the aerobic chamber, where air blowers aerate the primary treated effluent and promote the growth of aerobic bacteria suspended in the liquid. However, a very small number employ an attached growth system, where bacteria form a biofilm on media, which the effluent is trickled over. All systems in the area use chlorine as the disinfection agent. Current regulations state that aerobic systems must be serviced quarterly by a professional service agent, where the mechanical components are checked, and chlorine tablets replenished. It is recommended that both septic tanks and aerobic systems are desludged (pumped out) every four years (SA Health Commission, 1995, 1998). There are several proposed changes to systems maintenance under consideration by the local council where they would opt to take more involvement in, (i) conducting desludging programs, (ii) maintaining records of desludging events, (iii) sending desludging reminder notices, and/or (iv) information provision.

Groundwater quality protection is a high priority in the study area as the major water supply for the city is sourced from the Blue Lake, which is fed by the underlying unconfined karstic aquifer (BLMP, 2006). Karstic aquifers have many underwater caves and sinkholes and the groundwater within can be dangerously susceptible to contamination via diffuse recharge, point recharge or in depressions in the land surface (Davis *et al.* 2002). To assist local authorities in managing the impact of OWTS to ensure environmental protection of groundwater supplies, the authors attempted to investigate the community management of OWTS, opinions on preferred management strategies, institutional arrangements and possible reactions to future financial costs to householders.

Compliance with effluent quality and maintenance guidelines has been evaluated using field assessments of residential OWTS (Levett *et al.* 2009). This paper explores community knowledge of and attitudes to OWTS, and reactions to proposed management options that could be adopted by local government authorities, through a process of community consultation.

METHODS

A site inspection and householder survey was conducted for 74 households with OWTS, in parallel with the biophysical sampling program for OWTS and domestic supply bores. Of these, 30 households had aerobic wastewater treatment systems (AWTS) and 44 households had septic systems (see Levett *et al.*, 2009 for details). Surveys were used to collect demographic, system and maintenance details and opinions regarding system function. The householder survey also revealed system maintenance practices *in situ*. The survey was complemented by onsite inspections undertaken during sampling to record the location of systems in relation to bores, the condition of effluent dispersal areas and any obvious signs of failure such as waterlogged soil.

Concurrently, twenty six participants attended two community workshops held at Mount Gambier in February 2008. In-depth information was elicited from the community workshops providing a better understanding of management issues and practices, as well as attitudes toward local authorities and their role in facilitating environmental protection of groundwater supplies. Attendees were recruited by telephoning approximately 20 community residents for each workshop from a database of residents with OWTS, the selection provided by the local councils. The initial workshop consisted of 15 participants, all from households with septic systems. The second workshop of 11 participants consisted of seven participants from households with aerobics systems and three from households with septic tanks and one stakeholder. Residents of both genders attended the workshops; however the age of participants was not recorded. The purpose of the workshops was to provide richness in detail and understanding of issues and concerns associated with OWTS. Local Environmental Health Officers presented information and factsheets on features and regulations governing OWTS. Participants were asked a series of semi-structured questions on their experiences with OWTS and conversationally exchanged views within groups. Opinions were transcribed and collated.

In addition, six stakeholders involved in the distribution and maintenance of OWTS were interviewed and their viewpoints and experiences in dealing professionally with householders in reference to OWTS were analysed. Stakeholders were purposively selected from local authority information of service providers (qualitative selection) to understand other issues involved in wastewater treatment from a servicing perspective.

RESULTS AND DISCUSSION

The householder survey, site inspections, and effluent and groundwater quality sampling was conducted to assess functional aspects of OWTS. Levett *et al.* (2009) reported that the quality of effluent from septic tanks and AWTS was found to be poor, with none of the septic tanks and only one AWTS complying with all effluent quality criteria. Regardless, groundwater quality measured from household bores in the study region appeared to be good, with low levels of inorganic wastewater indicators, moderate levels of nitrate, and only three of thirty-one samples containing low levels of indicator bacteria.

Table 1 and Table 2 report the survey and observational findings from fieldwork and the questionnaire, including details about servicing events, reported problems, sources of system information, details about effluent dispersal areas and the location of bores. Descriptions of the community consultation process, workshop deliberations and interviews with stakeholders are subsequently presented.

Onsite observations and survey results

Householder survey results depicted in Table 1 and Table 2 indicate that most residents (93% with aerobic systems and 89% with septic systems) were satisfied their system was operating effectively, though there was evidence of system failures identified by householders as toilets “backing up”, and occasions of effluent discharging or pooling at the surface or waterlogged ground. Householders did not appear to conform to the four-yearly desludging schedule recommended for septic tanks (South Australian Health Commission, 1995, 1998; Levett *et al.* .2009) While 45% of septic tanks had been desludged within the previous four years, only 25% of householders reported regularly desludging their tanks every four years. Eighteen percent of

householders had desludged their tank once only (often upon moving into the property), and 9% reported desludging their tanks at irregular intervals in response to problems with the system. Thirty five percent of households surveyed with septic tanks had not been desludged for over five years, while the longest period of operation without the septic tank being desludged was 27 years. Most householders with AWTS relied on their service agent to tell them when their systems needed to be desludged, with one service agent believing they only needed desludging around every seven years, despite the recommendation being four years (South Australian Health Commission, 1998). Hence there is a variety of maintenance practiced.

Table 1: Aerobic system maintenance details obtained from householder surveys and site inspections.

Factor	Aerobic systems (n = 30) responses	
Age; capacity	83%	<10 years; 3000 L anaerobic chamber
	17%	<10 years; 4250 L anaerobic chamber
Maintenance	97%	Engaged a professional service agent
	3%	None
Time since last desludge	7%	<4 years as recommended [#]
	3%	>4 years
	30%	>4 years old, not desludged
	60%	<4 years old, not desludged
Repairs or upgrades	0%	0%
Opinion of system function	93%	System working effectively
	7%	Not sure of system's effectiveness
Problems reported by householder	Majority	Slight or intermittent odours
	17%	Blocked irrigation system
	17%	Mechanical faults
	20%	Effluent pooling or waterlogged soil
	30%	No problems reported
Problems observed during site inspection	30%	Mosquitoes or larvae present
	10%	Offensive odour
System choice	73%	System recommended by plumber or builder
	27%	Actively chose brand of aerobic system
Information on OWTS received	Some	Information from interactions with service agent
	50%	Received system manual
	7%	Received brochures
Irrigation area	23%	Complied with all regulations
	43%	Easy access to irrigation area
Bores	20%	AWTS or irrigation system within 50 m of bore ^{†#}

[#]South Australian Health Commission (1995; 1998); [†]legislated set-back distance.

Maintenance of AWTS was performed by a service professional in all but one system, yet these services did not always occur at the required interval of three months (South Australian Health Commission, 1998). In 93% of households surveyed the replenishment of chlorine tablets was left to the service agent, with only one resident checking the chlorine tablets themselves in between service visits. Thus, servicing of AWTS was a very important determinant in the level of residual chlorine, which in turn affected the levels of indicator bacteria (Levett *et al.* 2009). Of the irrigation areas inspected, 70% of households had dedicated irrigation areas, but only 23% completely complied with all regulations. Due to the poor state of many irrigation areas, which were not sufficiently separate from the recreation area, failure to regularly service an AWTS within three months increases the health risk from direct contact with inadequately treated effluent (Levett *et al.* 2009). Contamination of bore water was possible (though not evidenced in bore sampling) as 37% of septic systems and 20% of AWTS systems were within 50 m of bores. Two households reported that they drank their bore water, though most claimed bore water was used for irrigation purposes only.

Table 2: Septic system maintenance details obtained from householder surveys and site inspections

Factor	Septic systems (n = 44) responses	
Age; capacity	56%	>20 years; 1620 L
	42%	<20 years; 3000 L
	2%	<20 years; 4250 L
Maintenance	75%	Only in response to problems; many tanks are buried deeply preventing easy access for maintenance
	25%	Regularly desludged tanks every 4 years
Time since last desludge	35%	> 5 years (longest interval without desludging was 27 years)
	45%	<4 years as recommended [#]
	9%	Unknown by current owner
	9%	System <4 years old, not desludged
Repairs or upgrades	78%	Original system without any upgrades (to the knowledge of the current owner)
	16%	New or replacement trenches installed
	6%	Modifications to tank
Opinion of system function	89%	Operating effectively
	7%	Unsure
	4%	Trenches too short to be effective
Problems reported by householder	5%	Effluent pooling or boggy ground
	18%	Intermittent odour
	7%	Toilet “backing up” from system blocking due to ineffective drainage
Problems observed during site inspection	Majority	Mosquito-proof covers broken or absent
	7%	Offensive odour
	5%	Pooling effluent or waterlogged soil
System choice	Majority	Inherited system from previous owners or had installed the tank themselves before AWTS were available
	9%	Chose to install septic tank due: to longer life-span, simple operation, or cost.
Information on OWTS received	18%	Sought or were given information
	82%	Had not sought information
Irrigation area		Very few householders knew how long their trenches were, and some did not know where they were exactly
Bores	37%	Septic tank and/or effluent disposal field within 50 m of bore ^{†#}

[#]South Australian Health Commission (1995; 1998); [†]legislated set-back distance.

Few residents actively chose their brand of system, indicating a lack of knowledge of system functions or not knowing the advantage that one system would have over another, preferring to leave the choice with trusted plumbers and builders. Householders did not always receive an operating manual (as per regulations) when their AWTS was installed, or when they moved into a property with an existing AWTS, and in one case a householder was told by the manufacturer that they didn't have any information to send her. Many householders were misled by marketing claims to believe that AWTS effluent was 'purified' and 'close to drinking water quality'. Only 18% of householders with septic systems sought or were given information on septic system management from the local council, the internet or tank manufacturer, with most people believing they were familiar enough with their system's operation.

Community consultation process

The quality and implementation of environmental decision making can be improved through provision of information to the public and by active public participation (Gibson and Apostolidis, 2001; Brown and Farrelly, 2009). The need for community consultation in the Mount Gambier region was supported by the local authorities and deemed important to the development of any future management options.

A community consultation process was used to understand community opinions on management strategies, institutional arrangements and possible distribution of costs to householders if changes to maintenance and management systems were required to protect the groundwater supply (for more details see Alexander *et al.*, 2008a,b). Several major themes arose from workshop discussions including, (i) knowledge and experience of wastewater system types, (ii) preferred wastewater maintenance and management strategies, and (iii) community involvement and understanding of the need for regular system maintenance to protect groundwater.

Similar concerns emerged for residents with septic systems and AWTS, though there were some issues specifically relating to the different systems, reflecting different maintenance regimes and system features. Householders were concerned about their limited knowledge of system function, whether their systems were working efficiently and of their ability to recognise system failure. These concerns were supported by field observations and survey data that revealed poorly performing OWTS and a general lack of compliance with regulatory guidelines.

Community understanding of groundwater contamination

During the focus groups some participants voiced concerns about the risk of groundwater contamination by wastewater discharge on their own or neighbouring properties, and it was said that local authorities should exhibit tighter control over the approval of new OWTS and bores to take into account the position of existing systems and bores. Some residents were conscious of the need for maintenance to reduce the incidence of OWTS failure; however most participants agreed that if OWTS were shown to be contaminating groundwater supplies, they were prepared to consider several alternatives; as long as they had choice and the options were affordable. These responses indicate that communities are willing to respond to pressing environmental issues and are prepared to contribute financially towards management and maintenance that would better protect the groundwater supply.

No mention was made of the potential for additional risk resulting from rapid movement of contaminants in a karstic aquifer system, indicating that the community may not understand the geological implications that could lead to the movement of groundwater pollutants into their drinking water supply. Sinkholes and karst features are traditionally used for rubbish disposal (especially in rural areas), and changing attitudes to this is difficult, however local programs such as Blue Lake Water Care seem to be increasing understanding of how their actions have potential to impact the environment.

Options for OWTS management

Properly managed OWTS can provide communities with an equal level of long-term environmental and public health protection as sewer systems, and can do so at a lower cost (West, 2001). Management of OWTS can range from being entirely the householder's responsibility; through local authority management of maintenance tasks; to being managed entirely by a centralised management service (usually a utility). The level of environmental and public health protection increases with increasing levels of management. It is important to engage the community to determine the appropriate level of management for the Mount Gambier region.

Focus group participants voiced opinions that suggested they would accept increased regulation and ongoing data management by councils. In order to ensure protection of groundwater supplies, participants at the workshop had many suggestions of strategies to improve OWTS management such as:

- (i) changes to local authority administration practices with improved data management and implementation of system audits;
- (ii) provision of guidelines for maintenance procedures for householders;
- (iii) council-managed maintenance programs;
- (iv) increased regulation by Council and access to information on OWTS regulations;
- (v) provision of educational material on system operation and appropriate household chemical use;

- (vi) provision of incentives or rebates for regular maintenance and to purchase more effective OWTS; and
- (vii) ongoing research into contamination of groundwater sources by wastewater systems.

Participants perceived the local council's role and involvement is in ongoing administration and regulation of system approvals and installations, maintenance and monitoring programs, providing advice, distributing information and initiating information sessions. Local authorities could assist maintenance personnel by issuing standardised forms for reporting details of OWTS installation and maintenance. Suggestions were made for council to promote the benefits of wastewater system maintenance by appealing to self-interest and publicising the cost benefits of maintenance in avoiding system breakdown and increase community stewardship by demonstrating the need for groundwater protection.

Suggestions were made that maintenance of septic tanks with sludge removal could be managed under a central contract administered through the council. However, most participants with AWTS indicated that householders would prefer to continue to manage their own system maintenance, with direct payment to their chosen contracted service agents.

The majority of intervention options proposed imply an increase in the level of local government responsibility and a decrease in the level of householder responsibility, such as utilising centrally managed maintenance contracts. An alternative option, the introduction of a Community Wastewater Management Scheme (CWMS), is not feasible in the study area as the system density is too low.

Householder role in system management

Difficulties arise when householders have a high level of responsibility for the management of their OWTS but are unaware of the features of their wastewater treatment system, i.e. type, function, limitations and signs of malfunction, or the potential impact on groundwater quality. Arnold and Gallasch (2001) found a general lack of understanding of waste management issues and little recognition of the signs of septic system failure by residents in the Mount Lofty Ranges, South Australia, despite the potential for adverse impacts on the source of Adelaide's water supply. Similarly, Nunn and Ross (2006) attributed failure of AWTS to comply with regulations in Victoria to a lack of householder knowledge of the system function and maintenance requirements. In addition, residents who understand the need to maintain their wastewater treatment systems can be reluctant to engage in what they see as costly and unnecessary maintenance and may have limited knowledge of the impact of OWTS on the quality of drinking water sources such as groundwater (Schwartz *et al.*, 1998).

Similarly, some of the participants from the Mount Gambier region were ill-informed with little knowledge and understanding of the OWTS treatment processes and maintenance requirements. Most residents could not determine whether their wastewater systems were working effectively, as signs of failure were not immediately recognisable, and some expressed a desire for the Council to have a greater role in system management and maintenance. However, other participants were proactively interested in and involved in maintaining their OWTS. Many rural residents wanted to retain self-management as there are no legal requirements to maintain their systems regularly (recommended desludging only), while many peri-urban residents without previous experiences in OWTS preferred the option of council management.

Financial costs

Previous research suggests onsite systems can be perceived to be problematic and that residents prefer to shift the responsibility for the sewage and drainage systems, along with maintenance expenditures, to others. As found by Nunn and Ross (2006), McKee and McNulty (2003), and Schwartz *et al.*(1998), participants in this study were resistant to incurring costs for maintenance. However, if contamination from OWTS was found to be occurring, workshop participants were prepared to consider several alternatives, as long they were given a choice of affordable options. Various options considered suitable by participants included, (i) costs of changes to maintenance services to be absorbed by the current council rates, (ii) a \$50AUD

rebate on the cost of system maintenance, (iii) increased rates or levy to offset the increased cost to Council for management services and (iv) negotiation with community on the cost of change over to aerobic systems if septic systems were contributing to groundwater contamination. An alternative suggestion was for council to enforce regulatory changes with residents directly bearing the cost if current systems were found to be polluting the groundwater. In this study, effluent sampling showed that although AWTS generally treated effluent to a higher standard than septic tanks, most AWTS in the Mount Gambier region did not comply with all effluent quality standards, with over 70% failing the chlorine residual and faecal coliform guidelines (Levett *et al.* 2009), indicating a need for stricter OWTS management and maintenance.

Information requirements

It was considered essential that the local government authorities initiate a communication program to address the critical need for information regarding onsite wastewater treatment systems. This is supported by research findings in the Mount Lofty Ranges by Arnold and Gallasch (2001) and from research in New York State, by Schwartz *et al.*, (1998). Residents in these communities appreciated education booklets and programs, factsheets and brochures on OWTS function and maintenance.

Primarily, the residents of Mount Gambier wanted information about appropriate chemicals for use in their systems, recommended maintenance regimes, indications of system failure and desludging requirements. Residents with aerobic wastewater systems were also interested in information detailing regulations on the distance of irrigation systems from bores, and appropriate distribution of wastewater on suitable plants, fruit trees and lawns. Information could be distributed via information packs to individual households, but also supported by points of contact within the council, particularly for new and potential residents that had no prior experience with OWTS. Focus group participants suggested that brochures and factsheets could be distributed by local authorities to households at regular intervals (e.g. with council waste collection or rates notices) to promote knowledge uptake. Online information, television commercials, radio, local papers, flyers (letterbox drop), and school programs were also considered useful means for disseminating this information. Stakeholders such as service agents also saw the need for information on household chemical use, indicators of system failures and a choice of OWTS to be provided to residents.

While information is currently available from a variety of resources including the local councils and the South Australian Department of Health, the current level of householder understanding suggests these resources need be better promoted to the community and perhaps repackaged into more effective formats.

CONCLUSIONS

OWTS can be a potential source of contamination to the underlying groundwater and it is essential they are properly managed to prevent discharge of inadequately treated wastewater. The poor quality of effluent from AWTS and septic tanks in the Mount Gambier area has implications for public health and environmental protection, via contact with insufficiently treated AWTS effluent, or groundwater contamination (Levett *et al.*, 2009). Information from biophysical research has been supported by householder surveys, community workshops and interviews with stakeholders to elicit concerns about the management of wastewater systems. Many householders were not adequately equipped with knowledge regarding their system's operation, the impacts of household chemical use or the importance of regular maintenance, and did not conform to the four-yearly desludging schedule recommended in the Code (South Australian Health Commission, 1995) for septic tanks. Maintenance of AWTS in most cases was performed by a service professional, although it was not always performed regularly.

This study provides an increased understanding of how residents in the Mount Gambier region view personal responsibilities for their OWTS and how they respond to potential OWTS management initiatives. Local authorities and community members are interested in collaboratively developing management strategies aimed at preventing further contamination of

the groundwater. Thus, it is recommended that further community engagement is undertaken to develop an OWTS management strategy that is acceptable to the community, including appropriate changes to the local authorities' approval processes, possible new maintenance programs, and the most acceptable method for distribution of increased costs for wastewater management.

In the interim, there are clearly a number of recommendations arising from the community meetings that could be implemented to improve the current management regime, while also remaining valid under a revised management strategy. Local authorities could implement changes to administration of OWTS including improved data management and implementation of system audits. Householders also require information on OWTS regulations and system operation, guidelines for maintenance procedures and appropriate household chemical use. Ongoing research into contamination of groundwater sources by wastewater systems is also important as the community requested monitoring programs to assess the impacts of OWTS on groundwater quality, in order to substantiate the need for changes to the current management programs.

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