SO WHAT DOES "BEST PRACTICE" MEAN FOR MANAGING ON-SITE SYSTEMS?

Juliet Willetts and Cynthia Mitchell
Institute for Sustainable Futures, University of Technology, Sydney

Abstract

Environmental Health Officers (EHOs) charged with the responsibility of managing on-site systems face considerable challenges in this complex and rapidly developing field. One of these is that they need to keep abreast of best practice and innovation in the management of on-site systems. To do this, they need adequate, accessible and appropriately pitched information sources covering technical information and technological developments in this field. EHOs also need to know of innovative planning, regulatory and management strategies emerging across Australia, New Zealand and elsewhere, as well as effective communication strategies with householders and the wider community. The Municipal Association of Victoria (MAV) sponsored a project to fill this gap. The full set of information resources is available at www.clearwater.asn.au. Here, we provide a synthesis of the information collected and a current assessment of the essential elements to best practice management of on-site systems. We situate this synthesis in the context of a "soft path" approach to water and wastewater infrastructure that promotes matching infrastructure scale to need and capitalises on the benefits that on-site and decentralised systems offer.

Keywords

Best Practice: Local Government: On-site management

1 Introduction

In Australia and indeed elsewhere, small-scale systems are beginning to be considered long-term solutions to domestic wastewater treatment, re-use and disposal. In the past, there was always a sense of "waiting for the sewer to arrive" amongst both communities and regulatory authorities. This changing view of small-scale systems is bolstered by actions taken by the US EPA to support research into more effective and proactive management of such systems, so that they adequately protect public health and the environment (US EPA, 1997). Meanwhile, the concept of adopting a "soft path" approach (Lovins *et al.*, 2002) for the water and wastewater sectors is gaining momentum. A "soft path" entails matching infrastructure scale to need and revisiting the benefits that small-scale systems offer, and is consistent with looking to distributed strategies for solutions as well as large-scale infrastructure. Emerging analyses show the many cost and environmental savings of such approaches.

Today, the opportunity is to make sure that long-term sustainability requirements are supported by short-term actions. This paper presents an analysis of the immediate needs of Victorian Environmental Health Officers (EHOs) in local councils, and a synthesis of best practice management approaches for them. We provide insight into immediate, practical steps that enable distributed infrastructure to function at its maximum potential and enable it to be considered on an equal footing with large-scale approaches to wastewater service delivery.

2 Role of Local Government in Managing Domestic Wastewater

In Victoria, five stakeholders share roles in domestic wastewater management. They are the Environmental Protection Authority Victoria (EPA Victoria), local governments, water authorities, the Department of Sustainability and the Environment (DSE) and homeowners. EPA Victoria's role focuses on approval of designs and types of on-site systems, developing

and publishing the Septic Tank Code of Practice and establishing standards for discharge to surface water and off-site. Water authorities' role is limited to the treatment of sludge.

Local government Environmental Health Officers (EHOs), or public health officers, are primarily responsible for permitting and approval processes for new and existing systems and resolving issues associated with the overlap between planning processes and domestic wastewater (MAV, 2004). Hence, local councils are responsible for ensuring that new residential subdivisions without reticulated sewage consist of allotments capable of treating and containing domestic wastewater on-site. The permitting and approval processes are multi-faceted and reflect council's legal responsibility to ensure that public health and environmental risks are minimised. Councils issue (or refuse to issue) permits to install new systems according to site suitability and the system chosen. They are responsible for monitoring of existing septic tank systems. Local councils submit information to EPA Victoria about the number and types of systems in use and off-site discharge. Finally, councils identify towns that require reticulated or alternative sewerage systems.

Therefore, EHO roles and responsibilities toward on-site systems are diverse and complex, requiring geographically specific responses. In addition, on-site wastewater management is just one of many EHO roles. This presents a challenge both at the individual and organisational levels. In response to this challenge, MAV conducted a survey on the needs of EHOs in managing on-site wastewater. Three areas emerged: information management, community education and access to information sources and innovative management approaches to domestic wastewater. The project designed to address the latter is the subject of this paper. The next section describes the details of the information EHOs desired.

3 EHO Information Needs Explained

We provide some details here of the information needs identified by EHOs in MAV's survey in 2004. These needs are likely to be of relevance to EHOs in other States or to others who work with them to better understand their perspective. In addition, these needs, categorised in six key areas, provide background to the areas of best practice described subsequently:

1. **Technical Information** (treatment systems and their applicability, and methods of assessing land capability). EHOs need adequate information to be confident about matching different system types to site constraints. In addition, they need an explanation of maintenance regimes, responses to system failure and development pressure. Finally, EHOs would like to improve their ability to interpret land capability assessments.
2. **Technological Developments** (latest advances in the domestic wastewater field including new treatment methods and technologies that support domestic wastewater management). EHOs are interested in keeping up-to-date with new, different designs of systems and ways to upgrade off-site discharge systems cost-effectively. EHOs would like information on the range of systems available for new installations and upgrades.
3. **Innovation in Planning** (new strategies to improve planning for domestic wastewater). EHOs would like improved integration of planning for domestic wastewater management with other council functions, and better connections to relevant external organisations, including catchment management authorities, water authorities and State government departments. A desire exists to promote a more consistent (across the State) permit granting process and share operational and strategic planning issues and opportunities.
4. **Innovation in Management** (best practice management approaches for domestic wastewater, including risk management, information management and working with other agencies). Councils need resources to replace the hard-copy filing systems often used for domestic wastewater records and thereby improve data management. Time and resource constraints for EHOs mean that inspections often occur only after complaints and, in some councils, a contractor carries out inspections. On-site wastewater management resources

are directed to new on-site systems rather than management of existing systems which require improved, proactive and cost-effective management and monitoring.

5. **Regulatory Opportunities** (use of local laws and discussion of regulatory practices in other states and countries). EHOs currently feel they have little legal authority in the case of an owner who badly manages their septic tank. Councils have requested a more user-friendly Code of Practice to guide them. Such a Code would consider new and different designs, township wastewater management rather than only individual systems, and allow councils to enforce upgrades of old systems not compliant with current Codes).
6. **Homeowners and Community** (educational domestic wastewater materials and programs and methods for community participation). Councils recognise the importance of up-to-date information and support for residents but feel unable to provide it adequately. EHOs find that owners of septic tanks are unaware of the importance of good system maintenance. In addition, since responding to failed systems incurs a cost to homeowners, residents are often unwilling to comply with EHO requests. A lack of understanding in the community about more complex systems is common.

4 Methodology

The Institute for Sustainable Futures (ISF) was contracted by MAV to undertake a project to fill these information needs. From October 2004 to April 2005, ISF collected and reviewed information resources on domestic wastewater management, new developments and successful council initiatives that might be transferable to other councils within Victoria and beyond. These resources were identified through an email survey, telephone interviews and a literature search. The email survey was sent to all EHOs in Victoria, some councils in other States and established networks of small-scale wastewater professionals. Telephone interviews targeted "best practice" councils and wastewater professionals. The resources collected were filtered according to five criteria: the quality of the resource, its level of significance and innovation, relevance to the needs of EHOs, how well it was pitched to communicate to EHOs and its transferability across different local government contexts. The resulting group of innovative and best practice resources were documented, highlighting why a resource was chosen and its relevance to EHOs. The resources are available on the Domestic Wastewater pages of the Clearwater website (www.clearwater.asn.au). Although intended for Victorian EHOs, they will likely be useful for a much larger audience.

4 Descriptions of Best Practice

The sections below describe various best practice advances documented in the research process, providing a useful overview of the current state of the on-site field.

4.1 Technical information

Choosing the appropriate treatment system for a given circumstance remains an art, and the knowledge base to inform such decisions remains quite fragmented. Important factors include cost, land area, soil type and slope, level of complexity (and therefore required maintenance), level of treatment (quality of effluent) and so on. There are no 'perfect' systems as such, only different ones with different capabilities, strengths and weaknesses. In terms of best practice, it is essential to identify the key factors for a particular development, region or council area and to develop a means to ensure that key factors are taken into account in making decisions. Flowcharts and checklists can provide a useful structure to enable systematic decision-making in this instance (see for example, Gunn, 2004).

The many types of systems now available, while adding complexity, mean that no matter what the local environment, there will always be a small-scale solution available. This could mean using systems that obviate the need for the large disposal areas traditionally required for septic tank systems. The range of alternative systems includes, but is not limited to:

constructed wetlands (reed beds), aerated systems, re-circulating sand filters, pulse dosed aerobic sand filters, enhanced treatment oxidation systems, filtered septic tank systems, effluent landscaped sand mounds, waterless composting toilets, greywater systems, pump-out systems and evapo-transpiration trenches amongst others.

Some recent research focuses on sustainable lot density and making links between effluent quality and groundwater contamination (for example, Whitehead *et al*, 2003). Such research demonstrates just how location-specific treatment performance results are, and the need to choose treatment systems based on an intricate understanding of local conditions. Because there is a strong relationship between land capability and the standard of treatment, responses from councils can and should vary to reflect local conditions. In some cases, it may be appropriate to specify a minimum lot size. Where land capability is a constraint, councils could specify higher treatment standards, or a community-scale response. In terms of responses to system failure, the most obvious technical options include trouble-shooting the existing system(s) and/or upgrading the system by adding secondary treatment processes (e.g. additional filtration, constructed wetlands, or soil amendment) (Martens, 2001).

Conventional methods of determining dispersal areas required for septic tank or other systems were based only on hydraulics, sometimes including simple nitrogen and phosphorus mass balance calculations. These methods are not location specific, and may not give answers that reflect the field performance of a system once it is in place, owing to variability in how nutrients such as nitrogen and phosphorus are taken up within the soil, depending on soil type, slope or other physical attributes. The most recent innovative models originate from northern NSW, where Lismore City Council, and subsequently Byron Shire Council, have developed spreadsheet models that treat nitrogen in greater detail, and include location specific characteristics. These models could serve as a basis for councils in other areas, but would require parameters to be modified to reflect the local environment (i.e. waterways, soil types).

A clearer picture of best practice in terms of the technicalities of on-site wastewater treatment will likely emerge over the coming years, with improved documentation of performance in field trials conducted by councils and researchers and the knowledge base gradually increases.

4.2 Technological developments

Technological developments in the on-site field are diverse, incorporating developments in actual treatment technologies, as well as supporting management infrastructure, for example, technologies that enable efficient monitoring and information management.

Recent technological developments in single-lot systems are mostly focused around increased levels of treatment (secondary and tertiary) and the growing use of eco-sanitation. Eco-sanitation removes the need for water in dealing with human waste (see www.ecosanres.org). Composting toilets and urine separation technologies, which are examples of eco-sanitation approaches, are rapidly gaining popularity, particularly in parts of northern Europe (West, 2004). The major advantage of these systems is that nutrients are more readily available for re-use in agriculture, as well as water savings and reductions in cost and energy for treatment.

There is growing support for community or cluster-scale systems. Clusters might vary from just a few houses to twenty or so, sometimes more. Wastewater either undergoes primary treatment on-site, or is taken directly to a cluster-scale system. In the US, cluster systems are used more widely than in Australia, consequently greater experience designing and implementing such systems is available. Cluster systems raise different issues about selecting and planning systems; in particular, they require effective participatory processes to involve the various parties implicated (Clark, 2004). This scale of system has the scope to overcome many of the management problems associated with single-lot systems and to simplify

beneficial effluent re-use, whilst still meeting the sustainability objective of preferring treatment to transport.

As closer monitoring of on-site systems is initiated in Australia and elsewhere and the number of identified failing systems rises, the need for developments in retrofits and upgrades increases. This is, however, a recent phenomenon and there remains a significant research gap about how to cost-effectively deal with large numbers of failing systems. Current research in the US into how to improve septic tank performance seeks to address this lack. Adding a filter to septic tanks or amending the soil are potential solutions (Martens, 2001). Cluster or community-scale systems, particularly for secondary or tertiary treatment, might provide cost-effective solutions where septic tank/absorption systems are deemed inadequate for local conditions. Telemetry is increasingly used to monitor domestic wastewater systems, however, little information is available except from manufacturers or companies whose packaged systems include such capabilities. One Victorian council is trialling the use of a sludge detector to inform the required pump-out frequencies. Other, larger-scale projects are auditing a number of systems (for performance, householder maintenance practices and sometimes possible contamination), to create a baseline for monitoring processes (Beal *et al*., 2003).

Several Australian councils are starting to use geographical information systems (GIS) to map wastewater systems in their locality. The benefits are a robust data management system for domestic wastewater and better coordination of wastewater planning with other council functions. Using GIS enables a clear understanding of what systems are located where in relation to other environmental features such as waterways, varying soil types and slopes. This is an essential step to develop risk-based approaches to management (see 'innovation in management' area), particularly with respect to cumulative risk.

Best practice involves councils setting up integrated information management systems, which not only provide internal consistency and an ability to access information quickly (and send out necessary reminder letters to residents), but also to improve the quality and quantity of shared information with relevant agencies such as water authorities and catchment management authorities. Various proprietary systems are available and case studies of councils using such systems are provided amongst the resources.

4.3 Innovation in Planning

The emerging focus on domestic wastewater planning is relatively new to councils across Australia. The direction of best practice appears to be toward increased integration of domestic wastewater with other planning processes, and improved coordination of the relevant stakeholder agencies, organisations, community and individuals. Some excellent resources are now available. Firstly, the Municipal Association of Victoria's CD-ROM "Domestic Wastewater Management: a planning guide for local government" (MAV, 2004), which contains both a process to follow to achieve operational and strategic level planning, and case studies of a few Victorian councils in developing their plans. Secondly, the Septic Safe program in NSW developed the "Septic Safe Environmental and Health Guidelines" (Dept Local Gov., 1998) and related resources, all of which are useful in the planning context.

Various councils contacted during the collection of resources for this project noted the way in which wastewater increasingly was considered alongside other issues when other council planning processes were initiated, and how beneficial this approach had proved. Retrospectively considering how wastewater should be dealt with (e.g. when subdivision plans were already in place), has been highly problematic. Best practice involves implementing procedures that stipulate direct involvement of the relevant EHOs at appropriate points in council's planning processes, and mechanisms to ensure that EHOs are equipped with sound knowledge to argue coherently the possible domestic wastewater options and constraints. Council areas of responsibility where integration is likely to be worthwhile

include building, town planning, environmental planning, public health, strategic land use planning, stormwater management and infrastructure development.

An example of a best practice planning initiative is that conducted by Murrindindi Council, Victoria (Murrindindi Shire Council, 2002). This planning project successfully involved the Council, the community, the Environment Protection Authority, Department of Sustainability and the Environment, the relevant water authority, the relevant catchment authority, Lands Victoria and Melbourne Water. This project received specific funding, which supported its ability to coordinate these related but disparate groups. Smaller collaborations between stakeholder groups are possible without specific funding, and rely upon establishing good relationships with other agencies and developing synergies.

4.4 Innovation in Management

The latest national and international approaches to managing domestic wastewater begin with a growing acceptance of small, single-lot and cluster systems as valid long-term alternatives to sewers and centralised systems. Decisions about the most appropriate scale system for sustainable management of domestic wastewater for a given location are complex. Growing support exists for smaller scale systems versus large-scale sewerage, owing to the demonstrated advantages in closely matching capacity to need, flexibility to recycle water, qualitatively different risk profiles and community involvement at a local level. In addition, they are often the most cost-effective solutions. Based on this outlook to the future and the fact that such systems are here to stay, the need for proactive, carefully planned management of such on-site and cluster systems becomes paramount.

An innovation evident in the US and New Zealand is centralised management of on-site and cluster systems. This approach uses a similar model to centralised systems, in that an organisation (which might be a local council or equivalent, or a water authority) takes responsibility for looking after aspects of the management and particularly, operation and maintenance. Such a management structure has many benefits, both for homeowners who are released from responsibility for their individual system, and on a larger scale in terms of cost-effectively applying risk management and asset management approaches to inform long-term investment for optimal performance of such systems (Etnier *et al.*, 2005).

Effective data management is an essential element of best practice management of on-site systems. Some councils have already started using proprietary databases and electronically entering information pertaining to the systems they manage. Such data management systems allow them to follow-up easily on maintenance (e.g. septic-tank, monitoring, de-sludging, response to re-zonings) and can be designed to promote information-sharing between agencies. An example of the former is that automatic letters can be generated and sent to residents who need their system de-sludged. An example of the latter is coordination with local water authorities through use of common databases and digital input of information, which reduces the workload to all parties and enables regional initiatives (e.g. with regard to septic tank de-sludging). Extensions to basic data management are also possible. Firstly, electronic data management systems integrated with a GIS interface create the potential to examine and resolve management issues at a catchment scale. Secondly, as performance assessments become more common, the resulting information can be stored alongside permitting and approvals for given systems, gradually initiating an “asset management” database capable of informing long-term management decisions (Etnier *et al.*, 2005).

Best practice today usually involves some sort of risk management approach. Much recent research in the on-site field has focused in this area, resulting in the development of a range of modeling programs. The most widely known in Australia is OSRAS (on-site risk assessment system) and its successor OSRAS Rev 2. These processes usually incorporate layers of relevant information into a geographical information system (GIS) to enable identification of

likely contamination sources, or to chart out areas according to their relative environmental or public health 'risk'. Available resources can then effectively be targeted to highest risk areas and lower levels of management assigned to low risk areas. A comprehensive strategic decision-making process is necessary to make effective use of these tools. Such a process is described by Etnier *et al* (2005) in their risk management-asset management framework.

4.5 Regulatory opportunities

A few examples exist of local laws to give councils increased power to enforce good management. This means that although in the current regulatory framework councils have limited legal rights, such local laws can fill this gap and give councils the authority they need to manage issues effectively and ensure homeowners appropriately manage their systems. Complexities, however, will always exist. The costs involved with upgrading or replacing a malfunctioning system may be too high to be borne by an individual homeowner, and hence, other mechanisms are needed, hand in hand with such local laws, to address equity across communities and to enable such local laws to be reasonably enforced.

State-level on-site regulations and guidelines are subject to on-going changes and improvements. The current Victorian "Septic Code of Practice" released in 2003 already likely needs revision to keep up with changes in best practice such as those described in this paper. In Queensland, there is a move toward performance based regulation. In NSW, the guidelines produced in 1998 are currently being updated and interim guidelines for grey-water and sewage in multi-unit dwellings have recently been released. In all States and through a national roundtable of on-site regulators, there is on-going debate about how to create regulations that are practical and feasible to attain, whilst taking into account the need for locally-based solutions and the large range of possible technologies that have the potential to achieve the treatment standards required for safe disposal of domestic wastewater.

Developments in the USA and northern Europe provide insights to regulatory best practice. In the USA, in 2004, a draft, model performance code was recently adopted, which initiates the shift from prescriptive based regulation (which has proved to be problematic in both the US and Australian contexts) to performance based regulation (NOWRA, 2004). This is a national document aiming to inform and support a state-level regulatory framework. Some northern European examples demonstrate management of both urine and faeces, including obligatory urine separation policies for some areas.

4.6 Homeowners and Community

Interacting with homeowners and community with respect to domestic wastewater presents many challenges. Best practice approaches are needed both to generate adequate interest in collectively solving community wastewater issues, as well as to engender commitment and action on the part of individuals who own on-site systems to keep them in good working order. Development and dissemination of materials has been the community education method most commonly employed by councils. Best practice involves not only improving the quality of such materials, but also creatively generating other approaches to effectively involve community members and facilitate behaviour change. For example, Byron Council developed an educational video. In reality, inclusive, participatory processes for decision-making about wastewater planning and management are probably one of the most effective ways to engage the public comprehensively in domestic wastewater treatment. Meaningful participation in decision-making both improves people's understanding of the complex issues involved and empowers them to voice their views and to influence decisions on the risks and inevitable trade-offs that must be made in this as in any field of endeavour.

5 Conclusions: Where to Now?

The consolidated set of practical information resources is in a readily accessible format for Victorian EHOs and others to use. It will be important to evaluate its usefulness in a few years, and to add to it as innovations and developments take place. Some further research needs were identified in the research process. These include information about interpretation of land capability assessments, detailed research into existing regulations in Australia and elsewhere, including study of the impact of regulations, guidelines for dealing with failed systems and evaluation of the effectiveness of different approaches to community involvement and education about domestic wastewater issues. The key opportunity is to ensure that short-term decisions are consistent with the long-term soft path objectives identified at the outset of this paper.

Acknowledgements

Acknowledgement is made to staff of the Municipal Association of Victoria: Nathaniel Muller, Simon Holloway, Jacquie White and Nina Keath. The insight and commitment shown by MAV is to be congratulated. Thanks are warmly extended to the many people who contributed resources. The contribution of Harriet Westcott is gratefully acknowledged.

References

Beal C, Gardner T, Christiansen C and Beavers P (2003) Task 1 of audit of non-sewered areas in South-East Queensland, Prepared for Moreton Bay Waterways & Catchments Partnership. Available on http://www.clearwater.asn.au, Accessed 31.5.05

Clark, M (2004) The Art of Negotiation with Private Landowners for Municipal Cluster Systems, US National On-site Wastewater and Recycling Association (NOWRA) 12th Annual Conference and Exposition, Available on http://www.clearwater.asn.au, Accessed 31.5.05

Dept Local Government (1998) Septic Safe Environmental and Health Guidelines, prepared by Environmental Protection Authority, Department of Health, Department of Urban Affairs and Planning, Department of Land and Water Conservation. Available on http://www.clearwater.asn.au, Accessed 31.5.05

Etnier C, Willetts J, Mitchell CM, Fane S, Johnstone S (2005) Decentralized Wastewater System Reliability Analysis Handbook. Project No. WU-HT-03-57. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington Univ., St. Louis, Missouri, Stone Environmental, Inc., Montpelier, Vermont: 2005.

Gunn, I (2004) Selection and implementation guidelines: Wastewater servicing for single houses and small communities in rural areas, February 2004, Available on http://www.clearwater.asn.au, Accessed 31.5.05

Lovins A B, E K Datta, T Feiler, K R Rabago, J N Swisher, A Lehmann, and K Wicker (2002) *Small is Profitable*, Rocky Mountain Institute

MAV (2004) Domestic wastewater management: a planning guide for local government. CD-ROM

Martens, D (2001) Enhancing nutrient removal of existing systems, Proceedings from On-site 01: Advancing On-site Wastewater Systems: design and maintenance, Armidale

Murrindindi Shire Council (2002) Flowerdale area improvement program: Evaluation report

NOWRA (National On-site Wastewater Recycling Association) (2004) Draft model performance code report. Available on http://www.nowra.org/ or http://www.clearwater.asn.au, Accessed 31.5.05

US EPA (1997) *Response to Congress on use of decentralized wastewater treatment systems,* U.S. Environmental Protection Agency, Office of Water and Office of Wastewater Management, Washington DC

West, S (2004) Innovative on-site and decentralised sewage treatment reuse and management systems in Northern Europe & the USA: Report of a study tour, Available on http://www.clearwater.asn.au, Accessed 31.5.05

Whitehead J H, Geary P M and Saunders M (2003) Towards a better understanding of sustainable lot density: evidence from five Australian case studies, Proceedings of On-site 03: Future Directions for On-site Systems: best management practice, Armidale