RESULTS OF AN AUSTRALIA WIDE MAIL SURVEY OF EXISTING ON-SITE DISPOSAL SYSTEMS

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Abstract

This mail survey has sought information on the type, performance, merits, problems and management needs for the main on-site effluent disposal systems used within Australia. The survey had some limitations which included political sensitivity, environmental sensitivity, a restricted time schedule, a limit of five to six questionnaires per State and the performance ratings were largely based on subjective judgement and experience.

The response varied considerably, some authorities supplied very detailed information, others supplied adequate information and a few offered information that was difficult to constructively report. The response has involved a broad range of effluent disposal systems operating under widely varying climatic and site conditions. There are some technical, management and educational problems to overcome. The recently introduced AS/NZS 1547:2000 is expected to assist with site and soil assessments and effluent disposal management.

Keywords

evapotranspiration, infiltration trenches, irrigation, mail survey, on-site effluent, questionnaire

1 Introduction

The assessment of existing on-site effluent disposal systems is an on-going need. The issue as to whether the system is appropriate to the site and climatic conditions is often questioned. Comprehensive studies of alternative effluent disposal systems, at an on-site scale, have not been widely undertaken within Australia. Traditionally this type of work has been undertaken in North America.

It is recognised that the information sought on effluent disposal systems may be politically and environmentally sensitive for some Councils and Authorities. For this reason the systems covered in this mail survey have not been directly identified with the local authority or organisation that contribute to the survey.

2 Objectives

So that the information collected in the questionnaires could be analysed and the outcomes presented in this paper, the following procedures were undertaken to:

1. undertake a mail type survey of on-site effluent disposal systems commonly used within Australia. This included a limited number of trial systems;
2. note and discuss the performance of effluent disposal systems;
3. note the merits and problems encountered;
4. note management and educational needs;
5. assess the site suitability of system types; and
6. identify potential improvements to existing systems or optional disposal systems, based on the outcome of the survey.

3 Methodology

The methodology used was to contact various universities, key local authorities, State Government Departments and water authorities, and provide them with a detailed questionnaire regarding the disposal systems known to be used in their area. These various contact organisations then invited Councils and water authorities involved with on-site treatment and disposal systems to complete the questionnaire and return it to the writer. The questionnaire included the following aspects of on-site effluent disposal systems:

- type of system
- approximate age of the system
- soil types prevailing
- specific site and /or climatic suitability
- system areas, depths and widths
- management needs
- pre-treatment and/or polishing system used
- degrees of performance rating (1 being the lowest to 5 being the highest)
- suggested performance modifications
- typical flows
- aggregates and other materials used
- potentially feasible option

The information collected was organised into system categories, analysed with respect to the various objectives and summarised in Tables 1 and 2. The effluent disposal categories covered a range of systems known to operate within Australia. These included more traditional or conventional systems as well as more recent and innovative developments.

4 Survey Returns

The following Councils and authorities returned questionnaires:

- Brighton Council, Tasmania
- City of Blue Mountains, NSW
- City of Mandurah, WA
- Huon Valley Council, Tasmania
- Launceston City Council, Tasmania
- Mitchell Shire Council, Victoria
- Redland Shire Council, Qld
- Wingecarribee Shire Council, NSW
- City of Ballarat, Victoria
- City of Gosnells, WA
- Department of Human Services, SA
- Kingston District Council, SA
- Maroochy Shire Council, Qld
- Port Stephens Council, NSW
- Sorell Council, Tasmania

Questionnaires were sent to 32 councils or authorities in total, amounting to 5-6 in each state. The survey response was calculated to be 47%. It can be seen from the above list that the response varied with each state.

The types of systems reported and rated included the following broad categories:

- Shallow infiltration trenches and beds
- Leach drains
- Alternate dosing trenches and beds
- Surface irrigation
- Sand filters
- Brick pits
- Deeper trenches
- Mounds
- Mulch and garden beds

5 Mail Survey Limitations

It was appreciated that that the mail survey would have some limitations, mainly due to the restricted time to collect and report information. More specific limitations include:

- The mail survey was targeted to a limit of five to six invitations from each State, due to the restricted time to send out returns, analyse them and compile the paper.
- The detail requested within the survey was limited due to restricted time schedule.

- In some cases information could have been politically and/or environmentally sensitive.
- The assessments were largely subjective and based on experience.
- The rating of effluent disposal systems was also subjective.
- The program has been undertaken by various individuals within each Council or Authority, rather than by an individual undertaking the entire survey and ratings.
- It was appreciated that staff resources are often limited, therefore the questionnaire had to be reasonably concise
- Due to limited time scale it was not possible to validate the information collected
- Some respondents did not fill out the questionnaire completely and some of the sections were poorly completed.
- The detail and quality of the information provided varied considerably, some respondents showed much enthusiasm and supplied detailed information, whereas others tended to treat the questionnaire as a chore and time consuming exercise.

In most instances it was expected that the respondents did not have specific statistical or numerical information. The respondents had to rely on local knowledge and reported performances and problems.

6 Survey Outcomes

A significant amount of the information supplied in the survey has been presented in a summary form in Tables 1 and 2. Some of the detail has not been reported as it would have been difficult to do so without particular reference to the Council. The information not reported was largely of a political or environmentally sensitive nature, for example, specific incidences of failures or water pollution. However, given more time the Council or Authority could have been contacted and consent obtained to report this more sensitive information.

Table 1 covers the system age, pre-treatment, effluent standard, permeability, performance rating, soil type and supporting comments. Table 2 focuses on management needs and it suggests modifications to improve the system performance and its sustainability. Some of the design and operational problems, environmental concerns, suggested modifications and management needs have been mentioned further in Sections 7, 8 and 9.

7 Environmental & Management Aspects

The outcome of the questionnaire has revealed several environmental problems and management needs. Typical environmental concerns raised by Councils and Authorities included the following:

- effluent systems can be sources of groundwater contamination, particularly in perched or higher watertable situations
- the need to consider higher degrees of treatment, that is, aerobic type, with higher reductions in organic matter, solids, nutrients and pathogens.
- known environmentally sensitive areas require careful consideration by the use of higher degrees of treatment with more sustainable disposal systems.

It is interesting to note that the survey did not contain concerns about odours and the risk of direct human contact with wastewater or effluent. Management deficiencies included the need for a trained and competent workforce and specific budgets. There is a need for technical and financial resources to allow routine monitoring and performance assessment.

Owner education, with respect to the functioning and maintenance of wastewater treatment and effluent systems, is still seen as a need by some councils. Water conservation programs, similar to the Waterwise program in Queensland, should be promoted more.

In some instances there is a need to update the effluent disposal approval systems.

Due to the widely varying response to the questionnaire it has not been possible to produce statistics with reliability on the question of environmental and management aspects.

8 Problems Highlighted

Typical design, operational and maintenance problems raised by the Councils and Authorities included the following:

- The need to desludge pump chambers.
- Solids carry over from pump chambers and septic tanks.
- Solids carryover generally is an ongoing and important problem (many Councils reported the benefit of in-tank effluent filters as means of reducing this major problem)
- Lack of maintenance of surface irrigation systems.
- The need to modify trenches, by increasing the width and decreasing the depth, to enhance disposal by evapotranspiration
- The need to regularly move irrigation sprinklers to prevent ponding.
- The need for more reliable pump and control systems.
- Lack of signage for surface irrigation systems.
- The need for public and owner education on the functioning and maintenance of treatment and effluent disposal systems.
- The need to conserve water hence, requiring a smaller effluent disposal system.

9 Optional & Innovative Effluent Systems

As mentioned earlier, it has not been possible to produce reliable statistics on the above reported problems since the information submitted varied considerably.

It is the opinion of the writer that there is a need to develop additional effluent disposal systems, rather than to continue to rely on the use of conventional trenches, beds and irrigation fields. Practitioners have a responsibility to keep abreast with technological developments. This should include improving the functioning and sustainability of effluent disposal systems. Conventional or traditional systems could be modified or emerging systems further developed so they become viable options for effluent disposal.

The Councils have offered the following suggestions for improving existing systems or developing new concepts:

1. The intermittent dosed sand filter, receiving septic tank effluent, followed by a sub-surface wetland (reed bed) is producing very interesting results in terms of BOD, suspended solids and coliform reduction.
2. Pressure distributed surface irrigation beds, covered in mulch or bark.
3. Pump applied effluent beds and trenches, facilitating the dose and rest concept.
4. Deep ripping and applying gypsum, at the time of constructing trenches and beds in problem soils.
5. Using shallower and wider trenches and beds, designed to enhance disposal by evaporation and transpiration.
6. The use of filters in septic tanks to improve suspended solids reduction and minimise solids carry over has been suggested by many councils.
7. The use of designed sand mounds, for example the ECOMAX concept, for areas with climatic and site constraints has been suggested by several councils.

8. The importing of amended soils to enhance the performance of effluent systems.
9. The use of composting plants with satisfactory sullage treatment and disposal systems.
10. Precast concrete and PVC leach drains, using geotextiles, particularly in confined sites with lower groundwater levels.
11. Improved designs for brick pits or porous concrete risers, used in confined sites with lower groundwater levels.
12. The use of effluent filters in septic tanks so smaller diameter pipes can be used to improve distribution.

10 Conclusions

Given the large coverage of the Australian continent and the wide range of geographic, demographic and climatic conditions this mail survey has revealed a broad range of effluent disposal systems.

It has become apparent over more recent times, particularly within local government, that technical and marketing mail surveys are frequently undertaken, hence in some cases there is a resistance to completing questionnaires since it is seen as being an imposition.

It is apparent that in most instances systems have been or are being developed to suit particular site conditions.

It is possible that some effluent systems suit particular climates and they could be used in other States with similar climatic conditions.

It is expected that the new joint standard will greatly assist in the site assessment, soil assessment, design and maintenance of new wastewater treatment and effluent disposal systems. It is apparent, that at the time the questionnaire was conducted, several Councils were not familiar with AS/NZS 1547:2000, since many of the concerns raised have been addressed with this new joint standard.

The mail survey has identified some technical, management and educational problems. It is evident that some improvements and modifications could be made to existing effluent systems. The survey has also identified some potential effluent disposal options for some Councils and Authorities to investigate.

Acknowledgment

The assistance given by the initial contact organisations and the local authorities that submitted survey returns is most appreciated.

TABLE 1 SUMMARY OF EFFLUENT SYSTEM CHARACTERISTICS & RATINGS

CATEGORIES	Age (yrs)	Pre-treatment type	Effluent standard	Soil type	K (m/d)	Site suitability	Rating [1]	Comments
Absorption trench		filtered septic tank	primary	clay loam	0.5-1.5	suited to more sandy soils	3	
Absorption trench	50+	septic tank	primary	all types		not suited to shallow low permeability soils	1	55% failure rate, being phased out
Absorption trench	25	dual septic tanks	primary	light clays	0.06-2	high-medium permeability	3	< 8° slope
Absorption/ET[2]	10-15	septic tank	primary	sandy loam	>3.0		2	
Alternating beds	0.3	various	primary	clay soils	<0.01	not suited to steep slopes	2	management of alternating system required
Brick pit	25	septic tank	primary	duplex soil	high	only sandy soils with deep ground water	3	rarely used now, often used in confined spaces
Deeper trenches	3	septic tank	primary	fractured mud, silt stone	0.05-1	exposed areas	5	5-8° slope
ECOMAX[3]	1-2	septic tank	primary	all types	range	suitable for sloped and flat sites		
ET bed + surface irrigation	10	septic tank	primary	clay loam - light clay	0.06-1.5	lower permeability soils	4	for sullage only
Infiltration bed	10	septic tank	primary	all types	0.01-0.1		3	not suited to steep slopes
Infiltration bed/trench	100+	septic tank	primary	sandy soils	high	suited to sites with permeable soils	3	keep clear of flood prone areas
Infiltration trench – alternating	0.7	various	primary	sandy/silty clay or better	0.01-0.5		2	management of alternating system required
Leach drain - nutrient retention	10	septic tank	primary	sand	high	suited to high water table	5	suitable for sensitive areas; amended soil required
Leach drains	60+	septic tank	primary	sand	high	suited to sandy soils		>1.2 above ground water
Modified leach drains		dual septic tanks and HWWTP[4]	secondary	sandy, heavy	range		4	<5% failure rates
Overland flow	10+	sullage tank	primary	sandy-clay loam	0.06-0.6		4	for sullage only, occasional problems
Pressure irrigation - mulch covered	4+	HWWTP	secondary	sandy-clay loam	0.06-0.6			performance to be assessed

[1] Performance rating based on 1 to 5, 1 being poor and 5 being excellent
[2] Evapotransporation beds/trenches
[3] ECOMAX raised bed system
[4] Home Waste Water Treatment Plant

CATEGORIES	Age (yrs)	Pre-treatment type	Effluent standard	Soil type	K (m/d)	Site suitability	Rating [1]	Comments
Recirculating sand filter	2.5	septic tank	secondary	all types	range	exposed areas, silty sandy clays	5	5-8° slope
Sand mounds	5	septic tank	primary	all types	0.01-5	suited to low permeability soils, high water tables	4	generally not used on sloping sites >8°
Shallow infiltration trench	50+	septic tank	primary	loam and sandy	range	broad, lower ground water + rock	4	<10° slope
Shallow infiltration trench		septic tank	primary	loam - rocky	0.06-2		3	trenches installed along contours
Shallow infiltration trench	5	septic tank	primary	duplex soil	0.01-1.0	good in duplex soils to maximise upper horizon	4	not suited to very steep slopes; most soils
Shallow infiltration trench	3	HWWTP[2]	secondary	clay loam	0.5-1.5		2	can have root blockage problems
Shallow subsurface irrigation	2	septic tank	primary	silty clay	<0.06	exposed areas all soil types	4	5-10° slope
Shallow subsurface irrigation	3	septic tank	primary	duplex soil	0.1-1.0	flat sites, terracing required on slopes	4	for sullage only
Slow sand intermittent + wetland	1.5	septic tank	secondary	silty clay	>0.06		5	dispersive clay
Subsurface irrigation	0.5	filtered septic tank	secondary	all types	range		5	system being trialed, 5-8° slope
Surface + subsurface irrigation	10	HWWTP	secondary	all types	0.06-2.8	suitable for smaller blocks	5	preferred subsurface system
Surface irrigation	10+	HWWTP	secondary	sandy loam/ light clays	0.06-3.0	varied	2	steep contours are a constraint
Surface irrigation	12	HWWTP	secondary	loamy - heavy clay	range	broad	4	<10° slope
Surface irrigation	10	HWWTP	secondary	sand	high	high permeability soils	5	soil imported at times
Surface irrigation		HWWTP	secondary	all types	range	cultivated topsoil over irrigation area	3	not suited to steep slopes
Surface irrigation/raised garden bed	3	HWWTP	secondary	loam	1.5-3	suited to a range of sites	5	no failures reported
Surface irrigation/raised garden bed	4+	HWWTP	secondary	sandy-clay loam	0.06-0.6			performance to be assessed

[2] Home Waste Water Treatment Plant

TABLE 2 SUMMARY OF EFFLUENT SYSTEM MANAGEMENT NEEDS & SUGGESTED MODIFICATIONS

CATEGORIES	MANAGEMENT NEEDS	SUGGESTED MODIFICATIONS
Absorption trench	Trenches rested if possible. Use shallow trenches to promote ET. More regular pump out of septic tanks. Replacing trenches. Use dual trenches and alternating.	Install filters in septic tanks to reduce solids.
Absorption/ET		Try pumped distribution to improve life and performance.
Alternating systems - general	Public education needed.	
Brick pit	Rarely installed now. Check not polluting groundwater.	Possible application in confined sites
Deeper trenches	Similar to shallower trenches and beds.	3 year trial being undertaken. Could be more effective in areas with shallow soil pans.
ECOMAX	Not specifically mentioned in survey returns.	Worth trying in other areas.
ET bed + surface irrigation	More public education needed. Ongoing assessments.	Use of septic tank filters.
Infiltration bed	As mentioned in this table.	Larger trench areas required than previously specified. Try smaller distribution pipes – use tank filter to avoid blockage.
Infiltration bed/trench	More regular pump outs.	Use larger capacity septic tank with filters.
Infiltration trench - alternating	Use larger areas, in line with new joint standard.	Incorporate inspection openings. Deep ripping of disposal surfaces during construction. Gypsum treatment of soils.
Leach drain - nutrient retention	Not mentioned in survey returns.	Import nutrient (P) retentive sandy soils. Use amended soils.
Leach drains	Ensure at least 1.2m above groundwater .	Use dual drains and alternating. Use precast concrete and PVC drains with geotextile.
Modified leach drains	Not reported.	
Overland flow	Been operating 4 years in good soils. Owner education required. Site monitoring required.	
Pressure irrigation - mulch covered	Owner education needed.	Most suited to flatter slopes. Avoid long beds due to pressure distribution.
Recirculating sand filter	Owner education needed.	
Sand mounds	Cleaning of filter. Ensuring tanks pump out.	Use effluent filter in tanks. Use of smaller diameter pipes.
Shallow infiltration trench	More frequent desludging of septic tanks. Avoid tree root problems.	Distribution box beneficial for longer trench requirements. More frequent rotation of trenches.
Shallow subsurface (sullage)	Improved overall performance.	Flush distribution lines annually.(3 year trial) Use sullage tank filter.
Slow sand intermittent + wetland	De-sludge pump pit annually. Check system 6 monthly.	Nil.
Subsurface irrigation - general	As mentioned in this table.	Using pipework designed for effluent disposal.
Surface + Subsurface irrigation	As mentioned in this table.	Assess the best option for each site.
Surface irrigation	Better effluent distribution. More care of irrigation field. Need signage. Replace faulty sprinkler heads. Work well in some areas	Use cultivated soil over irrigation area.
Surface irrigation/raised garden bed	Replacing diseased or dead species.	