

DOMESTIC WASTEWATER MANAGEMENT PLANNING IN VICTORIA: WHERE CAN I BUILD MY DREAM HOME?

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ABSTRACT

In Victoria, Local Government is the approval authority for domestic wastewater systems. This inspection and approval process has traditionally been permit driven and local governments have rarely had the time or resources to strategically review the potential environmental impact that the discharge of these wastewaters could have on the township's water resources and downstream catchment. For the Shires of Glenelg and Corangamite the domestic wastewater management planning process provided an excellent opportunity to take a step back from the traditional permit dominated approach for domestic wastewater approvals and to undertake a strategic review of the development potential of allotments in six unsewered towns.

Using a blend of GIS techniques and onsite expertise, we looked at the towns strategically by evaluating each block according to its ability to sustainably deal with wastewater onsite. Mapping inputs to the model included soils, hydrogeological and groundwater information where relevant and available, aerial photographic images, rainfall and evaporation, cadastre (block size), surface waters, slope and existing dwellings. Australian Standards AS/NZS 1547:2000, the Victorian EPA Code of Practice – Septic Tanks (EPA, 2003) and EPA guidelines for on-site systems (EPA draft, 2007) provided the sizing criteria for effluent disposal fields. For trench and irrigation technologies, the sustainability of blocks was modelled and then mapped according to a traffic light principle – red having limited development potential, amber being sustainable for a two bedroom home, and green being sustainable for a three bedroom home (or possibly more).

The maps illustrated a range of problem characteristics. Some towns were experiencing minor problems, other towns had the potential for major problems if fully developed in the future, and in other towns there were clusters-of-concern. Because there is no Act of Parliament that would allow a Council to apply any environmental standard retrospectively, the maps provided a focal point for understanding where sustainability outcomes could be improved through community education, technology solutions, engineering solutions, or some combination of these. As a day-to-day tool, the Shires will use the colour coded maps as a referral trigger for individual permit applications.

Keywords: Conflict resolution, domestic wastewater planning, environmental planning, GIS, mapping, soils, strategic planning

INTRODUCTION

Small unsewered towns represent one of local government's most difficult challenges. In the 1990s the Victorian Government targeted towns with populations exceeding 500 for sewerage. But towns smaller than that are often uneconomical to sewer, and it would be expensive for dwelling owners to upgrade their wastewater systems from septic tanks to aerated wastewater treatment systems (AWTS). In many places, septic systems were installed as a stop-gap between night cart systems and sewerage schemes. Often sewerage schemes never eventuated, leaving whole towns subdivided into blocks too small to sustainably dispose of wastewaters onsite. In some places, older split systems that treat blackwater only may appear to be performing adequately, but this is often because greywater (the major component of wastewater) is disposed of to the stormwater system or the kerb and channeling. In other places, onsite systems appear to be performing adequately because highly permeable sandy soils are very effective at disposing of effluent, but not at treating it. Significant numbers of onsite systems predate the 1988 amendment to the Victorian Environment and Planning Act (1970) which, together with subsequent EPA Septic Tank Codes of Practice deal with onsite sewerage systems. Consequently many small towns are environmentally unsustainable and so are potential health hazards.

Strategic planning for small towns is complex because there are so many looming drivers for small town growth that planners and environmental health officers need to consider. These drivers include housing affordability, improved availability of broadband internet, and climate change. In the future, it is possible that many coastal towns will be vulnerable to sea level rises and other towns might need to accommodate displaced populations. Strategic planning decisions made now, that constrain or encourage development in small towns, may have serious implications for a society affected by climate change.

Often in the eyes of the public, small towns (particularly in coastal areas) provide an opportunity for affordable, lifestyle-focused living. These typically have numerous vacant allotments and are therefore potential places to build a Dream Home (a deliberately emotive term). In many places, there are ready-made subdivisions that lead to a justifiable expectation that this should be possible. Such subdivisions were often appropriate for their time, but if not connected to town sewerage, are unsustainable when assessed against present government and community expectations. Dream Home planning applicants who have lived predominately in areas that have access to reticulated sewerage are commonly unaware that where sewerage is not provided, they will be required to install a system that is capable of treating and then retaining all of the domestic wastewater onsite, and often have not budgeted for these systems.

In Victoria, when onsite wastewater systems are required, Local Government is the Responsible Authority for permitting the installation of onsite wastewater treatment plants. The harmony between those involved in the Dream Home proposal and Council often diminishes when a residentially zoned site does not have access to reticulated sewerage and the allotment is too small to deal with all of the domestic wastewater generated from the proposed dwelling. The result is increased tension between the permit applicant and the approval authority, and may even result in referral to Victorian Civil and Administrative Tribunal (VCAT). A common precipitant to tension occurs on sandy soils. Too-often Local Government is presented with Land Capability Assessments for small allotments that confuse wastewater disposal with wastewater management. Wastewater management consists of two critical elements, treatment and then disposal. Simply using soil percolation rates to determine a site's ability to manage wastewaters onsite is misleading and potentially environmentally disastrous if they do not consider the potential impacts on nearby groundwater bores, or the location of the seasonal water table.

To clarify the sustainability of unsewered allotments in their towns, the Shires of Glenelg and Corangamite sought to have each allotment color-coded to represent its development potential. The aim was to ensure that any potential obstacles to domestic wastewater management were highlighted to all stakeholders (Dream Home applicants and land capability assessors, existing home owners, land developers, and the approval authority) where ever possible. This was done in the hope that this information would facilitate informed decision making regarding the siting of Dream Homes and the type and location of onsite wastewater systems.

This paper describes the process for determining the development potential of allotments and discusses how this information can subsequently be used in the domestic wastewater planning process. It also highlights the limitations of legislation and policies in the process and describes a multi-faceted approach to dealing with these limitations that we hope to take.

THE GLENELG AND CORANGAMITE DOMESTIC WASTEWATER MANAGEMENT PLANS

Seed funding for the Glenelg Domestic Wastewater Management Plan (Shire of Glenelg, 2009) and Corangamite Domestic Wastewater Management Plan (Shire of Corangamite, 2009) was provided by the Department of Sustainability and Environment. The Domestic Wastewater Management Plan (DWMP) concept seemed simple enough - a process which was initially expected to take six months to complete, but in fact took two years. One reason it took so long was that it was necessary to create a new set of tools to assist in changing the perception that an allotment in a township zoned Residential is as-of-right suitable for the development of a three or four bedroom dwelling – it may not be.

The plans' development was undertaken in two phases, the first of which began in 2006. This phase was informed by Section 4.3 of the EPA's draft Septic Tank Code of Practice (2007). This section relates to reticulated sewerage versus onsite sewerage and states that "the feasibility of providing reticulated sewerage should be seriously considered for the development of individual lots and for subdivision proposals which would result in allotments smaller than 10,000 m²". Around 95% of all allotments in the Shires' towns were smaller than this risk threshold and were unlikely to be seweraged within the next five or even ten years. The first task involved the prioritization of individual towns and was undertaken by Mr. Larry White (White L, 2006a; White L, 2006b). Towns were classed as High, Medium or Low risk on the basis of criteria such as soils, slopes, location of water bodies, watercourses and water tables, allotment size, nature of existing developments, number of vacant allotments, zoning, and method of domestic wastewater disposal (reticulated sewerage available/or likely to be provided within 5 years). Following review of Mr White's risk assessments, the Shires nominated six towns for GIS modelling. In the Shire of Glenelg the towns were Allestree and Duttons Way, Cape Bridgewater and Nelson, and in the Shire of Corangamite the towns were Derrinallum, Lismore and Princetown.

The second phase was undertaken by two of the authors of this paper, Mr Ian Allan and Dr Robert van de Graaff (van de Graaff R and Allan I, 2008a; van de Graaff R and Allan I, 2008b; van de Graaff R and Allan I, 2008c). It involved detailed spatial modelling in each of the six high risk towns using a method akin to that coincidentally prescribed by Victoria's Auditor General (2006, p.52). To do this, we further developed Geocode's in-house MapInfo OnSite software. The software allowed us to model the implications of various

development scenarios in ways that accounted for EPA siting requirements (EPA, 2003) and disposal area requirements as prescribed by AS/NZS 1547 (2000). We created map models for entire towns to identify individual blocks and clusters of blocks that are currently or (in the case of vacant allotments) have the potential to cause wastewater problems. Map inputs to the model included buffers from surface waters, steep slopes, soils, buffers from adjoining allotments, block size, disposal area, reserve area of equal size to the disposal area, and a constant 450 m² of impervious surfaces. These are maps of wastewater performance in terms of surface runoff potential and do not account for impacts on groundwater. They illustrate that the development potential of a block is sensitive to its size, environmental constraints, soil and the wastewater technology used. Wastewater technology is a very important consideration because when properly designed, increased development potential is implied when irrigation systems are used. There are two reasons for this. The first is that in order to avoid clogging of the irrigation drippers, wastewater must first be treated to a higher standard than would be acceptable for trench disposal. This wastewater is pumped and hence even dosing occurs automatically throughout the effluent application area. The second is that even though the loading rates for irrigation systems are lower than for trench systems, the spacing between irrigation lines can be much closer than for trenches so a smaller disposal area is implied.

When undertaking any sort of modelling, it is often necessary to strike a balance between producing complex models that cater for every possible circumstance, or producing overly-simplified models that are meaningless. Our motivation for the balance we struck (using requirements prescribed in EPA 2003 and AS/NZS 2000) was that these are established standards that would be defensible in VCAT. We acknowledge that few existing households would have wastewater production rates as low as the one used in our models (110 litres/person/day) – for this group the map models are “aspirational”. However, for Dream Home applicants, the maps are in the most-part enforceable. We simplified the communicability of the maps by expressing each town’s domestic onsite wastewater performance according to traffic light colours. This is because Australians are taught at an early age to observe the principles of road safety and to obey traffic signals. In the final mapping, a block shaded red should be capable of dealing with wastewater for a house of up to 1 bedroom, amber up to 2 bedrooms, and green three or possibly more bedrooms (depending on the site). Block shape, actual site coverage, and position of development were impossible to incorporate.

The following case study illustrates the approach we took to the map modelling. Although the approach is generic, map inputs to the model were customized to reflect the uniqueness of the local environment in each.

THE NELSON CASE STUDY

Nelson is a small town located on the Glenelg River near the South Australian border approximately 60km west of Portland. The town has mains electricity but there is no reticulated water, sewerage or gas. A general store offers some basic services and there are no community facilities. There is a hotel, three caravan parks, and a public toilet block. Air photo analysis reveals that there are around 200 dwellings and a similar number of undeveloped parcels. Most land parcels are less than 800m². The town is a popular summer holiday destination and there are thought to be around 200 permanent residents (Nelson is incorporated into a large Australian Bureau of Statistics census collection district so its exact population is impossible to determine). Although Nelson’s geology and topography vary, it is best described as sandy rise country.

The housing stock in Nelson is well established, so the majority of the domestic wastewater systems consist of septic tanks and effluent absorption trenches. Older absorption trench systems often rely on the effluent running through their full length by gravity, which results in the first section of the trench getting most or all of the effluent, and further sections get none or little. This limits the potential of the soil to provide maximum treatment. The sandy soils in Nelson are so permeable and soil percolation rates so rapid that, while they are undoubtedly effectively disposing of septic effluent, unless trench systems are uniformly distributing effluent, little treatment occurs in the soil and the bulk of microbial and chemical contaminants may reach the groundwater table. Hence, the most likely wastewater impact relates to groundwater, and only in extreme circumstances would offsite effects such as overland flow of effluent into adjoining public and private spaces be important. This is concerning given that there are a large number of private groundwater bores in Nelson, and the Nelson township adjoins the Glenelg River.

Modelling Onsite Wastewater Performance Using Maps

As prescribed in the Septic Tanks Code of Practice (EPA 2003), watercourse, cadastre, soils and slope maps all contributed to the models, as did wastewater loading rate information (AS/NZS, 2000). Annual rainfall is not a factor for absorption field sizing in AS/NZS 2000. The inputs for Nelson are summarized in Table 1 and where appropriate are described in more detail below.

Table 1: Map inputs for Nelson. Disposal areas are calculated on the basis of AS/NZS 2000.

Theme	Class	Rule	GIS interpretation
Dwellings	N/A	N/A	Point source
Watercourse	Constraint	Development prohibited within 60m	60m buffer
Slope (derived from 3d model)	Constraint	Development prohibited on gradients exceeding 20%	>22% development unacceptable 18%-22% inspection recommended < 18% development acceptable
Cadastral (buffer)	Constraint	Development prohibited close to adjoining allotment	1.5m buffer (pressurized irrigation) 3m buffer (pressurised trenches)
Cadastral (block size)	Factor	Irrigation Trench 1br home disposal area: > 118m ² >140m ² 2br home disposal area: > 179m ² >287m ² 3br home disposal area: > 210m ² >336m ²	<2br: limited development potential 2br: 2br >2br: 3br or possibly more
Soils – uniform sands so not mapped.	n/a for Nelson	n/a for Nelson	n/a for Nelson

Soil Map

For Nelson, soil mapping was not required because a site visit revealed the soils to be uniform sands (AS/NZS category 1 soils). However, soil mapping was relevant to all of the other towns, and so is worthy of some discussion here.

For the other towns in this study, we were able to use existing published soil and geology studies to gain an understanding of the soils. However, none of these maps were of a suitable scale or quality such that they could be used off-the-shelf to inform a domestic wastewater management strategy of this type. Glenelg Shire had recently taken delivery of high quality contours which allowed us to remap the soils at a suitable scale and then make them relevant to domestic wastewater planning by relating the soil textures to AS/NZS 2000. The contour maps in Corangamite Shire were less detailed so the soil maps we produced were less accurate, especially in places where other maps did not assist with the interpretation.

Constraints Map

The constraints map incorporated slopes, watercourse buffers, and buffers from adjoining allotments. The Septic Tanks Code of Practice sets out required buffer distances (EPA 2003, Table 6.6). It prohibits the consideration of land for wastewater absorption fields if it is within 60m of a river, has slopes exceeding 20%, or is within 6 metres upslope or 3 metres downslope of an adjacent allotment. A slope map was derived from a digital elevation model and due to accuracy issues with this, slopes are shown as three classes (0-17% is unconstrained, 18-22% requires inspection and >22% is constrained). As prescribed by the Septic Tank Code of Practice, buffer distances from adjoining allotments were reduced by up to 50% for the modelling of irrigation systems. In map 1, allotments are buffered by 3m (black) and 1.5m (grey) on the basis of our recommendation that all wastewater systems should be pressurised. Some dwellings around Mitchell Avenue are constrained on the basis of the stream buffer, and around Mark Street on the basis of steep slopes.

Loading Rate

Although a review of the existing water usage patterns across a number of townships found that water usage was closer to the 145 litres/person/day, for all towns we adopted the lowest design loading rate specified in the Code (110 litres/person/day) to reflect the maximised water conservation strategies that are commonly available for environmentally sensitive consumers. This figure accounts for full water reduction facilities – 6/3 dual flush toilets, shower flow restrictors, aerated taps, front load washing machines, flow pressure control valves on all water use outlets (EPA, 2007, Table 6.3). This means that the trends illustrated in the map models are conservative because not all dwellings will be using full wastewater reduction facilities.

The draft Septic Tanks Code of Practice (EPA 2007, p.25) provides a formula to determine the daily sewage discharge (loading rate) from a dwelling (Equation 1).

$$\begin{aligned} \text{Equation 1: Equation to calculate the daily wastewater discharge rate from a dwelling.} \\ & ((\text{Number of bedrooms}) + 2) \quad \text{Daily household} \\ & \quad \text{multiplied by} \quad = \quad \text{wastewater generation} \\ & (\text{estimated sewage flow L/person/day}) \end{aligned}$$

On the basis of the 110 litres/person/day design rate that we adopted, for a 3 bedroom dwelling the formula is shown in equation 2 below.

$$\begin{array}{rcl} \text{Equation 2: Equation to calculate the daily wastewater discharge rate for a three bedroom home.} & & \\ ((3 \text{ bedrooms}) + 2) & & 550 \text{ litres/household} \\ \text{multiplied by} & = & \text{day} \\ (110 \text{ L/person/day}) & & \end{array}$$

There are a number of technologies available that could further reduce household wastewater production and / or further improve wastewater quality. Both approaches imply additional expense, but they also have positive implications for Dream Home developability. On a case-by-case basis the applicant would need to demonstrate that the proposed approach would be sustainable over the life of the dwelling and not just be appropriate to get their permit approved.

Onsite Wastewater Performance Mapping In Nelson

Because the housing stock in Nelson are of an age that would use trench systems, these were modelled first. This modelling revealed concentrations of existing developments that might require a priority response by Council, and also illustrated the extent of problems that might arise should Council continue to approve these systems. Next, we modelled irrigation scenarios to discover whether a town-wide upgrade to irrigation systems might lead to sustainable domestic wastewater management in the town, and perhaps provide an alternative to reticulated sewerage.

The maps (Figure 1) are models of the developability of properties (tenements) and parcels (allotments) using trench and irrigation technologies, and are expressed in terms of the maximum allowable bedrooms. These have been calculated on the basis of the block area less a 450m² allowance for impervious surfaces (e.g. footpaths, driveways, the dwelling and outsheds), the wastewater technology being modelled, for trench systems a reserve disposal area of equal size to the primary disposal area, and constraints such as steep slopes and buffers from adjoining allotments and water features. The incorporation of buffers from buildings was beyond the scope of the project. Simplistically, the map models are an evaluation of whether, after accounting for 450m² of impervious surfaces, there is an unconstrained area on the block that is large enough to dispose of wastewaters. For example, on sands, accounting for 450m² of impervious surfaces plus 336m² disposal area plus 336m² for a reserve area, a block would need to be at least 1122m² to sustainably deal with the wastewater produced by a three bedroom home if a trench system was to be used.

Using the constraint map (map 1), maximised water conservation strategies, properly performing systems and soils, we modelled four scenarios, each of which is very sensitive to block area. The modelled maps (map 2 through map 3) with an "a" suffix exclude a reserve field while maps with a "b" suffix include a reserve field.

1. *Trench systems on properties (map series 2):* Map 2a is a model of the sustainability of the area if only properties (tenements) were ever to be developed, and council continued to approve trench systems. This map series illustrates that the continued use of trench-based onsite technologies is not a sustainable option for town growth. There are a significant number of properties with limited development potential. Many of these are already developed (dots), and many are clustered suggesting that there are probably already wastewater problems in the area. Such clusters represent areas where point sources are most concentrated, and by inference are the areas of most pressing concern. Incorporating reserve fields into the model, map 2b indicates that if the present Code of Practice was in operation at the time of subdivision, the majority of properties would have been deemed to have limited development potential.
2. *Trench systems on parcels (map series 3):* Map 3a is a model of the sustainability of the area if all parcels were allowed to be developed and council continued to approve trench systems. Many parcels (allotments) have limited development potential if trench technology is used. Severe problems could emerge if all parcels were to be developed under this scenario. When reserve areas are incorporated into the model (map 3b), almost all parcels have limited development potential.
3. *Irrigation systems on properties (map 4):* Map 4 is a model of the sustainability of the area if only properties (tenements) were ever to be developed, and all trench systems were to be upgraded to irrigation systems. In the south, many blocks (650m² – 750m²) constrained when trench systems are used, are not constrained when irrigation technologies are used. Slope and stream buffer constraints have less impact on developability due to smaller disposal area requirements. However, in the north, blocks still have limited development potential because they're smaller (in the 500m²-600m² size range). The Septic Tanks Code Of Practice (EPA, 2003) does not require that a reserve field be incorporated for irrigation systems.



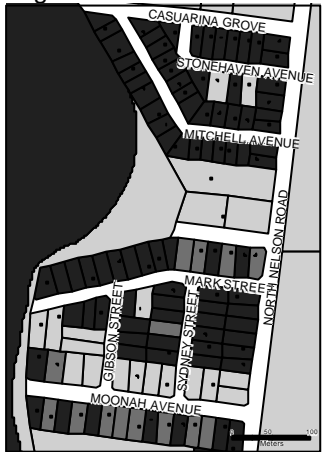
Map 1: Constraint map includes slope, stream and allotment buffers (1.5m for irrigation and 3m for trench)



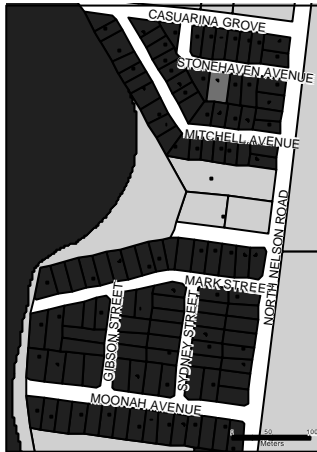
Map 2a: Developability of properties using trench systems (no reserve field).



Map 2b: Developability of properties using trench systems (with reserve field).



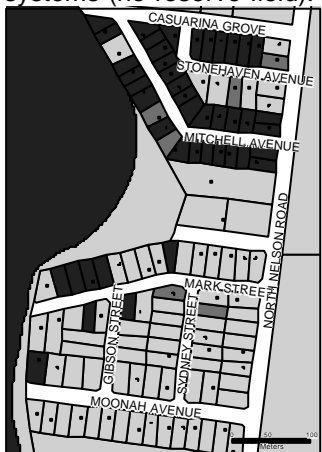
Map 3a: Developability of parcels using trench systems (no reserve field).







Map 3b: Developability of parcels using trench systems (with reserve field).



Map 4: Developability of properties using irrigation systems (no reserve field).



Map 5: Developability of parcels using irrigation systems (no reserve field).

- Constraint map**
-  Constrained
 -  Inspect
 -  Unconstrained
 -  Dwelling location

Legend





- Developability maps**
-  Limited development potential
 -  2 bedrooms
 -  3 bedrooms and possibly more
 -  Dwelling location

Figure 1: Onsite wastewater map modelling.

4. *Irrigation systems on parcels (map 5)*: Map 5 is a model of the sustainability of the area if all parcels (allotments) were allowed to be developed, and if the entire area were to be upgraded to have irrigation systems. The Septic Tanks Code Of Practice (EPA, 2003) does not require that a reserve field be incorporated for irrigation systems.

Interpretation Of The Modelled Maps

Failing or inappropriate onsite wastewater systems create concerns for human health and the health of the environment. There are two major problems that relate to onsite wastewater systems:

1. **Inappropriate technology**: Older homes are mostly installed with systems that were considered appropriate at the time they were built. Often these technologies were not ideally suited to the local situation. Time has moved on in terms of government and community expectations for system performance, and the wastewater technologies that are available to address those expectations.
2. **Lack of maintenance**: System performance drops if onsite wastewater systems are not maintained. Estimates of the number of systems failing at any one time vary throughout the literature, but a common theme is that the majority of systems in Australia and overseas, are failing (eg. Mancl, K; 1990, South Australian Government, 2003).

All the maps relating to trench systems have been produced based on the assumption that the systems are properly maintained and use dosing pumps to ensure the even distribution of effluent. The reality is that these technologies and maintenance regimes are unlikely to be in place for all developments. Hence, we have some major concerns for Nelson. Each of the maps flag the area bound by Mitchell Avenue, Casuarina Grove and North Nelson Road as being a problem. The dots on the map indicate dwelling locations interpreted from air photography, so this area is near-fully developed. This suggests that the domestic wastewater strategies for Nelson will need to incorporate communication with existing residents.

The maps indicate that for many blocks the situation would improve if irrigation systems were to be adopted (map 4 and map 5). Many of these sites are small, so to upgrade some it may be necessary to re-use existing trenches for AWTS treated water, or to install irrigation lines within existing trench areas.

It is clear from the mapping that existing systems are unlikely to be performing well (map 2a). The maps identify wastewater hot-spots, information that is an ideal starting point for additional environmental monitoring, further onsite wastewater investigations, and focused community engagement. They also highlight the current and potential impact the discharge of wastewater is likely to have on the receiving environment if all of the allotments in Nelson were to be fully developed. Acknowledging that a sewerage scheme is unlikely in the short term, the DWMP for Nelson recommended a series of low cost actions that could be implemented and prioritized on the basis of the mapping. These actions included ensuring that existing systems are being properly maintained and are working effectively (eg. install dosing pumps), and adopting strategies for reducing wastewater volumes.

THE ROLE OF LEGISLATION AND POLICY IN THE PROCESS

The hierarchy of Victoria's legislation, policies and guidelines domestic wastewater management is shown in Figure 2. Our plan focused on the requirements within the State Environment Protection Policy (SEPP) (2003) and the Septic Tanks Code Of Practice (EPA, 2003), and only referred to the Australia Standard 1547 (2000) when these were silent.

Clearly Victoria has a number of Acts, Policies and Guidelines that deal specifically with domestic wastewater (eg. Environment Protection Act, 1970; SEPP Waters of Victoria, 2003; Septic Tank Code of Practice, 2003) that can support Local Government in the development of policies and strategies that deal with onsite systems identified as being unsustainable. However, there is no Act of Parliament that would allow a Council to apply any environmental standard retrospectively. This means that if the original wastewater permit (if there was one) did not specify onsite system performance, suitability or maintenance requirements, a system could potentially continue operating in an unsustainable manner for the life of the dwelling.

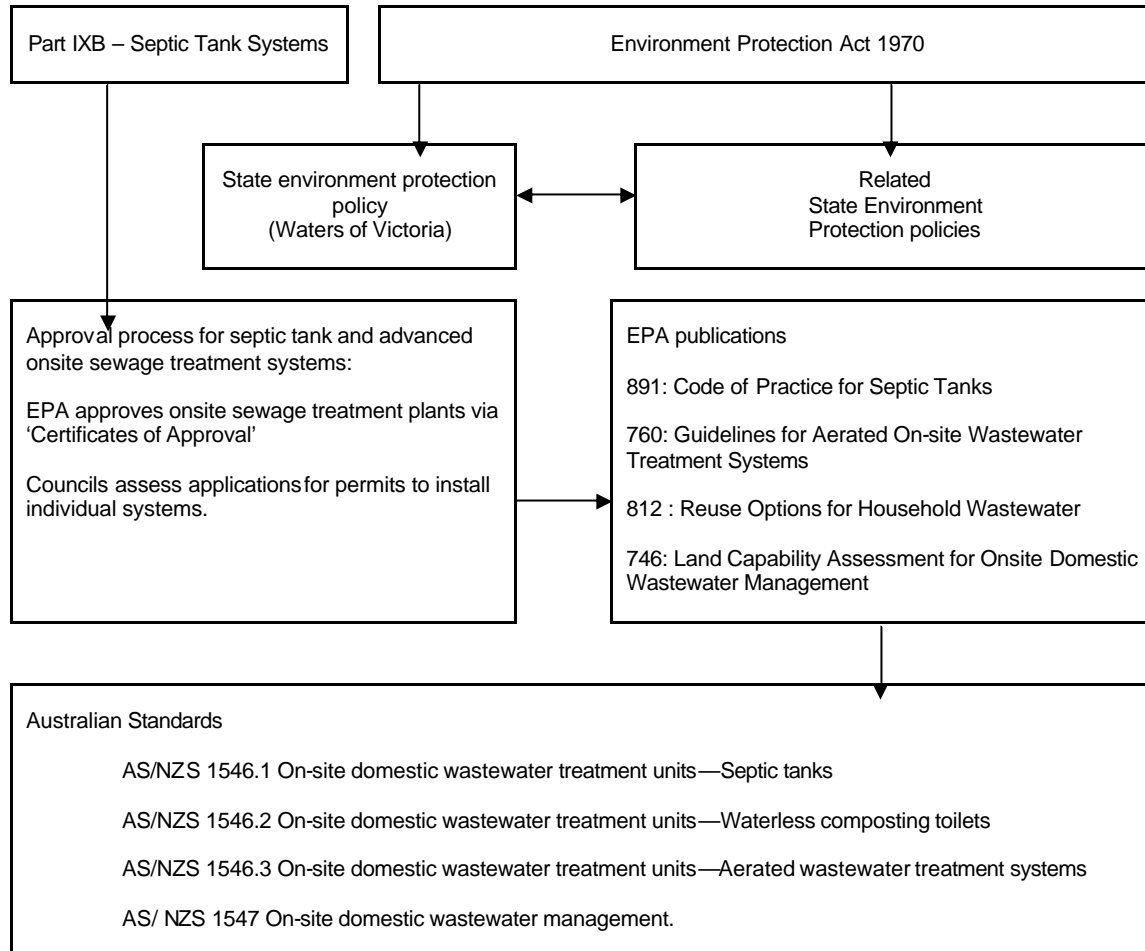


Figure 2: The hierarchy Victoria's legislation, policies and guidelines domestic wastewater management. Adapted from Victoria's Septic Tanks Code of Practice (EPA, 2003)

In developing our plans, we needed to be conscious of the numerous environmental standards used to assess domestic wastewater management, but also realistic about the impact our plan could have on older unsustainable systems. We also needed to be mindful that reticulated sewage would be unlikely to be provided in the short-term, so a focused wastewater behavior education campaign would be required. We anticipate the campaign will address issues relating to wastewater reduction, public health requirements, and the need for system maintenance.

Our modelling highlighted allotments not capable of containing their wastewater onsite. To convey this message to the relevant officers and agencies, we established a reference group that drew membership from two Water Authorities, two Catchment Management Authorities, Victorian Department of Sustainability and Environment, Victorian Department of Human Services, Victorian Environment Protection Authority, wastewater consultants, and town planning and environmental health personnel from the two Shires. The reference group has met on three occasions and its feedback has been of great assistance. We envisage that this group will continue, and assist us with public education campaigns and the development of appropriate township specific policies that address the sustainability of the domestic wastewater management for high and medium risk allotments.

DISCUSSION

In planning situations where conflict exists, the use of maps as a communication tool reduces interpersonal conflict, facilitates more productive planning forums, and leads to outcomes that are spatially consistent (Allan *et al.* 2002; Allan *et al.* 1998, Allan *et al.* 1993). For example, residents, local government and catchment managers worked together to model a planning scheme in the Lal Lal water catchment near Ballarat (Allan, 1996). Similarly, maps were central to a successful planning review that had historically been fraught with conflict at the Tambo Bluff estate on the Gippsland Lakes (Allan *et al.* 2006).

DWMPs are often developed without reference to town scale soil maps. Instead they tend to recommend that this mapping be undertaken (for example, South Grampians Shire 2006 p.105; South Gippsland Shire, 2007, p.16). In contrast, we began our DWMP by developing town scale soil maps. For the towns in this study, relevant maps existed in the form of regional soil maps, geology maps and topographic maps, so high quality soil maps for each town could be produced relatively quickly. In some towns this mapping phase revealed that the soils were uniform, and in other towns it revealed major soil variations. In all cases the soil maps we produced allowed us to GIS map model the sustainable development potential of individual blocks in a way that reflected each block's underlying soil.

The idea of modelling whole-of-town onsite sustainability has parallels with the discovery of the hole in the ozone layer. Molina *et al.* (1974) noted that CFCs breakdown ozone, and Farman *et al.* (1985) discovered the ozone hole over Antarctica. However, it was not until a satellite image map of the ozone hole was produced that the non-science community grasped the full magnitude of the problem. Similarly, authorities have suspected for many years that a domestic wastewater problem might exist in many small towns. Our modelling of the Code of Practice requirements shows that onsite domestic wastewater systems presently installed across many small towns are indeed unsustainable. Although the focus of our modelling has been on the sustainability of onsite wastewater systems for individual blocks, future models will address the collective performance of individual wastewater systems, an issue that is crucial to the protection of a township's water catchment. As an example, a township of 200 three bedroom homes, each producing 550 litres of wastewater per day, would contribute 110 kilolitres of wastewater per day to its local catchment. Where the source of this wastewater is a town dominated by unsustainable onsite systems, there are enormous implications for both catchment and public health. It is our belief that the consistent pattern of unsustainable wastewater systems shown in the six towns we studied would be repeated in many other towns in many other catchments across Australia.

The maps of onsite sustainability have been extremely useful. They have already been used to successfully communicate strategic wastewater problems to the reference group, and we are hopeful that they will also serve as a communications tool to landowners, and eventually become a front-of-house planning tool for Councils. More importantly, the maps have given us an understanding of the onsite wastewater issues in our towns in ways that we had not thought possible. For example, we are now aware that in some towns there are areas that we should be very concerned about, and others that we need be less concerned about. As a direct consequence of this approach, planners are now more aware of the importance of wastewater issues in the unsewered small towns we studied, and for at least one town it has precipitated a strategic rethink of township development plans.

To ensure that all strategies are fully debated prior to release for public comment, the DWMPs will be presented to the two newly elected Councils in early 2009. Because Parliament gives no powers to deal with old unsustainable onsite systems, we hope to gain Councils' support for our approach. First, we would like to see the DWMPs linked closely to the Planning and Environment Act (1987). A recommendation will be put that the planning schemes be amended and the DWMPs be deemed as incorporated documents. This will allow a wastewater policy and environmental overlays to be established. Second, we would like to use the maps as a tool in a raft of communications strategies directed to each town's community.

Working with the town communities to define environmental solutions that will ensure that residential growth can continue will be a big challenge. We have identified three audiences for our information.

1. Existing residents: Four approaches are proposed:

- A public education campaign: We plan to promote the monitoring of onsite systems and a reduction of household wastewater.
- Community engagement: We plan to undertake an extensive community engagement program and an environmental program review. The review will focus on understanding ways to reduce the impact of failing wastewater systems. It will require Catchment Management Authority and Water Authority involvement to determine if reticulated sewerage schemes are feasible.
- Environmental overlay for onsite system upgrade: An environmental overlay will require building permit applicants to upgrade onsite systems to comply with the Septic Tank Code of Practice (2003).
- Promotion on Council's website: To ensure all stakeholders are aware of the need to develop appropriate onsite wastewater strategies, the maps and supporting information will be placed on Council's website.

2. Owners of vacant allotments: The maps will be a very important tool to assist in communications with owners. Two approaches are proposed:
 - Restructure overlay for boundary consolidation: The mapping has highlighted small allotments with limited development potential. We plan to review these to determine which adjoining allotments can be consolidated to ensure the onsite wastewater disposal area is large enough.
 - Prioritization of Councils' Domestic Wastewater Management activities: Councils' human and financial resources are limited. The mapping will allow the prioritization of high risk townships and also individual pockets within the townships that may need to be monitored or reviewed for the purpose of boundary consolidation.
3. Permit applicants: The color coded maps have already been useful in discussions with permit applicants and prospective purchasers. Their use is also likely to streamline internal local government referral processes and speed the permit process. Although the permit application procedures are not yet fully developed, the following is likely:
 - Sites for which onsite systems are mapped as being sustainable would not need to be referred to the Environmental Health Officer if the application complied with the Septic Tank Code of Practice (EPA, 2003).
 - Sites for which onsite systems are mapped as being unsustainable would require a site specific land capability assessment to be lodged with the town planning application prior to referral to the Environmental Health Officer.

CONCLUSION

We have shown that detailed maps of soils and constraints can be related to cadastral maps and used to model the sustainability of onsite systems for individual blocks in a way that accommodates Victoria's Septic Tanks Code of Practice guidelines. The models are sensitive to block size, local constraints and wastewater technology. Using this approach, many onsite systems in the towns studied were shown to be unsustainable, and the residential development potential for a large number of allotments unrealizable.

The mapping enabled town-scale domestic wastewater management planning, in contrast to many DWMPs that are undertaken at a strategic level only. Mapping the range of problem characteristics in the towns (i.e. minor, major, and clusters-of-concern) has provided a focal point for understanding where sustainability outcomes could be improved through planning overlays, focused community engagement, technology solutions, engineering solutions, or some combination of these.

It is important to plan small towns strategically because there are a number of looming drivers for demographic change and unsustainable onsite systems have implications for both catchment and human health. Because the maps are sensitive to local environments at the allotment scale, we feel confident that the local expression of the plans will be spatially consistent and fair. We also expect more efficient use of Councils' internal resources because the maps give focus to efforts. As a day-to-day tool, the Shires will use the colour coded maps as a referral trigger for individual permit applications.

So, when someone asks "Where can I build my dream home?", all stakeholders will have access to the same decision making tool.

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