WHEN GOOD GOES BAD – HOW MANY LAND TREATMENT SYSTEMS OPERATE AS INTENDED?

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ABSTRACT

Industry advisors and regulators spend hundreds of thousands of dollars researching, investigating, developing, consenting and preparing management plans for land treatment systems. These efforts allow a high level of detail to accompany a design and system plans for the client and to obtain the necessary regulatory approval. But what happens once the seal of approval has been given?

While systems can be technically correct, the ability to ensure the effects are as planned is dependent on the ability to manage the system in accordance with the design specifications. For a range of reasons design plans are often neglected or deviated from when the scheme is commissioned. Some reasons include:

- Operational budgets get cut, and if not linked to compliance tasks the requirements get dropped.
- Staff running schemes do not understand system complexity and biological systems, and neglect critical aspects of the systems management
- Staff (uninformed) do not see the relevance of design and management features and make modifications
- There is a genuine lack of understanding of compliance requirements and tasks (even when specified in conditions)
- Once a system is approved the designers and advisors are dropped out to reduce costs

So what do we do to ensure the longevity of the systems we are developing? Should management be left to management plans or should there be more detail in the consents? Should consent conditions be prescriptive regarding operation? It is clear that a lack of ongoing investment and adherence to the initial management plans can result in systems falling over and becoming non-compliant.

This paper explores some of these reasons with examples and discusses possible solutions, including more operational aspects being incorporated into conditions and the need to require regular reviews that involve the initial designers or other appropriately qualified and experienced practitioners.

KEY WORDS

Key words: land treatment, failure, compliance, costs, money saving

INTRODUCTION

Land treatment is one solution to introduce treated effluent into a receiving environment. Historically, many communities were located adjacent to waterways to allow for the sourcing of drinking water, quick runoff of stormwater and the discharge of wastewater. While there are greater controls on what can be taken and discharged, most wastes are treated and effluent is typically still discharged to surface waters.

However, land treatment is a viable and well used alternative, and as with surface water discharges, has to be designed, consented, installed and operated correctly. A review undertaken by LEI (unreported) of land treatment schemes has indicated that they can cost between $1,400 and $5,000 per person to design, consent and establish when retrofitted to an existing treatment plant. If reticulation and treatment plants are to be considered the costs can be greater than $15,000 per person. Typically, the per person cost increases with a smaller community.

This cost is a result of local authorities spending hundreds of thousands of dollars researching, investigating, developing, consenting and preparing management plans on land treatment systems. Much of the cost is spent on advisors and regulators developing a high level of detail to accompany a design and system plans to obtain the necessary regulatory approval. But what happens once the seal of approval has been given?

Like any system, failure to operate it within the bounds of its design and 'best practice' will result in the compromised performance of that system; of which the same applies to any land treatment system. Land treatment systems run by local authorities face unique challenges, and while similar to industrial systems, often suffer from poor resourcing and fail to meet the initial performance expectations.

GETTING THE PROPOSAL OVER THE LINE

There are a number of steps in getting a land treatment system up and running, which, while common for any land treatment system, municipal systems have their own additional challenges.

Local Authorities utilise ratepayer finances and are therefore accountable to their communities. Through the local government process (LGA, 2002) the expenditure for capital and operational budgets is influenced by the desires of the community through the setting of Long Term Plans, and the election of councillors. Further, when permitting a system under the Resource Management Act (RMA, 1991) the community can also have an input through a resource consenting process.

The consequence of community input at both levels is a need to provide a high level of confidence to that community that given their expenditure the system will work, design is appropriate and the effects are acceptable. In order to reach this threshold of meeting public expectation a lot of detail is required. This detail comes at a cost, and the detail can result in intricate systems that have belts and braces applied, increasing the systems complexity. This greater complexity is often a consequence of the regulatory approval process and dealing with community expectations (and answering questions to justify the expenditure).

The greater the level of complexity, the higher the potential for something to go wrong. The potential for things to go wrong are heightened in fiscally constrained environments, such as those under which Local Authorities operate where they attempt to satisfy the ratepayers by limiting rate increases. Minimising rate increases can be achieved by cutting operational expenditure.

The ironic situation, which is not limited to land treatment schemes, is it is the community that demands solutions that cost money, but it is also the same community that wants to save money and minimise the operation expenditure by limiting rate increases.

TYPICAL PROBLEMS

While not always the case, many problems with land treatment systems come back to money, and in some cases changes to the operational rules once the design has been finalised. Typical problems once established include:

- Planners and the Environment Court modify conditions of consent which are inconsistent with the system design: e.g. increasing the return period so insufficient water can be applied in a given week on the land area available.
- Variation to Consent to change a condition of Consent e.g. soil moisture monitoring condition is removed meaning that deficit irrigation management cannot be assessed in the field.
- Operational budgets get cut, and if not linked to compliance tasks, the requirements get dropped e.g. coppicing trees are not harvested.
- Staff running schemes do not understand system complexity and biological systems, and neglect critical aspects of the systems management e.g. soil moisture is not taken into account and over irrigation results in localised ponding, plant death and soil damage.
- Staff (uninformed) do not see the relevance of design and management features and make modifications e.g. filtration systems are bypassed and the discharge emitters get clogged.
- There is a genuine lack of understanding of compliance requirements and tasks (even when specified in conditions) e.g. pond levels are not kept low enough forcing over irrigation onto saturated soils to avoid pond over topping.
- Once a system is approved the designers and advisors are dropped out to reduce costs e.g. despite having design manuals operational staff change application rates which results in excessive leaching and groundwater contamination.
- New staff are involved and make poor or uninformed decisions, or decisions inconsistent with operational guides e.g. an operator leaves and the new operator is not told to check the spray nozzles weekly for sprinkler damage resulting in uncontrolled discharges as a result of tree branches breaking off a sprinkler head.

EXAMPLES

System A – A system was established to irrigation a rectangular piece of land using travelling irrigators. The irrigation system was changed to use a centre pivot, missing out the corners. Over loading occurred and the application rate was in breach of consent conditions.

System B – Summer flows were to be applied to land using solid set sprinklers. Winter flows (high river conditions) were to be discharged to a soakage trench. To save on harvesting costs and the need to tend to the sprinklers, the soakage trenches were used almost continually with minimal land treatment used during low river flow conditions.

System C – Leading up to the consent being granted considerable effort was put into soil investigations. A very technical groundwater model was also developed which was dependent on irrigation application rates and highly variable soil conditions across a river flood plain, as determined by the soil investigations. When installed all topsoil was stripped, mixed and re-laid, creating a compacted soil that while homogeneous, was nothing liked that used in the modelling.

System D - Solid set sprinklers were designed to apply 5 mm/d onto sandy soils. Actual operation sees a single application of 35 mm/wk applied. While the same weekly volume is applied, the result is excessive leaching and very high levels of nitrogen in adjacent surface water.

System E – Drip irrigation was used to irrigate a eucalypt plantation to be coppiced on a 3 yearly cycle. Budgetary constraints leading to a failure to fix soil moisture probes resulted in over irrigation and tree death in localised areas. Removal of trees resulted in damage to the drip irrigation creating a greater occurrence of localised wet conditions, which in turn lead to surface runoff. The irrigation system was partially abandoned in favour continuous surface water discharge that should have only been used when soil conditions did not permit and stream flows were high.

System F – An attempt to control odour on an anaerobic pond saw straw placed on the pond surface. The straw sunk and blocked the irrigation filters. The irrigation filters were bypassed and the emitters in the drip line blocked.

System G – A prescriptive resource consent required regular wastewater (monthly) and soil (annual) monitoring. After two years of operation no monitoring had occurred. The council chose not to employ a manager and the person overseeing the plant was unaware of the consent compliance requirements.

SOLUTIONS

Most land treatment systems that pass through a regulatory process are sound, albeit sometimes with a few design limitations. However, there will always be financial pressures to spend less, and this is likely to mean less effort will be put into system operation and maintenance. However, as technology and operation performance improves, there may be better ways of operating systems that result in a lesser environmental effect and are more cost effective.

It is noted that the need for performance limits and compulsory management by suitably qualified people is now being applied to onsite wastewater systems. Surely community systems that use public money should be subject to the same level of diligent operation and regulatory requirement.

Listed below are a few suggestions that may assist in ensuring the effort that goes into a well thought through land treatment system allows it to operate successfully over the longer term.

- Better consent conditions - Many consent conditions are complex and difficult to interpret, especially by operational staff. Conditions should be simple and easily understood, not ambiguous, and have clear intent. Advice notes should be used to help where needed to provide clarity.

- Management Plan vs Conditions – In regulatory circles there is debate on whether controls on the effects or the operation should be specified in consent conditions. As the RMA (1991) is effects driven it would seem logical that the effects should be the focus. However, history has demonstrated that effects can often be hard to distinguish from those of background activities and some consent holders have an inability to manage let alone assess effects. Consequently, while legally correct to regulate effects, management should be specified in order to keep the gate closed to stop the horse bolting.

- Use of Suitably Qualified People – Many local authorities use wastewater treatment plant operators to oversee the operation of their land application system. While they have the best intentions, they often do not understand the fundamentals of how to operate a land treatment system. We are now seeing the specification of Suitably Qualified (and Experienced) People being used for designing and managing onsite wastewater systems, so surely this should also apply to larger municipal systems, especially when ratepayer finances are being used. An example of a consent condition which addresses this are:

  "(a) Prior to the commissioning of the treatment and land treatment areas, a maintenance service contract, which provides for the servicing of the treatment and land treatment area(s) at least once every 12 months, shall be entered into with a ***suitably qualified person/organisation****. The contract shall include a requirement to ensure that the treatment and land treatment area(s) are operated and managed in accordance with the Operations and Management Manual prepared in accordance with Condition 19 of this consent.*
  (b) A copy of the contract shall be forwarded to the Consent Authority prior to the commissioning of the treatment and land treatment areas.
  (c) Following every service, a written report shall be prepared and a copy provided to the Consent Authority with the annual report required under Condition 18 of this consent."

- Sufficient Staff Hours – The amount of time needed to adequately manage a land treatment system is frequently underestimated. Because the management of the system is typically less than a full time position, often it is carried out as an "extra" rather than "core" task – whether by a WWTP operator or a third party farmer/land manager. As a result, less care is used than is needed. Prior to committing to a land treatment system there needs to be a clear understanding of the labour needed to ensure successful operation.

- Independent Review – As with the use of "suitably qualified persons", the need for independent review of system (including discharge) performance is increasingly

included in onsite system consents. A similar approach would provide an opportunity to identify and correct any practices or equipment selection that were causing a land treatment system to perform differently to the consented system. The following are some actual examples of consent conditions:

"(a) The consent holder shall, on each 10th anniversary of the commissioning of the first treatment system and land treatment areas, engage a suitably qualified professional to undertake an inspection of the wastewater treatment and disposal system. This inspection shall include, but not be limited to:

(i) General examination of the treatment plants and land treatment areas for any signs of malfunction or failure;

(ii) Inspection of sludge levels and identification of any other maintenance required to ensure optimal performance of the treatment plant; and

(iii) Inspection of the land treatment areas and identification of pipeline clearing or any other maintenance required.

(b) The findings of the inspection shall be reported to the Consent Authority within 6 weeks of the inspection being undertaken.

(c) The consent holder shall undertake any work that is recommended in the report to ensure the efficient and safe operation of the treatment system and land treatment areas."

An example used in a recent discharge consent for a municipal land treatment system is:

"Before 1 September of each year that the discharge occurs, the consent holder shall provide a report to the Council, prepared by a ***suitably qualified and experienced engineer or scientist****, covering the preceding 12 month period ending 30 June. As a minimum this report shall include the items listed below and a comparison with previous years:*

a) a summary of all monitoring undertaken as required by this consent, and any additional monitoring undertaken by the consent holder to better characterise the effects of the discharge on the ---------- Stream;

b) a critical analysis of the monitoring information in terms of compliance and adverse environmental effects;

c) an assessment of the flow data, an assessment of the expected flow increase over the next 24 months period taking into account expected population increase and ingress and infiltration and the potential need for additional irrigation area in the next 24 month period. If additional irrigation area is required, details of the proposed action by the consent holder to increase the capacity of the system including a timetable over which the work will be undertaken is required;

d) comment on any non-compliances and operational problems, and any actions undertaken to address these;

e) identification and comment on any trends in data collected, both within the annual period and compared to previous years;

f) a summary of nitrogen application rates for the irrigated portion of the site, in terms of kilograms nitrogen per hectare per annum;

g) a waste profile analysis which assesses the source of wastewater entering the system and identifies any potential increases in risk as a result of this;

h) details of any works undertaken or proposed to improve the performance of the treatment system, and the timeframe for completion of any proposed works;

i) recommendations regarding alterations or additions to the monitoring programme;
j) the tabulated results of the laboratory analytical monitoring; and
k) any other issues considered important by the consent holder."

- Reporting and Review – Most Resource Consents include a condition which allows for the Regional Council review the activity against the provisions of the consent, and to reassess the conditions if needed. This is an important mechanism to require improvements where the environmental performance of a system does not match the system, whose effects were assessed and consented. A typical example of a condition for this is:

  "The Regional Council may review any or all of the conditions of this consent by giving notice of its intention to do so pursuant to Section 128 of the Resource Management Act 1991, at any time within three months of the annual anniversary of the date of commencement of this consent for any of the following purposes:
  - *to deal with any adverse effects on the environment which may arise from the exercise of this consent, and which it is appropriate to deal with at a later stage;*
  - *to review the adequacy of any monitoring requirement(s) so as to incorporate into the consent any modification to any plan(s) or monitoring requirement(s) which may become necessary to deal with any adverse effects on the environment arising from the exercise of this consent;*
  - *to alter the monitoring requirement(s) in light of the results obtained from any previous monitoring;*
  - *to require remediation measures to be undertaken if adverse effects from the activity are greater than anticipated in the application."*

- Controlled Activity – The use of a Controlled Activity Rule to manage municipal discharges may assist to reduce consenting cost and the risk of inappropriate conditions. Many consents for land application have basically the same conditions. If these conditions were the target for developing the system why would there be a need to litigate the activity, especially as the scope of the activity would not change. Greater Wellington Regional Council have developed a Controlled Activity rule for municipal discharges (Rule R79, Proposed Natural Resources Plan), and it is hoped that this may encourage the Local Authorities to consider reducing their surface water discharges. The controlled activity proposed includes the design criteria to be met for a low rate land treatment system and details what should be included in Management and Operation Plans.

TAKE HOME MESSAGE

If time and effort is being invested in developing a land treatment system, at ratepayers' expense, then surely it is in the interest of rate payers to ensure it keeps on running successfully. It is important that the owners of the scheme, being the local authority, have a strong understanding of the system, its intent, the Resource Consent requirements and their obligations regarding its operation. This requires a commitment from the scheme owner, being the local authority, to invest in necessary maintenance and operational requirements, and by the Regional Council to ensure the effects are as intended.