THE OPPORTUNITY FOR MUNICIPAL WASTEWATER IRRIGATION IN THE LOWER NORTH ISLAND

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Abstract

Many New Zealand communities discharge their wastewater to waterways after treatment in oxidation ponds. There is the potential for these discharges to be applied to land, especially during low flow conditions which are common over the summer periods. The switch from water to land discharge provides an opportunity to lessen the environmental impact associated with surface water discharges, improve recreational water quality, address cultural concerns and provide an opportunity for agronomic financial gain. However, there are management limitations with year round land application and industry bodies are conscious of the market perception of using wastewater for production purposes.

Much has been said with the potential for improvement in surface water conditions by using land application; however the practicalities are often not thought through. Not many areas in New Zealand have the potential to receive high rates of land application year round, as winter application can adversely affect crop/pasture production. Further, industry bodies are becoming increasing aware of land management practices which could limit access of produce to international markets, with Fonterra already placing significant limitations on wastewater use on dairy farms. A solution to the land management issues is consideration of combined land and water discharges (CLAWD).

In an area extending from Wairoa to Martinborough, and Pukerua Bay to Wanganui, there are 426,000 people. They typically produce 58.4 million cubic metres of wastewater, or 137 m^3 per person annually. In this same area non-deficit irrigation would require 6,600 to 11,400 ha. Storage would be greatest for the land only option at about 37,500,000 m^3, and least for the CLAWD system at 1,600,000 m^3.

For a community the size of Otaki (5,680 people) the areas needed for deficit and non-deficit, and combined and land only, range from 90 to 150 ha; with storage ranging from 21,000 to 500,000 m^3. Costs could range from $1.2 to 2.3 million for irrigation alone and depending on configuration, reticulation and storage could cost $6.5 to 16 million.

With the addition of wastewater the opportunity of additional nutrient and irrigation benefit arises. Non-deficit irrigation results in the annual application of 85 kg N/ha and 20 kg P/ha. It should be noted that while these loadings may seem low, many nutrients are removed from the wastewater during treatment; with reduction also being needed to meet industry application requirements. The irrigation benefit 510 mm is also possible. Again this loading may seem low, but requires averaging over a time period, with some years possibly seeing greater rates applied.

Careful consideration of the wastewater quality and the receiving land and water environments provides realistic opportunities to improve water quality in our rivers.

Additional benefits come for agricultural production, but a realistic approach is needed to avoid over application affecting farm management and placing communities under significant financial burden.

Introduction

For many New Zealand communities management of their wastewater is under scrutiny and improvements to the impact it is having on their local environment are being evaluated. The scrutiny comes from a range of directions including changes in the regulatory environment, greater awareness in peoples' interest in water quality and greater demand on water resources for recreational and production purposes.

An opportunity to improve wastewater management is to remove municipal discharges from surface waterways and apply the wastewater to land. Although land application is a viable option it comes with limitations that must be accommodated to result in the optimum benefits for the community, the environment and the property receiving the wastewater.

Regulatory Drivers

There are a number of influential drivers that currently promote the shift away from surface water discharges and the application of wastewater to land. The Resource Management Act (1990) promotes sustainable management of natural and physical resources, and in particular land, air and water. The Resource Management Act (1990) enables regulatory bodies (Regional and District Councils) to develop objectives and policies which reflect the desires of their community, including how communities want water quality to be managed.

Such a policy includes (Horizons One Plan, 2010):

Policy 6-11: Human sewage discharges

Notwithstanding other policies in this chapter:

(a) before entering a surface water body all new discharges of treated human sewage must:

(i) be applied onto or into land, or
(ii) flow overland, or
(iii) pass through a rock filter, or
(iv) pass though a wetland treatment system, or
(v) pass through an alternative system that mitigates the adverse effects on the mauri of the receiving water body, and

(b) all existing direct discharges of treated human sewage into a surface water body^ must change to a treatment system described under (a) by the year 2020.

Land Application Considerations

Benefits

The benefits of applying wastewater to land include moisture availability, nutrients and potentially an increase in land value. Irrigation in coastal Manawatu can on average increase production by 30%. More critically, irrigation decreases variation in production between years, thus acting as a form of insurance. Nutrients in wastewater are soluble and slow release which supports suitable plant uptake and plant growth.

Limitations
Despite the benefits of irrigating land, the use of wastewater for irrigation requires careful management to make it a practical and viable resource. Wastewater is continuously produced whether it's needed or not; with the greatest volume is produced in winter due to leaky sewers. This is often at a time when agricultural soils are already wet and least able to accept more water.

Land around each community will have differing soil types, with some less able to accept larger volumes of water compared to others. For example coastal communities surrounded by sands will be able to receive water during most periods of the year.

A further limitation to land application is its industry acceptance. New Zealand's clean green and contaminant free image has resulted in the development of limitations placed on farmers which can limit what is applied to crops their animals eat. Fonterra has established significant criteria around material that can be applied to pasture and crops fed to dairy cattle. This places strict boundaries on how, when and where wastewater is applied.

Conundrum
The community desire for a clean green environment and the use of land treatment has the potential to conflict with the practical reality of both year round land application and the industry acceptance of land treatment. On one hand the community desires clean water, a sustainable clean environment and products from the farming industry to support that. On the other hand the farming industry has practical limitations for utilising wastewater, including the ability to accept water in winter and limitations on what wastewater can be applied without industry restrictions being placed on produce produced.

Combined Land And Water Solutions

Utilising wastewater discharges to land and to water helps to address the conundrum; with many limitations of land application avoided. Discharges to land occur when the river levels are low, and conveniently this generally occurs in summer when soils are driest. Discharges to the river occur when the soils are wet; with this generally occurring in winter after higher rainfall periods when river levels are higher and greater dilution of the discharges can occur. When neither land or river conditions are suitable for discharge then storage of wastewater is necessary.

The Spectrum
The spectrum of discharges includes:

- River only discharge;
- Land only discharge; and
- Combined Land and Water Discharge (CLAWD).

CLAWD options can have a range of permutations around how much the land is irrigated. As with land only discharges, irrigation can be applied at rates which do not result in induced drainage, being deficit irrigation. However this places limitations on the days of irrigation available. Non-deficit irrigation allows for greater volumes to be applied but induces drainage, with some reaching groundwater.

To investigate this spectrum in greater detail a series of scenarios have been developed. For river only discharges the volume entering the waterway is dependent on river flows and the

assimilative capacity of the river. At low river flows the discharge is reduced or stopped and storage is required. For land only applications non-deficit irrigation is utilised and cessation of irrigation is based on the time when excessive amounts of water in the soil may impact plant growth.

Based on a non-deficit irrigation approach an annual application of 85 kg N/ha and 20 kg P/ha is likely to occur. It should be noted that while these loadings may seem low, many nutrients are removed from the wastewater during treatment. The annual irrigation depth would be on average 510 mm. Again this loading may seem low, but requires averaging over a time period, with some years possibly seeing greater rates applied depending on river and soil conditions.

A key difference between the three scenarios for wastewater application is the amount of storage required. Storage allows the wastewater treatment requirements to be moderated. For the CLAWD scenario less intensive treatment would be required because discharge is not needed in low river flow, whereas for the river only option without storage intensive treatment can be required. The CLAWD option provides significantly reduced storage requirements. There is the potential that a river discharge option would need 2.5 times more storage than a CLAWD system, whereas the land only discharge option requires an astronomical 23 times more storage.

Opportunities in the Lower North Island

Typically wastewater is managed in by individual communities, with reticulation between communities being uncommon. However, for the purposes of considering the larger scope of land treatment communities in the lower North Island have been assessed collectively.

In an area extending from Wairoa to Martinborough, and Pukerua Bay to Wanganui, there are 426,000 people. They typically produce 58.4 million cubic metres of wastewater, or 137 m^3 per person annually. In this area about 11,400 ha would be needed if all the wastewater was applied to land. This could decrease to approximately 6,600 ha using a CLAWD system. Storage would be greatest for the land only option at about 37,500,000 m^3, and least for the CLAWD system at 1,600,000 m^3.

Table 1: Land and Storage Requirements for Wastewater Scenarios in the Lower North Island)

		A - River Only	**B - CLAWD**	**C - Land Only**
Area	(ha)	0	6,600	11,400
Storage	(m^3)	4,100,000	1,600,000	37,500,000

At an individual community level the land area for irrigation and volume of storage is considerably less. For a community similar in size to Otaki with 5,680 people, the area needed for non-deficit irrigation is in the order of 90 ha to 150 ha for the CLAWD and land only scenarios respectively. Storage would range from 21,000 to 500,000 m^3 for CLAWD and land only options respectively. These requirements are summarised in Table 2.

Table 2: Wastewater application scenario requirements for a typical community

		A - River Only	B - CLAWD	C - Land Only
Area	(ha)	0	90	150
Storage	(m^3)	55,000	21,000	500,000
Irrigation Costs	$M	0	6-9	11-17
Storage	$M	6-10	7-16	15-25
Potential annual rate	$/household	100	270	450

What is affordable?

In addition to the logistics of making a land application system work, it has to be affordable to the community. The costs of ideal solutions are often over looked; but it is important they are kept in mind to ensure the desirable outcomes are actually affordable. Table 2 provides an indicative idea of costs, clearly indicating the magnitude facing small communities.

Conclusions

Social and environmental concerns, regulations and market demands are driving improvements to sustainable wastewater management. Combining land and water applications of wastewater increases the opportunities to progress sustainability, but the benefits must be weighed up against the limitations of the operations. Markets are not necessarily receptive to product from wastewater treated land.

Suitable land and water properties to receive the wastewater, and adequate storage requirements, are necessary to ensure appropriate timing of applications. The community involved needs to accept one option, and the increase in rates associated with that option.

References

Manawatu Wanganui Regional Council (2010): Horizons OnePlan – Decisions version.

Resource Management Act (1991): Ministry for the Environment.