RECLAIMED WATER IRRIGATION – A RISK BASED APPROACH TO MANAGEMENT

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RECLAIMED WATER IRRIGATION – A RISK BASED APPROACH TO MANAGEMENT

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EXECUTIVE SUMMARY

Using reclaimed water for irrigation has numerous benefits and risks associated with it. The most successful schemes have the highest benefits with the risks well managed.

There is not a single recipe that can be applied across all situations. Practices used at one site may appear less sophisticated, or use a more basic level of technology than another. However, both sites may be using best practice for their situation.

Best practice is one that ensures the level of risk and level of difficulty for a particular site is managed appropriately so that the desired outcome is achieved. Consequently practices for high-risk situations are much more demanding than for low-risk scenarios.

Risks associated with reclaimed water irrigation vary according to:

- The quality and quantity of reclaimed water available;
- The physical characteristics of the site being irrigated;
- The irrigation system used;
- The type of plant being irrigated; and
- The management system in place.

Generally high-risk scenarios are to be avoided and methods available to reduce risk should be implemented. However for any changes identified the impact on social and economic benefits must be considered. The overall benefit, in a triple-bottom line sense, may mean that operating at a higher risk level is preferable.

The Victorian EPA Guidelines for Reclaimed Water Irrigation are in the process of being updated. They will take a risk-based approach similar to that outlined.

1.0 INTRODUCTION

RM Consulting Group (RMCG) are industry experts in recycled water irrigation, working with community, government and industry to produce sustainable, viable and practical outcomes for use of recycled water. Our services include site investigation, environmental assessment, feasibility studies, irrigation design, implementation and monitoring.

Recently RMCG have been involved in development of EPA Draft Publication 168a *Best Practice Environmental Management Guidelines for Reclaimed Water Irrigation* (2004). These guidelines take a risk-based approach to site selection and management of reclaimed water irrigation.

This paper will look at examples of high and low risk and the associated management practices, based on RMCG's experience developing the EPA guidelines and our involvement in reclaimed water irrigation at over 50 sites across Victoria.

2.0 RISK MANAGEMENT

Risk is measured in terms of a combination of the consequences of an event and the likelihood of it happening.

Risk management is about understanding what can go wrong, taking steps to reduce the potential for problems and being prepared for when things do go wrong.

For reclaimed water irrigation this means the following process:

- Consider each element of the system
- Recognise the desired performance outcomes
- Determine the risk level associated with each performance outcome
- Select an appropriate practice to prevent, minimise or manage the risk
- Select a monitoring/review system to ensure the practice is effective.

The elements of reclaimed water irrigation include:

- Reclaimed water - quality, quantity, nutrients, salinity, toxicants;
- Environmental factors - soil, surface water, groundwater, native vegetation; and
- Social/economic factors - cultural heritage, human and stock health, public amenity, viability.

Each element has its own set of performance outcomes that are part of, and consistent with, the overall objective of sustainable reclaimed water management. They all interact with the risk level to determine the practices required.

One of these elements is considered in the following section as an example of risk levels and management practices required.

3.0 NUTRIENTS

3.1 Outcomes

The desired outcomes for nutrients are:

- The applied nutrients (in reclaimed water or additional fertiliser) are utilised for plant growth or remain safely in the soil for future uptake by plants;

- The applied nutrients do not build up in the soil to a level where they can cause an adverse impact on beneficial use on-site, or off-site (via surface runoff or leaching to groundwater)

3.2 Risk

Nutrients are required for healthy plant growth. However excess nutrients can cause issues such as blue-green algae in waterways.

Of the range of nutrients required for plant growth, phosphorus and nitrogen are the most likely to have potential adverse impacts on the environment. Here phosphorus will be discussed.

While phosphorus removal by plants is dependent on the particular crop grown, risk levels can be determined based on the majority of crops and typical application rates used in irrigation. The level of phosphorus in the soil also impacts on risk. Refer to Table 1.

The amount of phosphorus applied includes that sourced from both reclaimed water and fertiliser. The portion applied from the reclaimed water is calculated from the concentration in the reclaimed water and the application rate.

Table 1: ***Risk due to Phosphorus***

Phosphorus Application (kg/ha/yr)	Soil Phosphorus (mg/kg Olsen P)				
	<20	**20-30**	**30-40**	**40-50**	**>50**
< 20	VL	VL	L	M	H
20-40	VL	L	M	H	H
40-60	L	M	H	H	EX
>60	M	H	H	EX	EX

Note that operating at the very low risk level will limit production for the majority of land uses. This will both reduce water usage and impact on the viability of the reuse operation.

3.3 Management Practices

Best practice is one that ensures the level of risk and level of difficulty for a particular site is managed appropriately so that the desired outcome is achieved. Consequently practices for high-risk situations are much more demanding than for low-risk scenarios.

The practices to be implemented for the various risk levels for phosphorus could be as outlined in Table 2.

Table 2: ***Practices for different risk levels.***

	Record application	**Soil test**	**Monitor Production (ie. nutrient removal)**	**Demonstrate Tailwater System Functions or Scheduling Appropriate**	**Measure Runoff Volume Leaving Site**	**Monitor Runoff Quality Leaving Site**	**Other**
Very Low	√	√	√	x	x	x	x
Low	√	√	√	x	x	x	x
Moderate	√	√	√	√	x	√ (3 events per year only)	x
High	√	√	√	√	√	√	Select land use with high nutrient removal and implement management program to ensure production is achieved. Consider installation of wetlands or treed buffer zones for nutrient stripping of rainfall runoff.
Extreme	√	√	√	√	√	√	As for high risk, plus

							Provide additional storage for collection of contaminated runoff.

Note that:
This table provides an example of how practices might vary according to risk level. These are not necessarily the exact practices required or those that will be approved by the EPA.
Runoff refers to rainfall runoff from the site. Irrigation runoff should either not occur (spray/drip irrigation) or be collected and reused (flood irrigation). Rainfall runoff should be allowed to leave the site unless it is contaminated. It is the natural flow for the land and is critical to the health of surface waters in terms of maintaining environmental flows.

3.4 Monitoring and Review

Within the management practices identified, there are requirements for ongoing monitoring – eg. reclaimed water quality, runoff quality.

Following identification of practices, those that involve ongoing monitoring should be listed along with:

- The frequency of monitoring required;
- Who is responsible for doing the monitoring;
- What the monitoring involves – which parameters are to be measured and how.

Trigger points and response actions should also be set so that changes in the system and the level of risk can be responded to appropriately.

An example of a trigger point and response is provided in Table 3.

Table 3: ***Trigger Points and Response Actions***

Trigger	Response
Phosphorus levels in reclaimed water increase by 20% to 10 mg/l in one month.	Check treatment system and inputs to treatment plant to determine source.
Phosphorus levels in reclaimed water increase by 20% to 10 mg/l on average over a year.	System has moved to higher risk level. Implement additional management (eg. monitoring of rainfall runoff quality) or increase area irrigated (to spread nutrients further).

4.0 REAL LIFE EXAMPLE

4.1 Murray Goulburn Cobram

Over time irrigation with milk factory wastewater, which tends to be high in nutrients, has increased soil phosphorus levels at the Murray Goulburn site at Cobram. This resulted in an unacceptable risk of contaminated runoff to the nearby Murray River.

The interim solution was to provide additional storage to catch the contaminated flow. This was a relatively expensive option that reduced the irrigation area available and did not improve the over loading issue that had caused the problem originally.

To ensure long-term sustainability the water is now being piped over 20 kms to a number of dairy farms along the highway to Yarrawonga.

The farmers shandy the wastewater with their channel supply to reduce the amount of nutrient applied. The wastewater effectively replaces the need for fertiliser on the properties.

5.0 RISK FOR THE SYSTEM AS A WHOLE

The approach involves consideration of each element of the system in turn.

There is no empirical way of stating what will lead to a low or high risk position for the whole system. At some sites one high risk category will be sufficient to jeopardise the achievement of the overall objective of beneficial and sustainable irrigation. Other sites may have several high risk categories but the overall risk of achieving the objective could be relatively low.

There is also the scenario where low risk for one environmental element, results in high risk for another. For example, permeable soils potentially result in a low risk to plant production and water use, but a high risk to beneficial use of groundwater. Finding the balance can be an issue.

Generally high risk scenarios are to be avoided. Where they are identified, consider methods to reduce risk (eg. change type of irrigation, land use, application rate) or consider alternative irrigation sites. However, for any changes identified the impact on social and economic benefits must be considered. The overall benefit, in a triple-bottom line sense, may mean operating at a higher risk level is preferable.

6.0 ADVANTAGES OF RISK MANAGEMENT

There are a number of advantages in using a risk management approach. These include:

1. Practices can be selected to suit a particular site and the level of risk identified. It is not a one size fits all approach. This means those at low risk are not expected to implement an onerous management system, while those at high risk are effectively penalised and have to do more. There is not a single recipe that can be applied across all situations. Practices used at one site may appear less sophisticated, or use a more basic level of technology than another. However, both sites may be using best practice for their situation.

2. Consideration of all the elements individually enables the management system to focus on those areas of concern. Prioritisation can occur.

3. Appropriate management is implemented to protect the environment.

4. Ongoing monitoring and review is an adaptive management process that will ensure risk to environment is managed in the long-term.

5. As well as managing risk to the environment, it enables management of an organization's exposure to risk. It avoids costly surprises or consequences. The

adaptive approach enables issues to be foreseen.

6. There is flexibility provided. Alternative actions can be selected and an organization can even choose to operate at a different risk level. This gives potential to balance capital and operating costs. It also recognizes the triple-bottom line approach. Selecting a high environmental risk approach (with appropriate management practices) may be justified by the social/economic benefits achieved.

7. It is a structured systematic approach. Risks can be identified and therefore controlled.

7.0 CONCLUSION

There are numerous benefits and risks associated with reclaimed water irrigation. The most successful schemes have the highest benefits with the risks well managed.

The quality of water coming from the treatment plant, the species of plant used, the site selected, the irrigation type and the management system all interact with the risk level to determine the practices required. Practices for high-risk situations are much more demanding than for low-risk scenarios.

The Victorian EPA Guidelines for Reclaimed Water Irrigation are in the process of being updated. They will take a risk-based approach to management.

There are a number of advantages obtained through a risk management approach including flexibility, focus on the key issues, a structured approach and an adaptive management system.

8.0 REFERENCES

Best Practice Environmental Management Guidelines for Reclaimed Water Irrigation, Draft EPA Publication 168a, prepared by RMCG for EPA Victoria, Draft Version 4, March 2004.

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