# Dairy Green – Alternative Dairy Effluent Application Methods

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## Background

With the increase in dairying in Southland (29,000 cows in the 1980s to 240,000 cows in 2000) the pressure on the waterways has increased. This is expected to continue with further conversions planned and intensification of current dairy farms through increased stocking rate. A MAF report has forecast a 50% increase in dairy land area in the next five years.

Recent monitoring by AgResearch and Environment Southland has shown that the application of dairy shed effluent to land by small travelling irrigators is sometimes causing pollution to waterways. The effluent irrigators currently used typically have a water application rate up to five times higher than some soils can cope with. The excess effluent either runs off the paddock, or goes through cracks in the soil and into mole and tile drains, and into the waterways. The recommendation is therefore to set irrigators to the fastest speed and apply only small amounts of effluent at a time (10 mm depth).

However this is not always practical for farmers and some system designs will not achieve this. Much of the current effort in this area is concentrated on best management practices for existing methods whereas there is an opportunity to re-evaluate the land disposal practices to develop a better system.

## Project plan

The project is divided into four phases:

### *Phase 1*

Monitoring of the present situation on 8-10 farms. Set up monitoring protocols and benchmarks including; analysis of dairy effluent, irrigator liquid application rates and depth, area covered and return times, nutrient loading, water use/cow, soil characteristics, drainage water quality.

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**Notes:**

### *Phase 2*

Collate all available information on alternative options, decide on which systems to trial on farm. Evaluate and trial new technology. Monitor the new system using the same protocols and benchmarks as above.

### *Phase 3*

Compare the effectiveness of the new system against the old.

### *Phase 4*

Extension through field days and media.

## Milestone timeline

| Milestone | Description | Date Expected |
|---|---|---|
| 1 | Establish the monitoring group (up to 10 dairy farmers with varying effluent storage/disposal systems) | 31 August 2002 |
| 2 | Establish monitoring protocols and benchmarks | 31 August 2002 |
| 3 | Collate information on alternative effluent management technologies | May 2003 |
| 4 | Annual meeting of monitor group to assess first years results | June 2003 |
| 5 | Develop a new/modified effluent management system | August 2003 |
| 6 | Pilot the selected technology | December 2003 |
| 7 | Fine tune and install on two demonstration farms | May 2004 |
| 8 | Monitor the new system using the same parameters and benchmarks as for assessing the 'old' system | May 2005 |
| 9 | Final field day to spread the word | May 2005 |

## Findings

### *Monitoring Results*

*Problems Faced by Dairy Farmers – A Summary*

Dairy farmers face a range of practical problems in managing effluent application systems. Some are created through poor design, others by the environment of the dairy farm, particularly soils and climate.

The following observations were made during the first year of the project:

- Sand traps that are poorly designed are difficult to clean
- Dairy sheds without a rainwater diversion have a larger volume of effluent to deal with
- Water use associated with the dairy shed is often poorly regulated. The volume of effluent produced per cow is highly variable
- Effluent pump wear can be very significant, even within one season, leading to a significant loss of performance
- Automatic effluent pump controls are not always reliable
- The travelling irrigators commonly used to apply effluent are subject to wear and this can have a significant effect on irrigator performance
- The distribution of effluent by travelling irrigators is uneven and typically the instantaneous application rates are high
- Farms with only 1 to 2 days storage are virtually committed to irrigating daily regardless of soil and weather conditions. This increases the risk of ponding and run off
- Effluent receiving areas tend to grow more grass due to the application of nutrients which means more frequent grazing. This increases the risk of soil structure damage.

### *Soil infiltration results*

Infiltration measurements were taken in spring, summer and autumn on 10 farms.

*Spring 2002*

**Table 1:** 20 minute cumulative infiltration depth (mm) – clean water

| **Infiltration Depth** | **No. of Farms** |
|---|---|
| 0-10 mm | 4 |
| 10-20 mm | 2 |
| 20-50 mm | 2 |
| 50 mm + | 2 |

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**Notes:**

*Summer 2003*

The least depth of infiltration after 20 minutes was 70 mm, the greatest was 240 mm.

Inspection showed that the water was travelling down the shrinkage cracks through the topsoil into the subsoil particularly for the soils with higher readings.

*Autumn 2003*

Six farms had infiltration depths between 20 mm and 50 mm. Four farms had infiltration depths greater than 50 mm.

### Irrigator performance

The distribution of effluent under the travelling irrigators was checked on each farm during the season. Jars were placed across the irrigator's line of travel at 2.0 m intervals. The depth of application at that point was then measured and plotted. The rate of travel of the irrigator was also recorded.

*Results*

When the irrigator is stationary and distributing effluent the wetted pattern is a donut shape. When the irrigator moves forward this pattern is maintained. Consequently the depth of application is quite variable. Also it is badly affected by wind. Consequently the range in depth of application across the wetted diameter can vary from 12-40 mm, not counting the edge effects. The rate of application is also very high as typically the irrigators were set to speeds of 0.8-1.2 m per minute. Up to 40 mm depth of application could be applied in 0.5 hours or less. Irrigators in good order and set to their fastest speed could achieve average application depths as low as 10 mm but the range in depth was still significant.

### Nutrient loadings

During the season, samples of the effluent were collected representing what was being sprayed onto pasture.

Assuming 15 mm depth of application (i.e. 150 $m^3$ per hectare), the following table shows total nitrogen and phosphate loadings for a single irrigation event.

**Table 2:** Nutrient Loadings per ha per 15 mm Effluent Application Depth

| Farm | Total N kg | Total P kg |
|---|---|---|
| 1 | 50 | 8 |
| 2 | 69 | 6 |
| 3 | 90 | 27 |
| 4 | 57 | 7 |
| 5 | 24 | 4 |
| 6 | 60 | 9 |
| 7 | 54 | 7 |
| 8 | 51 | 8 |

Farms with the lowest loadings had the greatest amount of solid settling or removal prior to irrigation.

### *Implications*

Soils on the effluent receiving areas need to be managed to maintain structure and to balance nutrients.

Effluent needs to be applied at a rate that matches infiltration rates and applied when there is a suitable soil moisture deficit.

### *Trial work*

*K Line for effluent application*

To achieve a low application rate (mm/hr) much smaller nozzles are required than those currently used on travelling irrigators.

Because K line technology can be purchased off the shelf it was decided to trial this system in the first instance. Four farms took part in the trial. All had a pond with at least a month's effluent storage.

Initially the only change that was made to the existing effluent system on each farm was to disconnect the travelling irrigator and connect 12 K line pods and sprinklers. Blockages were

**Notes:**

expected since no filtration was installed but the aim of the exercise was to check the effect of low application rates on the soils.

Nozzle sizes of 3.0 mm up to 4.0 mm were tried. 4.0 mm nozzles were found to achieve an application rate of about 3.0 mm per hour. At that application rate there was no ponding and no bypass flow through the topsoil to the subsoil.

The second step was to trial a mesh filter and surface pump on one of the farms. Through trial and error it was found that the surface pump had to be a single stage centrifugal pump with plenty of clearance at the eye of the impellor. A 4 kw Grundfos ™ pump has been successfully trialled.

A 5,000 l plastic tank with holes drilled in it and wrapped in mesh was used as a filter. Although unwieldy, initial experience suggests it is doing the job in the short term.

### *Mechanical solids separation*

Farms with only 1-2 days storage for effluent cannot use K line irrigation without physically removing the solids.

A mechanical solids separator that works on the principle of a screw press was purchased and set up on a fifth farm.

Effluent is pumped from the existing pump sump with a Yardmaster RH3 ™ pump to the separator. The separator discharges the separated liquid to a 22,500 l tank and the solid into a large polypropylene bag (ex urea bag). From the 22,500 l tank the liquid effluent is pumped through a K line system.

## Conclusions to date

- The project so far has definitely confirmed the advantage of applying effluent at a low application rate
- Ponding, run off and bypass flow through the topsoil have all been eliminated
- The farmers involved also believe they are growing more pasture under K line than with the travelling irrigator
- More work is required to develop a reliable manageable system for those with ponds and those with pump sumps
- The need to remove solids from the pond system also needs to be considered.