Farm Dairy Effluent Irrigation Evaluations

Traveller 2

System details

- Small traveller with rubber orifices on rotating boom
  - Used to apply all effluent generated from the shed
  - Irrigator run at 'medium' speed
  - No overlap between runs
- Soils are variable; Takapau silts,
  - Significant ponding and runoff on day of visit
- Irrigation
  - Farm is not irrigated

Figure 1. Effluent irrigator crossing catch can transect

Consents and Conditions

Effluent consents held

1. All works and structures relating to this resource consent shall be designed and constructed to conform to the best engineering practices and at all times maintained to a safe and serviceable standard.

2. The consent holder shall undertake all operations in accordance with any drawings, specifications, statements of intent and other information supplied as part of the application for this resource consent. Where a conflict arises between any conditions of this consent and the application, the conditions of this consent will prevail.

3. The effluent discharged shall be generated from the milking of a herd of no more than 900 cows.

4. **All effluent from the farm dairy shall be collected in holding ponds with a total minimum capacity of 1400 m^3.**

5. The level of effluent in the holding pond shall be managed so that there is at least 500mm freeboard, in order to ensure that there is sufficient available capacity to allow for storage during wet weather and potential mechanical failure.

6. All clean stormwater from the farm dairy and feedpad shall be diverted away from the effluent collection holding ponds by means of an effective, purpose-made structure.

7. **The effluent spray irrigated to land shall be spread over an area not less than 48.2 hectares (based on 900 cows) and no more than 136 hectares annually to not exceed**

the maximum nitrogen loading of 150 kg/ha/yr (within the area shown on the plan attached to and forming part of this consent as Attachment 1). When the herd size is less than the maximum allowed, the area over which the effluent shall be irrigated will be determined by Table 1 (see advice notes) using the herd size at the peak of the season.

8. No effluent shall be discharged, either directly or indirectly through spray drift, within 200 metres of any residential dwelling, unless written approval has been obtained from the owner or occupier.

9. The consent holder shall calibrate the effluent irrigator at least twice per year (see advice notes b & c).

10. The consent holder shall record the following information.

    a) The number of cows milked as at the beginning of each month;

    b) The irrigator calibration details (including mm per pass);

    c) A map showing the location of the paddocks over which the discharge takes place (including paddock identification) and the area of each paddock that can be irrigated (in hectares);

    d) A daily record of each paddock over which the discharge took place (including paddock identification) and the number of passes.

    The consent holder shall provide the information listed above to the Council (Environmental Regulation Section) on request at the time of a monitoring inspection, or at any other interval that may be requested by the Council.

11. The consent holder shall ensure a sample of the farm dairy effluent is taken during September 2008, 2010, 2012 and 2014 and analysed for Total Nitrogen.

12. All effluent sampling shall be carried out by a suitably qualified person as authorised by the Manager: Environmental Regulation.

13. All effluent analyses shall be carried out by an independently accredited laboratory in accordance with the Standard Methods for the Examination of Water and Wastewater (20^{th} edition 1998), published jointly by the American Public Health Association, American Wastewater Association, and Water Environment Federation.

14. The results of the sampling shall be forwarded to the Council (Environmental Regulation Section) within one month of the sampling results being received.

15. That where, for any cause (accidental or otherwise), wastes associated with the Consent holder's operations escape to water other than in conformity with the consent, the Consent holder shall:

    a) Immediately notify the Council of the escape, and;

    b) Report to the Council, in writing and within 7 days, describing the manner and cause of the escape and steps taken to control it and prevent its recurrence.

If a conflict arises between any conditions of this consent and the application, the conditions of this consent will prevail.

Effluent irrigation evaluation

Small Traveller

This irrigator was applying effluent at rates in excess of the soil's infiltration and water holding capacities. This was easily identified with ponding covering much of the wetting area and effluent running up to 3m to the side on relatively flat ground. A summary of system performance is given in Table 1.

The table shows three sets of performance indicators: "Low Pressure" is based on 20m diameter spread of the wetting pattern as measured on arrival at the property. "Normal Pressure" calculations use measurements with a significant leak repaired, giving a 26m wetting diameter and lane spacing. "Full speed Equivalent" values are determined from the 26m Effective values, but for an irrigator travelling at full speed (50% faster). Note the higher speed changes the applied depth, but not rates or uniformities.

The maximum application rate is calculated from the area of the ring wetted by the irrigator boom as it rotates. Most of the effluent is applied in a ring between 13m and 15m out from the centre of the irrigator. In this smaller area, the effective instantaneous application rate is very high, causing noticeable ponding and run off.

In the graph (Figure 2), the depths measured in the field are shown as the dark orange line (low pressure with leak) and pink line (normal pressure, no leak). The relative applied depth if the irrigator was set to run at full speed is shown as the blue dots.
The peaks at the sides of the application pattern are typical of small travelling irrigators. Because of the ring application pattern and the forward movement, the sides receive effluent for a longer period than the centre of the travel path.

Table 1: Summary of Effluent Irrigation Performance

Small Traveller	Low Pressure	Normal Pressure	Full Speed Equivalent	
Wetting Diameter	20	26	26	m
Instant Application Area	314	531	531	m2
Machine speed	0.31	0.34	0.51	m/min
Effluent Mean Depth	42.1	35.1	23.4	mm
Mean Application Rate	38.9	27.6	27.6	mm/h
Wetting Ring Area	170	276	276	m2
Max Application Rate	72.0	53.0	53.0	mm/h
Hi Quart Mean Depth	67.1	62.9	42.0	mm
Lo Quart Mean Depth	22.5	21.2	14.1	mm
DU high	1.59	1.79	1.79	
DU low	0.53	0.60	0.60	

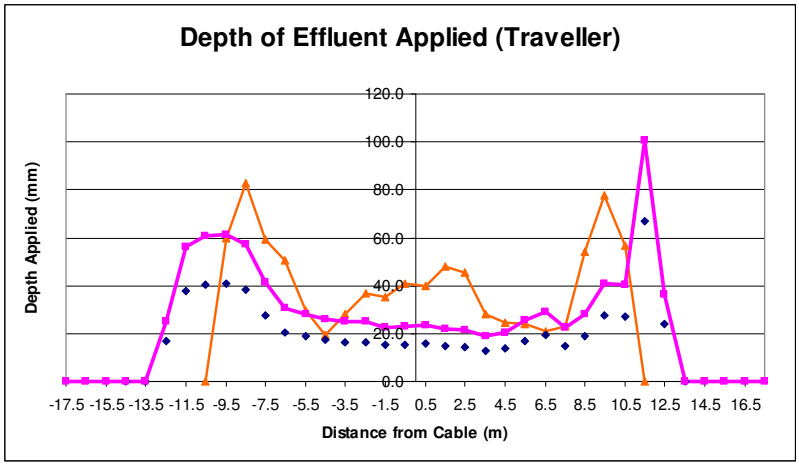

Figure 2. Effluent application pattern as measured at low pressure, normal pressure and an equivalent calculated for full machine speed

Recommended improvements

There is surface ponding

- The high application rate on small areas is causing surface ponding. This is causing redistribution through overland flow, though not to sensitive areas in the field where testing took place.
- Holes dug in the area immediately following application showed clear evidence of 'preferential flow', with soil wet to several centimetres in many parts, but wetted through the topsoil and into sub-soil in some locations. This is typical of high application rates to dry and potentially hydrophobic soils.
- Increasing machine pressure and speed will help reduce ponding. Increasing the width of the wetting ring will also help.

Pressure must be managed

- The owner ensured the effluent irrigator was tested exactly as it had been operating. Pressure was initially very low.
- After the initial evaluation, a leak in the delivery hose was repaired and the system retested. This increased pressure and wetting diameter, but ponding and surface flow were still evident and full speed would be preferable.
- The system was still running at a relatively low pressure but without test points, pressure could not be determined. Because the length of delivery hose varies as the machine is moved from paddock to paddock, there will be significant pressure differences. Further paddocks are likely to be adversely affected by low pressure and poor machine performance.

The boom applies effluent in a narrow ring.

- Fitting splash plates could increase the area of instantaneous application, and together with faster forward speed could reduce ponding.
- Figure 3 shows a splash plate fitted to a large travelling irrigator to deflect and widen the stream from the end nozzle.

Figure 3. Splash plate fitted to end nozzle to widen spread

Figure 4. Rubber nozzle crimped & cut to increase footprint

The effective lane spacing used for successive runs was not clear. A policy of alternating machine paths would help improve the overall uniformity over successive applications. This will not help on a single event basis, but will over the course of a season.