Farm Dairy Effluent Irrigation Evaluations

Stationary Gun 1

System details

- Two stage pond system
  - Effluent discharged to land via stationary gun
  - Tractor PTO pump at pond
  - Effluent into system appears well settled

- Moveable fixed gun 'Explorer' 30mm nozzle
  - Used to apply all effluent generated from the shed
  - Irrigator run for hours in each position
  - Overlap between adjacent positions unknown

- Soils are variable; silt loam
  - Considerable ponding and runoff on day of visit caused by inadequate operating pressure. Condition largely alleviated by increasing pressure.

- Irrigation
  - Farm is not irrigated

Figure 1. Effluent irrigator operating at 40kPa.

Figure 2. Effluent irrigator operating at 175 kPa.

Consent Details

Effluent consents held:

1. 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.
2. There shall be no surface ponding, or contamination of water resulting from the spray irrigation of farm dairy effluent to pasture, nor shall the disposal system be operated in such a way that offensive or objectionable odours or any other nuisances are created.
3. A buffer zone of 20 metres width shall be maintained between any waterbody and the edge of the spray disposal area. There shall be no direct spraying or entry of spray drift into any buffer zone.
4. The consent holder shall calibrate the farm dairy effluent irrigator at least annually, and shall record the effluent irrigation details on a land discharge report or management plan which shall include:
   a) The average number of cows milked each season;
   b) The irrigator calibration details (see Advice Notes b and c);
   c) The paddocks over which the discharge took place (including paddock identification);
   d) The size of each paddock (ha); and
   e) The discharge time period for each paddock (hours).

   The consent holder shall provide the farm dairy effluent irrigation details to Council on request.
5. The consent holder shall, commencing September 2000, take a sample of the farm dairy effluent during September every second year and analyse it for Total Nitrogen.

   The samples shall be tested at an independently accredited laboratory. The results of the sampling shall be forwarded to the Council (Environmental Regulation Section) within one month of the sampling results being received.
6. 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.
7. The effluent discharged shall be generated from the milking of a herd of no more than 400 cows.
8. All effluent from the farm dairy shall be collected in holding ponds, which have a minimum capacity of 3600 $m^{3.}$
9. 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.
10. All clean stormwater from the farm dairy and feedpad shall be diverted away from the effluent collection holding pond by means of an effective, purpose-made structure.
11. The effluent spray irrigated to land shall be spread over an area not less than 15 hectares annually at the maximum herd size allowed by this consent, in order not to exceed the maximum nitrogen loading of 150 kg/ha/yr. 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.

Effluent Irrigation Evaluation

Stationary Gun

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. When pressure was increased, performance was greatly enhanced. A summary of system performance is given in Table 1.

Table 1: Summary of Effluent Irrigation Performance

Stationary Gun	**40kPa**	**175 kPa**	
Wetting Diameter	30	60	m
Wetting Area	707	2827	m2
Mean Application Rate	28.3	19.1	m/min
Max Application Rate	100	36	mm/h
High Quarter App Depth	66.4	27.1	m2
Low AppDepth	6.9	10.1	mm/h
DU High	2.34	1.42	mm
DU Low	0.24	0.53	mm

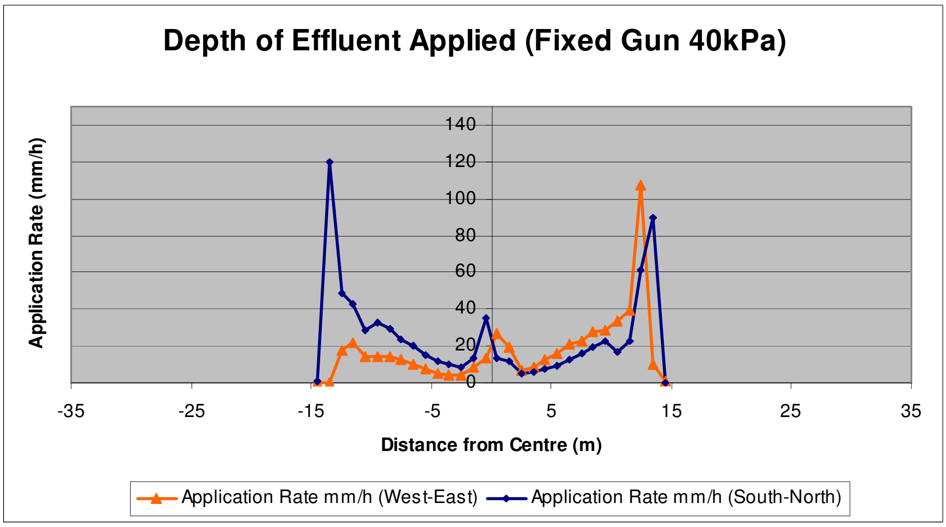

Figure 2. Effluent application pattern measured at original pressure (no overlap between adjacent sites)

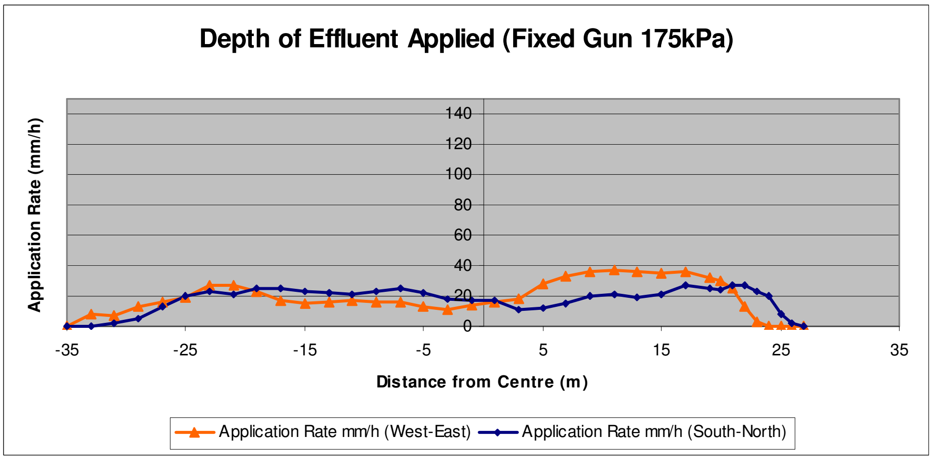

Figure 3. Effluent application pattern measured at increased system pressure (no overlap between adjacent sites)

In the graphs (Figures 2 and 3), the depth of effluent measured in the field is shown as the depth applied in one hour (equivalent to rainfall intensity). The two lines represent two transects measured at right angles to one another across the area served by the gun.

The peaks at the sides of the application pattern in figure 2 show very clearly that the stream leaving the nozzle did not break up, but landed in a very narrow band as the gun rotated. This was due to excessively low operating pressure at the nozzle.

Figure 3 shows results after pressure was increased more than fourfold. A much more even pattern was obtained, and a greatly increased area was covered. Figure 3 also shows the impact of wind displacing the application pattern. The less coarse droplets and higher trajectory combined to make this more noticeable than in the first low pressure test.

The low quartile application uniformity of the system once pressure was increased was DU_{LQ} = 0.53. This is generally considered poor, but the calculations included the area at the perimeter where only very low rates of application were measured. If these were ignored, the uniformity would increase. It is very likely that further increasing system pressure will also further improve uniformity, and probably further reduce application rates.

Recommended Improvements

1. The machine performance was severely affected by low pressure.

The system relies on a tractor driven PTO pump and effluent hose to deliver effluent to the gun.

- The hose rating limits pressure to 600 kPa, and the tractor pump cannot create sufficient pressure anyway.
- The gun has a minimum recommended operating pressure at the nozzle of 300 kPa.
  - At 300kPa the wetting radius should be 48 m.
  - When testing started nozzle pressure was only 40 kPa and wetting radius was 15 m
  - At 175 kPa the radius increased to 30 m.

2. There was surface ponding

The high application rate on a very small area caused surface ponding and runoff.

- This is causing redistribution extending tens of metres away from the target area, though not to sensitive areas in the field where testing took place.
- Increasing gun pressure reduced ponding. Increasing the wetting radius also reduced applied depth, increases the served area and allows longer run times in any one location.
  - Kronos Explorer gun data tables show application rates for 30mm nozzle at 300 to 400kPa of 6 to 8mm/hour.

3. Pump system upgrade would be helpful

The current system cannot meet satisfactory performance standards.

- The gun is capable of achieving good uniformity and applying effluent at appropriate rates over a large area.
- A correctly designed and installed pumping system and main lines with hydrants would greatly improve system performance and reduce labour demands.