



# Dairy Shed Water Use in Victoria

2009 Analysis

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Published by the Department of Primary Industries  
March 2010

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Authorised by the Department of Primary Industries  
1 Spring Street, Melbourne 3000.

ISBN 978-1-74264-065-5 (online)

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## Acknowledgements

The statistical analysis in this report was prepared by Leigh Callinan PhD, AStat from Bendigo Scientific Data Analysts. The Department of Primary Industries (DPI) appreciates his help in preparing this report.

DPI would also like to acknowledge the assistance received in the preparation of this report from:

DPI - Rachael Ward, Benita Kelsall, Scott McDonald, Rod Eldridge, Julie Williams, Joel Spry, Barrie Bradshaw, Ann McDowell, Sue Keirnan and Leah de Vries

Fonterra Australia - John Kane

AgVet Projects - Dr Rob Greenall

Dairy Shed Water Licence Transition Program Committee - Chair, Patrick O'Halloran (Department of Sustainability and Environment), and committee members Simon Cowan (Goulburn-Murray Water), Basil Ryan (Victorian Farmers Federation) and Peter Haynes (Australian Dairy Products Federation).

# Dairy Shed Water Use - 2009 Analysis

For the past nine years, DPI dairy extension officers have been assisting dairy farmers across Victoria to develop effluent management plans for dairy sheds.

This has involved comprehensive on farm data collection, which includes water use measurements and calculations to determine water use by each of the main processes in the dairy operation.

In 2005 DPI senior dairy extension officer Scott McDonald produced a report 'Water use in dairy sheds' from data collected to that point. The report highlighted the variation in the volumes of fresh and recycled water used in dairy shed processes and the total volumes for various dairy shed systems.

This information has been useful for DPI dairy extension staff and service providers assisting dairy farmers to assess and compare their water use requirements against similar dairy shed systems. In turn, this has enabled farmers to adopt water saving strategies and maintain dairy operations despite drought conditions.

Industry bodies, United Dairyfarmers of Victoria (UDV) and Victorian Farmers Federation (VFF), campaigned to ensure sufficient water allocation for existing dairy farmers and also to allow new entrants into the dairy industry.

In line with current water policy, the Department of Sustainability and Environment (DSE) introduced a policy to allow this to happen, with water corporations responsible for the licensing process.

This report has been prepared for DPI by Biometrician Leigh Callinan, Bendigo Scientific Data Analysts, as an update of the 2005 report and to provide predictions of 'reasonable' daily water use.

The key aspects of this report have been reproduced in the Department of Primary Industries booklet 'Dairy shed water – How much do you use?' The booklet is a comprehensive guide to calculating water use in the dairy shed and is available on the DPI website or by contacting DPI and DSE Customer Service Centre on 136 186.

This biometric report has been compiled to determine correlations between the volume of water used within the dairy shed per day and herd numbers or shed type.

The information used to prepare this report was sourced from the DPI Dairy Nutrients databases and collected from more than 1,500 farms across the dairying regions of Northern Victoria, South West Victoria and Gippsland. Data relating to water used in the dairy shed was collected during the development of effluent management plans for the individual farms.

This report has identified a relationship between herd numbers, dairy shed type (rotary, double up herringbone, swing over herringbone) and the volume of water used per day. This is shown in Table 6, 75<sup>th</sup> percentile for predicted individual Water Use per Day (l) by Herd Size and Dairy

Type of this report, and as Table 1 on page four of the DPI booklet 'Dairy shed water – How much do you use?'

However, it should be noted that the dataset is limited in regard to

- rotary dairies with more than 600 cows (only 27 dairies in the dataset);
- double up dairies with herds of more than 400 cows (only three dairies in the dataset); and
- swing over herringbone dairies with herds of more than 400 cows (only four dairies in the dataset).

As such the percentiles for these categories may be unreliable.

The daily water usage has also been converted to an annual water use by using a multiplier of 365, and is shown in Table 2, Predicted 75<sup>th</sup> percentile for Dairy Water Use per Year (ML/yr) by Herd Size and Dairy Type of the DPI booklet 'Dairy shed water – How much do you use?'. This gives an indication of 'reasonable' annual dairy shed water usage.

Even though the report showed a correlation between herd size and water use, it is worth noting even the smaller herd operators have been known to have water consumption equalling the larger herds.

When the data was collected, the daily water use was determined by either flow rate or storage volume measurements as well as detailed discussions with dairy owners and shed operators. Flow rate was measured by timing how long a known volume container took to fill then multiplying this by the time taken for each process, and totalling to reach the daily water use. However, this method relied heavily on the accuracy with which the dairy shed operator could determine how long each task took with variables including daily, seasonal and operator differences. Alternatively, if all the water used in the dairy shed was sourced via a storage such as a tank, then a daily estimate could be made from the proportion of the storage volume used.

When calculating and comparing total dairy water use it is worth noting that within the dairy the tasks that generally require large amounts of water are the plate cooler, yard wash and continuous platform sprays used in some rotary dairies. Although the water from these tasks is often reused within the dairy, such as recycling the plate cooler water for yard wash, this is not always the case and can be the reason for high annual volumes of water used.

Also note that in this report the term effluent refers to the urine and solid components accumulated in the yard and dairy and the water used to clean the yard and inside the dairy (all material that would enter the effluent management system).

Water saving strategies in the dairy are important, but these should never compromise milk quality.

## The Biometrician Report (4 August, 2009) - Summary

The Department of Primary Industries surveyed water use volumes and practices on approximately 1,500 dairy farms in Victoria (Gippsland, North and South West), from January 2001 to February 2009. The means, medians and ranges for all the water use components within the dairy, as well as an overall comparison of regions and dairy types (double up herringbones, rotaries and swing over herringbones) are reported here.

South Western Victoria had proportionately more swing overs (61 per cent compared to 42 per cent in Gippsland and 51 per cent in the North) and less doubles.

Northern Victoria had proportionately more rotaries (26 per cent compared to 21 per cent in Gippsland and 23 per cent in the South West).

Water use per day was significantly greater in the North than in South West which in turn was significantly greater than in Gippsland. Water use per day was significantly associated with both dairy type (rotary greater than swing over and in turn greater than double) and herd size. Water use per day increased with increasing herd size in swing overs to a significantly greater extent than in doubles or rotaries; and doubles to a greater extent than in rotaries. Rotaries have higher water use which is less sensitive to herd size.

Water use per day per cow, as well as being significantly associated with region (North greater than South West and Gippsland), was significantly associated with dairy type (rotary greater than swing over and in turn greater than double).

Rotaries had significantly:

- More effluent per cow produced than either herringbones
- Greater incidence of recycled water use than double
- Greater incidence of caught shed water than double
- More flood than hose yard wash than either double or swing over
- Greater incidence of plate cooler water diverted than swing over

Swing over had significantly:

- Greater incidence of caught shed water than did double

- Lower incidence of plate cooler water diverted than did swing over.

Gippsland had significantly more hose than flood yard wash than either the North or South West.

Gippsland and Northern Victoria had significantly higher proportions of farms that used recycled water and caught shed water than the South West.

Gippsland and the South West had a significantly greater proportion of farms that had plate cooler water diverted than did the North.

Northern Victoria had significantly more plant rinse and pit/platform washing than the South West.

## Methods

The distribution of continuous variables like water use per day was tabled with:

1. The number of farms with water use per day recorded
2. The mean of water use per day
3. Some percentiles of water use per day, viz: 0, 5, 25, 50, 75 and 100. The 0 percentile is the minimum water use per day recorded, the 100 percentile is the maximum and the 50 percentile is the median. When recorded water use per day are arranged from lowest to highest, the median is the value in the middle, or the mean of 2 values in the middle, the 5 percentile is the highest value of the lowest 5 per cent of values.

Significant differences between levels of factors such as region in variates such as water use per day were determined by analysis of variance, using Fisher's Unprotected Least Significant Difference with a type 1 error of 5%, ie. LSD<sub>5%</sub>. Residual Maximum Likelihood (REML) was used to determine the significance of differences between levels of multiple factors and variates. Contingency table analyses were done with X<sup>2</sup> test, Fisher's Exact 2 \* 2 test and multinomial analytical methods. In this report significant means p < 0.05, unless otherwise specified.

Statistical analyses were done with:

- GenStat for Windows. (2007). 10th Edn. VSN International Ltd., Hemel Hempstead, UK,
- R version 2.7.2 (2008). The R Foundation for Statistical Computing, and
- StatXact Version 8.0.0. Cytel Studio. MA, USA.

## Results

Data was collected from 14 January 2001 to 9 February 2009.

## Region

The regional distribution of water use per day is shown in Table 1.

|                |             |                 | Percentiles |             |             |             |              |              |               |
|----------------|-------------|-----------------|-------------|-------------|-------------|-------------|--------------|--------------|---------------|
| Region         | No.         | Mean            | 0%          | 5%          | 25%         | 50%         | 75%          | 95%          | 100%          |
| Gippsland      | 702         | 9780.69         | 100         | 1501.5      | 3500        | 6000        | 10400        | 30000        | 140000        |
| North          | 337         | 14867.82        | 1010        | 3000        | 6045        | 9900        | 19700        | 45220        | 84000         |
| SW             | 298         | 10568.97        | 1000        | 2113.5      | 4887.5      | 7000        | 12075        | 29150        | 97000         |
| <b>Overall</b> | <b>1337</b> | <b>11238.63</b> | <b>100</b>  | <b>2000</b> | <b>4220</b> | <b>7200</b> | <b>13350</b> | <b>35000</b> | <b>140000</b> |

Table 1. Frequencies, means and percentiles for water use per day (l/day) by region

Water use per day was significantly greater in the North than in the South West which in turn was significantly greater than in Gippsland.

The data indicates that dairies in the northern area use more water per day than dairies in the South West or Gippsland for comparable herd size and shed type. This could be due to a number of reasons:

- Many of the effluent plans for the northern area were done in earlier years, prior to the current prolonged dry conditions and reduced access to water, when the farms had ready access to a plentiful supply of water via the channel system
- Comparative higher rainfall in Gippsland and South West could also contribute additional water to the effluent system, to be stored in the ponds for reuse or recycling
- Greater volumes of water used for cooling cows to reduce heat stress
- Higher evaporation, resulting in drying and caking of manure, requiring more water to washdown.
- Significantly more floodwash systems in larger dairy sheds in the North.
- A report by Dairy Australia on dairy farms and cow distribution in Catchment Management Authority (CMA)

regions (2007) indicated the Goulburn Broken has more larger farms (more than 300 cows) compared to other catchments.

## Herd Size

Water use per day increased significantly ( $p < 0.001$ ) with increasing Herd Size (Figure 1).

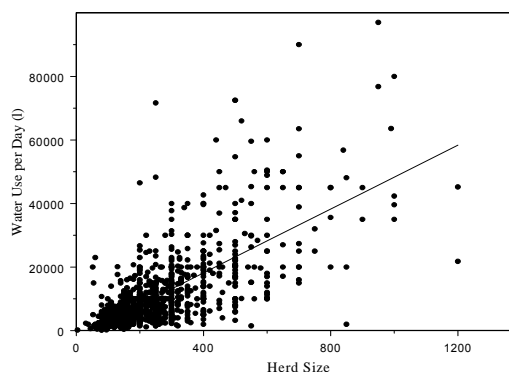


Figure 1. Water use per day by herd size with linear best fit (1 outlier removed)

## Water use per day per cow

There was a near significant ( $p = 0.07$ ) decline in water use per day per cow during June 2001 to February 2009 (Figure 2).

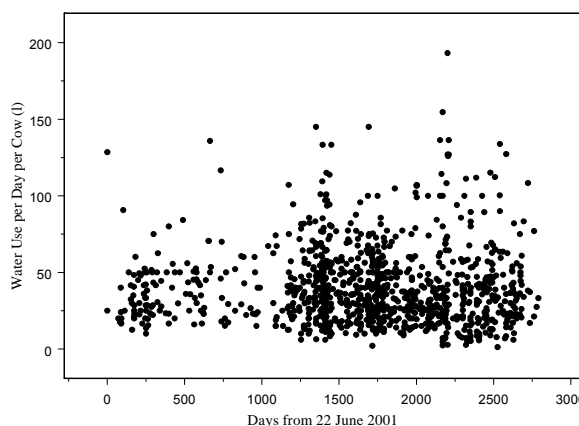


Figure 2. Water Use per Day per Cow vs Date

Statistical models of water use might need to include day number as an explanatory variable.

There was no significant association between water use and day number of year. This is not surprising, as water use per day is an estimate for the overall milking period, not the water use on the day the farm was visited.

Water use per day per cow was significantly higher in the North than in either Gippsland or the South West (Table 2).

|                |             |              | Percentiles |              |              |              |              |               |               |
|----------------|-------------|--------------|-------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Region         | No.         | Mean         | 0%          | 5%           | 25%          | 50%          | 75%          | 95%           | 100%          |
| Gippsland      | 681         | 39.51        | 1.25        | 10.00        | 20.00        | 32.50        | 50.00        | 89.44         | 384.62        |
| North          | 336         | 53.00        | 6.40        | 17.09        | 30.05        | 43.08        | 64.27        | 115.13        | 383.33        |
| SW             | 270         | 36.24        | 3.94        | 12.50        | 22.93        | 31.33        | 45.81        | 71.14         | 155.00        |
| <b>Overall</b> | <b>1287</b> | <b>42.35</b> | <b>1.25</b> | <b>11.62</b> | <b>22.86</b> | <b>11.62</b> | <b>51.05</b> | <b>100.00</b> | <b>384.62</b> |

Table 2. Frequencies, means and percentiles for Water Use per Day per Cow (l/day)

## Dairy Type

Herringbone dairies can be either double or swing over; the latter has one cluster shared between each pair of adjacent cows. Twenty three dairies were not identified as either double or swing over. For the purposes of the analysis, this group was omitted (Table 3).

|                   |            |                 | Percentiles |             |             |             |              |              |               |
|-------------------|------------|-----------------|-------------|-------------|-------------|-------------|--------------|--------------|---------------|
| Dairy Type        | No.        | Mean            | 0%          | 5%          | 25%         | 50%         | 75%          | 95%          | 100%          |
| Double H/bone     | 221        | 7038.95         | 100         | 1570        | 3500        | 5025        | 9000         | 18930        | 30000         |
| H/bone            | 23         | 6963.04         | 2400        | 2500        | 3875        | 6500        | 10000        | 13250        | 14000         |
| Rotary            | 182        | 25102.16        | 1500        | 4929        | 12250       | 20000       | 30225        | 60361        | 140000        |
| Swing over h/bone | 389        | 8010.33         | 480         | 1922        | 3880        | 6200        | 10000        | 20552        | 48300         |
| Walk-through      | 17         | 2909.41         | 150         | 190         | 1010        | 2000        | 3000         | 7800         | 15000         |
| <b>Overall</b>    | <b>832</b> | <b>11357.97</b> | <b>100</b>  | <b>2000</b> | <b>4000</b> | <b>7000</b> | <b>14450</b> | <b>35270</b> | <b>140000</b> |

Table 3. Frequencies, means and percentiles for water use per day (l/day) by dairy type

There was a significant ( $p < 0.01$ ) association between region and dairy type (Table 4).

| Region       | Double H/bone | Swing over H/bone | H/bone    | Rotary     | Walk through | Total      |
|--------------|---------------|-------------------|-----------|------------|--------------|------------|
| Gippsland    | 141           | 199               | 23        | 93         | 16           | 472        |
| North        | 69            | 150               | 0         | 77         | 1            | 297        |
| SW           | 12            | 47                | 0         | 18         | 0            | 77         |
| <b>Total</b> | <b>222</b>    | <b>396</b>        | <b>23</b> | <b>188</b> | <b>17</b>    | <b>846</b> |

Table 4. Frequency distributions for dairy type by region

South West Victoria had proportionately more swing overs (61 per cent compared to 42 per cent Gippsland and 51 per cent in the North) and less doubles. The North had a greater proportion of rotaries (26 per cent compared to 21 per cent in Gippsland and 23 per cent in the South West).

Water use per day, as well as being significantly ( $p < 0.001$ ) associated with the region (North greater than Gippsland and in turn greater than South West), was significantly ( $p < 0.01$ ) associated with dairy type (rotary greater than swing over and in turn greater than double) (Table 5).

There was no significant ( $p = 0.13$ ) interaction between these two factors. The differences between dairy types did not differ significantly between regions (Table 5).

| Region             |             | Double         | Rotary          | Swing Over      | All Regions     |
|--------------------|-------------|----------------|-----------------|-----------------|-----------------|
| Gippsland          | Mean        | 6574.82        | 21802.73        | 6449.22         | 9795.19         |
|                    | No.         | 140            | 93              | 199             | 432             |
| North              | Mean        | 8489.87        | 30355.40        | 10338.28        | 14937.28        |
|                    | No.         | 69             | 73              | 148             | 290             |
| SW                 | Mean        | 4111.00        | 20312.19        | 7203.81         | 9669.81         |
|                    | No.         | 12             | 16              | 42              | 70              |
| <b>Total</b>       | <b>Mean</b> | <b>7038.95</b> | <b>25102.16</b> | <b>8010.332</b> | <b>11666.90</b> |
| <b>All Dairies</b> | <b>No.</b>  | <b>221</b>     | <b>182</b>      | <b>389</b>      | <b>792</b>      |

Table 5. Frequencies and means of water use per day for region by dairy type

Water use per day was significantly associated with both dairy type (rotary greater than swing over and in turn greater than double,  $p < 0.001$ ) and herd size ( $P < 0.001$ ), and there was a significant interaction between dairy type and herd

size, viz: water use per day rose with increasing herd size in swing overs to a greater extent than in doubles or rotaries; and doubles to a greater extent than in rotaries ( $p < 0.001$ ). Rotaries have higher water use and are less sensitive to herd size.

The statistical model predicts that 75 per cent of individual dairies would have water use per day below the thresholds shown in Table 6 below.

| Dairy Type\Herd Size | 50   | 100   | 200   | 300   | 400   | 500                | 600                | 700                | 800                | 900                |
|----------------------|------|-------|-------|-------|-------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Double               | 5642 | 6456  | 8465  | 11131 | 14654 | 19348 <sup>1</sup> |                    |                    |                    |                    |
| Rotary               |      | 18358 | 21057 | 24142 | 27694 | 31790              | 36509 <sup>1</sup> | 41957 <sup>1</sup> | 48243 <sup>1</sup> | 55502 <sup>1</sup> |
| Swing Over           | 4921 | 6113  | 9444  | 14618 | 22663 | 25195 <sup>1</sup> |                    |                    |                    |                    |

<sup>1</sup> There were only three double and four swing over dairies with herd sizes of more than 400 and there were only 27 rotary dairies with herd size of more than 600; so percentiles for these categories may be unreliable.

Table 6. 75th percentile for predicted individual water use per day (l) by herd size and dairy type.

Water use per day per cow, as well as being significantly ( $p < 0.001$ ) associated with the region (North greater than Gippsland and South West), was significantly ( $p < 0.01$ ) associated with dairy type (rotary greater than swing over and in turn greater than double) (Table 7). There was no significant ( $p = 0.18$ ) interaction between these two factors.

| Region      |      | Double | Rotary | Swing Over | All Regions |
|-------------|------|--------|--------|------------|-------------|
| Gippsland   | Mean | 32.75  | 50.05  | 33.73      | 35.63       |
|             | No.  | 135    | 91     | 196        | 422         |
| North       | Mean | 43.84  | 65.69  | 48.62      | 56.38       |
|             | No.  | 69     | 72     | 148        | 289         |
| SW          | Mean | 19.55  | 50.11  | 36.02      | 39.72       |
|             | No.  | 11     | 15     | 39         | 65          |
| All regions | Mean | 36.94  | 51.73  | 36.48      | 42.41       |
|             | No.  | 215    | 178    | 383        | 776         |

Table 7. Frequencies and means of water use per day per cow (l) for region by dairy type.

## Dairy Size

Dairy size was measured by total number of clusters in use at any one time.

Total cluster number was not significantly different between regions (Table 8).

| Region         | No.        | Mean        |
|----------------|------------|-------------|
| Gippsland      | 441        | 25.73       |
| North          | 281        | 27.91       |
| SW             | 51         | 26.98       |
| <b>Overall</b> | <b>773</b> | <b>26.6</b> |

Table 8. Frequencies and means for total cluster number by region.

Water use per day was significantly and positively associated with total cluster number. Water use per day per cow was found to be significantly associated with dairy type ( $p < 0.001$ ), but not with total cluster number ( $p = 0.12$ ) and there was no significant interaction between dairy type and total cluster number ( $p = 0.46$ ).

## Vat Washing

The distribution of vat washing overall and in the regions is shown in Table 9.

|                |            |               | Percentiles |           |            |            |            |            |             |
|----------------|------------|---------------|-------------|-----------|------------|------------|------------|------------|-------------|
| Region         | No.        | Mean          | 0%          | 5%        | 25%        | 50%        | 75%        | 95%        | 100%        |
| Gippsland      | 12         | 378.75        | 35          | 49        | 100        | 325        | 525        | 890        | 1000        |
| North          | 310        | 366.71        | 10          | 42        | 116        | 300        | 600        | 800        | 1600        |
| SW             | 88         | 423.75        | 20          | 40        | 150        | 300        | 600        | 1000       | 2500        |
| <b>Overall</b> | <b>410</b> | <b>379.30</b> | <b>10</b>   | <b>40</b> | <b>120</b> | <b>300</b> | <b>600</b> | <b>800</b> | <b>2500</b> |

Table 9. Frequencies, means and percentiles for vat washing (l/day) by region

There was no significant ( $p = 0.79$ ) difference in vat washing between the North and South West. There were too few vat washing dairies in Gippsland to include in this analysis.

Vat washing was recorded for only two walk-through dairies. This category was not included in Table 10.

|                   |            |               | Percentiles |           |            |            |            |            |             |
|-------------------|------------|---------------|-------------|-----------|------------|------------|------------|------------|-------------|
| Dairy Type        | No.        | Mean          | 0%          | 5%        | 25%        | 50%        | 75%        | 95%        | 100%        |
| Double H/bone     | 79         | 275.57        | 20          | 34        | 70         | 200        | 400        | 800        | 800         |
| Rotary            | 75         | 572.13        | 100         | 100       | 325        | 600        | 800        | 1060       | 1600        |
| Swing Over H/bone | 166        | 347.74        | 20          | 46        | 111        | 300        | 500        | 800        | 1400        |
| <b>Overall</b>    | <b>322</b> | <b>383.28</b> | <b>10</b>   | <b>40</b> | <b>120</b> | <b>350</b> | <b>600</b> | <b>800</b> | <b>1600</b> |

Table 10. Frequencies, means and percentiles for vat washing (l/day) by dairy type

There was significantly more vat washing water used in rotaries than in swing overs and significantly more in swing overs than in doubles.

However, there were no significant differences between dairy types in vat washing per cow (Table 11).

| Type of Dairy          | Count      | Mean         |
|------------------------|------------|--------------|
| Double Herringbone     | 78         | 1.396        |
| Rotary                 | 74         | 1.311        |
| Swing over Herringbone | 165        | 1.689        |
| <b>Overall</b>         | <b>317</b> | <b>1.529</b> |

Table 11. Frequencies and means for vat washing (l/day) per cow

## Plant rinse

The regional distributions of plant rinse are shown in Table 12 - see next column.

|                |            |                | Percentiles |            |            |            |             |             |              |
|----------------|------------|----------------|-------------|------------|------------|------------|-------------|-------------|--------------|
| Region         | No.        | Mean           | 0%          | 5%         | 25%        | 50%        | 75%         | 95%         | 100%         |
| Gippsland      | 12         | 974.17         | 150         | 309.5      | 500        | 700        | 1075        | 2340        | 3000         |
| North          | 315        | 1174.70        | 60          | 271        | 600        | 940        | 1200        | 2500        | 18000        |
| SW             | 90         | 850.56         | 100         | 205        | 500        | 800        | 1000        | 1600        | 2750         |
| <b>Overall</b> | <b>417</b> | <b>1098.97</b> | <b>60</b>   | <b>236</b> | <b>600</b> | <b>900</b> | <b>1200</b> | <b>2452</b> | <b>18000</b> |

Table 12. Frequencies, means and percentiles for plant rinse (l/day) by region

The North had significantly ( $p = 0.005$ ) more plant rinse than the South West. There were not enough dairies with plant rinse in Gippsland to include in this analysis.

Only one walk-through had a record for plant rinse. Significantly more plant rinse occurred in rotaries than in either herringbones (Table 13).

|                        |            |                | Percentiles |            |            |            |             |             |             |
|------------------------|------------|----------------|-------------|------------|------------|------------|-------------|-------------|-------------|
| Dairy Type             | No.        | Mean           | 0%          | 5%         | 25%        | 50%        | 75%         | 95%         | 100%        |
| Double Herringbone     | 81         | 887.78         | 60          | 120        | 500        | 750        | 980         | 2000        | 9000        |
| Rotary                 | 75         | 1852.80        | 150         | 800        | 1200       | 1600       | 2400        | 3060        | 6470        |
| Swing over Herringbone | 170        | 874.58         | 140         | 240        | 600        | 800        | 1175        | 1473        | 5454        |
| <b>Overall</b>         | <b>326</b> | <b>1102.91</b> | <b>60</b>   | <b>240</b> | <b>600</b> | <b>900</b> | <b>1200</b> | <b>2485</b> | <b>9000</b> |

Table 13. Frequencies, means and percentiles for plant rinse (l/day) by dairy type

There were no significant differences in plant rinse per cow per day between dairy types (Table 14).

| Dairy Type             | Count      | Mean         |
|------------------------|------------|--------------|
| Double Herringbone     | 80         | 4.673        |
| Rotary                 | 74         | 4.262        |
| Swing over Herringbone | 169        | 4.494        |
| <b>Overall</b>         | <b>323</b> | <b>4.485</b> |

Table 14. Frequencies and means for plant rinse per cow (l/day) by dairy type.

## Pit and Platform Washing

The regional distributions of pit and platform washing are shown in Table 15.

|                |            |                | Percentiles |            |             |             |             |                |              |
|----------------|------------|----------------|-------------|------------|-------------|-------------|-------------|----------------|--------------|
| Region         | No.        | Mean           | 0%          | 5%         | 25%         | 50%         | 75%         | 95%            | 100%         |
| Gippsland      | 6          | 2000.00        | 300         | 475        | 1050        | 1600        | 2375        | 4375           | 5000         |
| North          | 301        | 5413.96        | 40          | 800        | 2000        | 3990        | 6000        | 13500          | 91000        |
| SW             | 77         | 3256.10        | 100         | 380        | 1250        | 2400        | 4000        | 10328          | 15600        |
| <b>Overall</b> | <b>384</b> | <b>4927.92</b> | <b>40</b>   | <b>500</b> | <b>2000</b> | <b>3500</b> | <b>6000</b> | <b>12426.5</b> | <b>91000</b> |

Table 15. Frequencies, means and percentiles for pit and platform washing (l/day) by region.

The North had significantly ( $p < 0.001$ ) more pit and platform washing than the South West. There were not enough dairies with pit and platform washing in Gippsland to include in this analysis.

The distribution of pit and platform washing in the dairy types is shown in Table 16.

|                   |            |                | Percentiles |            |             |             |             |              |              |
|-------------------|------------|----------------|-------------|------------|-------------|-------------|-------------|--------------|--------------|
| Dairy Type        | No.        | Mean           | 0%          | 5%         | 25%         | 50%         | 75%         | 95%          | 100%         |
| Double H/bone     | 74         | 4684.27        | 100         | 323        | 1500        | 3000        | 4800        | 9210         | 91000        |
| Rotary            | 73         | 8510.66        | 600         | 2240       | 4000        | 6800        | 10800       | 21780        | 43200        |
| Swing over H/bone | 157        | 4157.05        | 40          | 800        | 2000        | 3200        | 5625        | 9020         | 48000        |
| <b>Overall</b>    | <b>325</b> | <b>5315.97</b> | <b>40</b>   | <b>800</b> | <b>2000</b> | <b>3750</b> | <b>6000</b> | <b>13160</b> | <b>91000</b> |

Table 16. Frequencies, means and percentiles for pit and platform washing (l/day) by dairy type.

There were no significant differences between dairy types in pit and platform washing per cow.

## Flood Wash

The regional distributions of flood wash are shown in Table 17.

|                |            |                 | Percentiles |             |             |             |              |              |              |
|----------------|------------|-----------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|
| Region         | No.        | Mean            | 0%          | 5%          | 25%         | 50%         | 75%          | 95%          | 100%         |
| Gippsland      | 4          | 19125.00        | 3000        | 3300        | 4500        | 6750        | 21375        | 52275        | 60000        |
| North          | 192        | 10931.36        | 1000        | 1300        | 4000        | 8650        | 15000        | 27956        | 60000        |
| SW             | 10         | 8625.009        | 1800        | 1845        | 2487        | 5550        | 9500         | 24600        | 30000        |
| <b>Overall</b> | <b>206</b> | <b>10978.50</b> | <b>1000</b> | <b>1374</b> | <b>4000</b> | <b>8000</b> | <b>15000</b> | <b>29720</b> | <b>60000</b> |

Table 17. Frequencies, means and percentiles for flood wash (l/day) by region

There were too few dairies in Gippsland and the South West with flood washing for any statistical inference about regional differences.

The distribution of flood wash in the dairy types is shown in Table 18.

|                   |            |                 | Percentiles |             |             |             |              |              |              |
|-------------------|------------|-----------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|
| Dairy Type        | No.        | Mean            | 0%          | 5%          | 25%         | 50%         | 75%          | 95%          | 100%         |
| Double H/bone     | 23         | 8732.17         | 1260        | 1550        | 3500        | 7000        | 13990        | 15900        | 18000        |
| Rotary            | 61         | 16403.44        | 2400        | 4500        | 10000       | 15000       | 18000        | 40000        | 60000        |
| Swing Over H/bone | 75         | 8096.47         | 1000        | 1200        | 3038        | 6000        | 11650        | 20300        | 45000        |
| <b>Overall</b>    | <b>159</b> | <b>11375.38</b> | <b>1000</b> | <b>1500</b> | <b>4150</b> | <b>9969</b> | <b>15000</b> | <b>27480</b> | <b>60000</b> |

Table 18. Frequencies, means and percentiles for flood wash (l/day) by dairy type

There were no significant differences between the dairy types in flood wash used per cow. The data for teat washing, yard washing, plate cooler, cup sprays and yard wetters are very sparse (Table 19) and will not be further considered.

| Region    | Teat Washing |     | Yard Washing |     | Plate Cooler |     | Cup Sprays |     | Yard Wetters |     |
|-----------|--------------|-----|--------------|-----|--------------|-----|------------|-----|--------------|-----|
|           | Mean         | No. | Mean         | No. | Mean         | No. | Mean       | No. | Mean         | No. |
| Gippsland |              |     | 4717         | 10  | 2000         | 5   |            |     |              |     |
| North     | 291          | 61  |              |     | 11177        | 30  | 6139       | 50  | 2616         | 7   |
| SW        |              |     | 5008         | 58  | 2880         | 1   | 4909       | 10  |              |     |

Table 19. Frequencies and means for teat washing, yard washing, plate cooler, cup sprays and yard wetters (l/day) by region.

## Effluent produced per year

Effluent was not recorded in the North (Table 20).

| Region         | No.        | Mean        | Percentiles |          |          |            |          |           |           |
|----------------|------------|-------------|-------------|----------|----------|------------|----------|-----------|-----------|
|                |            |             | 0%          | 5%       | 25%      | 50%        | 75%      | 95%       | 100%      |
| Gippsland      | 515        | 4.74        | 0.05        | 1        | 2        | 3.6        | 5.6      | 13.16     | 30        |
| SW             | 267        | 4.08        | 0.65        | 1.2      | 2.15     | 3.1        | 4.5      | 10        | 27        |
| <b>Overall</b> | <b>782</b> | <b>4.51</b> | <b>0.05</b> | <b>1</b> | <b>2</b> | <b>3.5</b> | <b>5</b> | <b>11</b> | <b>30</b> |

Table 20. Frequencies, means and percentiles for effluent (ML/year) by region

There was no significant ( $p = 0.26$ ) difference in effluent produced per dairy between Gippsland and the South West.

The distribution of effluent in the dairy types is shown in Table 21.

| Dairy Type             | No.        | Mean        | Percentiles |          |          |            |            |           |           |
|------------------------|------------|-------------|-------------|----------|----------|------------|------------|-----------|-----------|
|                        |            |             | 0%          | 5%       | 25%      | 50%        | 75%        | 95%       | 100%      |
| Double Herringbone     | 140        | 3.25        | 0.2         | 1        | 1.77     | 2.65       | 4          | 8         | 11        |
| Rotary                 | 99         | 9.27        | 1.5         | 3.1      | 5        | 7.2        | 11         | 24.3      | 30        |
| Swing over Herringbone | 223        | 3.40        | 0.3         | 1        | 2        | 3          | 4.1        | 6.6       | 14        |
| Walk-through           | 13         | 2.05        | 0.1         | 0.1      | 1        | 2          | 2          | 5.7       | 10        |
| <b>Overall</b>         | <b>475</b> | <b>4.52</b> | <b>0.1</b>  | <b>1</b> | <b>2</b> | <b>3.5</b> | <b>5.2</b> | <b>12</b> | <b>30</b> |

Table 21. Frequencies, means and percentiles for effluent (ML/year) by dairy type.

Effluent produced per cow was significantly higher in rotary than in double and swing over.

Effluent (megalitres per year) increased significantly ( $p < 0.001$ ) with increasing herd size.

Effluent (megalitres per year) increased significantly ( $p < 0.001$ ) with increasing total cluster number.

## Yard Scraping

Gippsland had significantly higher proportions of farms that did yard scraping than the South West and North Victoria (Table 22).

| Region       | No          | Yes       | Total       |
|--------------|-------------|-----------|-------------|
| Gippsland    | 683         | 61        | 744         |
| North        | 541         | 2         | 543         |
| SW           | 332         | 3         | 335         |
| <b>Total</b> | <b>1556</b> | <b>66</b> | <b>1622</b> |

Table 22. Frequencies for yard scraping by region.

There was no significant difference between dairy types and the incidence of yard scraping (Table 23).

| Dairy Type             | No         | Yes       | Total      |
|------------------------|------------|-----------|------------|
| Double Herringbone     | 209        | 14        | 223        |
| Rotary                 | 176        | 12        | 188        |
| Swing over Herringbone | 361        | 35        | 411        |
| Walk-through           | 17         | 0         | 17         |
| <b>Overall</b>         | <b>763</b> | <b>61</b> | <b>824</b> |

Table 23. Frequencies for yard scraping by dairy type

## Recycled Water Used

Recycled water refers to the liquid effluent component recycled for washing the yard.

Gippsland and the North had a significantly greater proportion of farms that used recycled water, than the South West (Table 24).

| Region       | No          | Yes        | Total       |
|--------------|-------------|------------|-------------|
| Gippsland    | 596         | 147        | 743         |
| North        | 447         | 98         | 545         |
| SW           | 292         | 42         | 1288        |
| <b>Total</b> | <b>1335</b> | <b>287</b> | <b>1622</b> |

Table 24. Frequencies of recycled water used by region

A significantly greater proportion of rotary and swing over dairies used recycled water than did double herringbones and all three had a significantly greater proportion than did walk-through (Table 25).

| Dairy Type             | No         | Yes        | Total      |
|------------------------|------------|------------|------------|
| Double Herringbone     | 174        | 49         | 223        |
| Rotary                 | 126        | 62         | 188        |
| Swing over Herringbone | 277        | 119        | 411        |
| Walk-through           | 17         | 0          | 17         |
| <b>Overall</b>         | <b>594</b> | <b>230</b> | <b>824</b> |

Table 25. Frequencies of recycled water used by dairy type

## Shed Water Caught

Gippsland and the North had a significantly greater proportion of farms that caught shed water (Table 26).

| Region       | No          | Yes        | Total       |
|--------------|-------------|------------|-------------|
| Gippsland    | 478         | 265        | 743         |
| North        | 351         | 194        | 545         |
| SW           | 279         | 55         | 1288        |
| <b>Total</b> | <b>1108</b> | <b>514</b> | <b>1622</b> |

Table 26. Frequencies of shed water caught by region

A significantly greater proportion of rotary and swing over dairies caught shed water than double herringbones and all three had a significantly greater proportion than did walk-throughs (Table 27).

| Dairy Type             | No         | Yes        | Total      |
|------------------------|------------|------------|------------|
| Double Herringbone     | 134        | 89         | 223        |
| Rotary                 | 73         | 115        | 188        |
| Swing over Herringbone | 164        | 232        | 411        |
| Walk-through           | 17         | 0          | 17         |
| <b>Overall</b>         | <b>388</b> | <b>436</b> | <b>824</b> |

Table 27. Frequencies of shed water caught by dairy type

## Plate Cooler Diverted

Plate cooler diverted refers to when water used in the plate cooler flows into a tank to be reused for the plate cooler again or for yard wash.

Both Gippsland and the South West had a significantly greater proportion of farms that had plate cooler diverted than the North (Table 28).

| Region       | No         | Yes        | Total       |
|--------------|------------|------------|-------------|
| Gippsland    | 443        | 300        | 743         |
| North        | 364        | 181        | 545         |
| SW           | 191        | 143        | 1288        |
| <b>Total</b> | <b>998</b> | <b>624</b> | <b>1622</b> |

Table 28. Frequencies of plate cooler diverted by region

There was a significantly greater proportion of swing overs with plate cooler diverted than double or rotary. All three had a significantly lower proportion of plate cooler diverted than did walk-through (Table 29).

| Dairy Type             | No         | Yes        | Total      |
|------------------------|------------|------------|------------|
| Double Herringbone     | 180        | 43         | 223        |
| Rotary                 | 164        | 24         | 188        |
| Swing over Herringbone | 217        | 179        | 411        |
| Walk-through           | 4          | 13         | 17         |
| <b>Overall</b>         | <b>565</b> | <b>259</b> | <b>824</b> |

Table 29. Frequencies of plate cooler diverted by dairy type

## Yard Wash Type

Gippsland had significantly more hose than flood yard wash type than either the North or South West (Table 30).

| Region       | Flood      | Hose       | Hydrant   | Total      |
|--------------|------------|------------|-----------|------------|
| Gippsland    | 44         | 219        | 14        | 277        |
| North        | 71         | 230        | 7         | 308        |
| SW           | 21         | 55         | 5         | 81         |
| <b>Total</b> | <b>136</b> | <b>504</b> | <b>26</b> | <b>666</b> |

Table 30. Frequencies of yard wash type by region

Rotary had significantly more flood type than did either double or swing over (Table 31).

| <b>Dairy Type</b>      | <b>Flood</b> | <b>Hose</b> | <b>Hydrant</b> | <b>Total</b> |
|------------------------|--------------|-------------|----------------|--------------|
| Double Herringbone     | 14           | 150         | 5              | 169          |
| Rotary                 | 61           | 55          | 6              | 122          |
| Swing over Herringbone | 33           | 214         | 13             | 260          |
| Walk-through           | 0            | 7           | 0              | 7            |
| <b>Total</b>           | <b>108</b>   | <b>426</b>  | <b>24</b>      | <b>558</b>   |

Table 31. Frequencies of yard wash type by dairy type