DairyNZ farmfact

# Travelling irrigators: measuring application depth, intensity and nutrient loading (6-41)

Care must be taken to ensure appropriate effluent loading with travelling irrigators. Three simple steps can help you do this: calculate application depth and rate, determine level of nutrients in the effluent, and work out the nutrient application per pass of the traveller.

It is good practice to do the application depth test at the most extreme set up which you run the irrigator at. For instance, at the highest elevation above the pump, or the paddock that is the greatest distance from the pump. This will give you an idea of the 'worst case' performance of the system, which must meet depth and nutrient loading requirements*. Farmfacts 6-44 and 6-45* cover tips for improving irrigator performance and maintenance tasks, which may be of use if the irrigator is over-applying effluent.

## How to test application depth and rate

### *Test location*

Test the application depth at the location which puts the pump under the greatest work load, e.g. at the greatest distance from the pump, or at the highest elevation above pump station.

### *Collection containers*

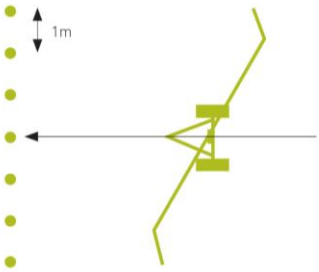
When testing you can use either rectangle trays with straight sides, rectangle trays with sloped sides or standard round buckets. You will need about 20 of these. You must use a different calculation depending on the type of collection container.

### *Step 1:*

**Containers**

Before applying effluent, put containers in a line across the path of the applicator:

1. 1-2 metres apart
2. use enough containers across the spray width of the irrigator
3. put a stone in each container to stop it blowing over.




### *Step 2:*

**Run irrigator**

Run the irrigator as normal:

1. record the actual amount of time that effluent is falling in the containers.

# Calculating application depth and rate

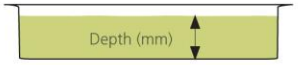
## *Step 3:*

Measure the depth of effluent in every 'wet' container.

**For RECTANGLE TRAYS WITH STRAIGHT SIDES:**

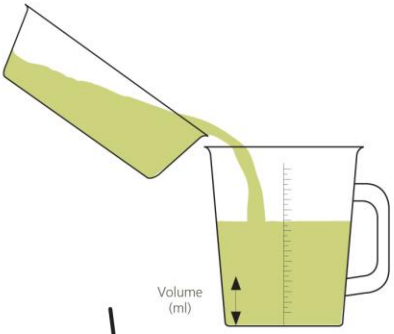
1. use a tape measure
2. remove the stone
3. measure how deep the effluent is in each container (mm)
4. write down depth for each container.

**Tip:** Make sure container is level (not on a slope) before you measure.



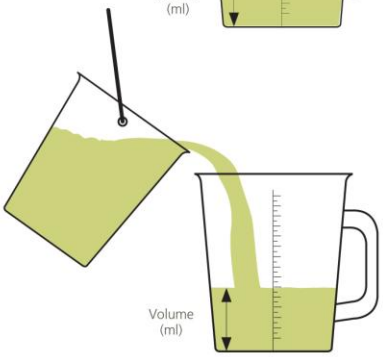

**For RECTANGLE TRAYS WITH SLOPING SIDES:**

1. remove stone
2. tip effluent into measuring jug record the volume (ml)
3. write down volume for each container.



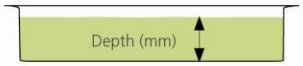

**For ROUND BUCKETS WITH SLOPING SIDES:**

1. remove stone
2. tip effluent into measuring jug record the volume (ml)
3. write down volume for each container.



# How to calculate application and depth rates

## Rectangle trays with STRAIGHT sides




**Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.**

Container 1 Container 2 etc ...

**TOTAL (mm)**

**TOTAL (mm)** ÷ **NUMBER OF CONTAINERS** = **AVERAGE APPLICATION DEPTH (mm)**

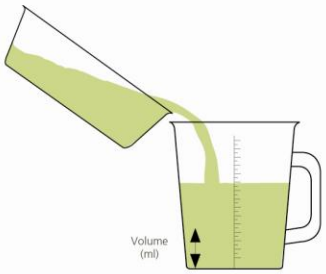
**AVERAGE APPLICATION DEPTH (mm)** ÷ **TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs)** = **AVERAGE APPLICATION RATE (mm/hr)**

Note: Maximum application depth = The CONTAINER with the deepest measurement.

**Tip:** To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

# How to calculate application and depth rates

## Rectangle trays with SLOPED sides




**Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.**

Container 1 Container 2 etc ...

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | + | | + | | + | | + | TOTAL (ml) |

| | | | |
|---|---|---|---|
| TOTAL (ml) | ÷ | NUMBER OF CONTAINERS | = AVERAGE VOLUME (ml) |

| | | | |
|---|---|---|---|
| CONTAINER WIDTH (mm) | X | CONTAINER LENGTH (mm) | = CONTAINER AREA ($mm^2$) |

| | | | | | |
|---|---|---|---|---|---|
| 1000 | X | AVERAGE VOLUME (ml) | ÷ | CONTAINER AREA ($mm^2$) | = AVERAGE APPLICATION DEPTH (mm) |

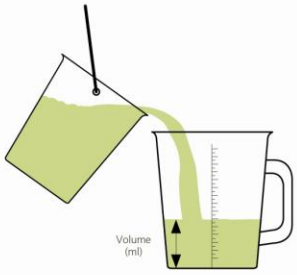
| | | | |
|---|---|---|---|
| AVERAGE APPLICATION DEPTH (mm) | ÷ | TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs) | = AVERAGE APPLICATION RATE (mm/hr) |

Note: Maximum application depth = The CONTAINER with the deepest measurement.

**Tip:** To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

## How to calculate application and depth rates

### Round buckets with SLOPED sides




**Record the depth from each container, e.g. on a sprinkler with a 40 m diameter wetted area, there may be 20-40 containers.**

Container 1 Container 2 etc ...

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | + | + | + | + | + | + | + TOTAL (ml) |

| | | | |
|---|---|---|---|
| TOTAL (ml) | ÷ | NUMBER OF CONTAINERS | = AVERAGE VOLUME (ml) |

| | | | |
|---|---|---|---|
| CONTAINER WIDTH (mm) | ÷ | 2 | = CONTAINER RADIUS (mm) |

| | | | | | |
|---|---|---|---|---|---|
| 3.14 | X | CONTAINER RADIUS (mm) | X | CONTAINER RADIUS (mm) | = CONTAINER AREA (mm²) |

| | | | | | |
|---|---|---|---|---|---|
| 1000 | X | AVERAGE VOLUME (ml) | ÷ | CONTAINER AREA (mm²) | = AVERAGE APPLICATION DEPTH (mm) |

| | | | |
|---|---|---|---|
| AVERAGE APPLICATION DEPTH (mm) | ÷ | TIME (hrs) (e.g 1hr 15 mins = 1.25 hrs) | = AVERAGE APPLICATION RATE (mm/hr) |

NOTE: Maximum application depth = The CONTAINER with the deepest measurement.

**Tip:** To convert seconds or minutes to decimal, divide by 60 e.g. 21 mins = 21 ÷ 60 = 0.35 hrs.

For assistance and advice on testing application depths and rates on pivot systems, please contact DairyNZ.

The maximum application depth and rate will be driven by a number of factors, such as the soil type, drainage, topography, the type of applicator being used and the soil moisture conditions. For more about how to identify the soil risk features on your farm, see Farmfact 6-61: How landscape and climate affect effluent management.

## Nutrient loading

The nutrient concentration of effluent will also play a part in determining the speed at which you run the irrigator. The concentration is determined from a sample and this result is used to calculate the nutrient application per pass. See Farmfact 6-28 *Effluent slurries, sludge, and solids spreading* for more information about the *Farm Dairy Effluent Spreading Calculator* which can be used to determine application depths to achieve specific nutrient loadings.

## Taking nutrient samples

To work out the value of nutrient in effluent, you need to collect a sample to send to a lab for analysis. Be aware that the nutrient content of effluent will vary for a number of reasons, including variations in the cows' diet during the season and between seasons, the solids content of effluent (how well agitated the effluent is prior to application), and the length of time the effluent has been stored.

**Step 1.** Collect sample. Use effluent from the measuring jug (collected in the depth test, this includes effluent collected from *all* the ice-cream containers). If you need a sample and you're not doing a depth test at the time, be sure to take the effluent sample from the irrigator not the pond.

**Step 2.** Fill a sampling bottle about two-thirds full with the effluent from the jug, squeeze till effluent reaches the top to remove air, and then screw the lid on. Put your name and sample identification on bottle.

**Step 3.** Keep sample chilled! This is very important for good quality results.

**Step 4.** Record your details and desired tests on the lab's effluent sampling form, attach to the sample, and send to the lab as soon as possible. Useful tests include % DM, total nitrogen (N), phosphorus (P), potassium (K), sulphur (S), calcium (Ca), magnesium (Mg) and sodium (Na).

## Calculating nutrient application per shift

There are two steps to working out nutrient loading per shift of the traveller. The loading can then be compared to recommended levels.

### Step 1. Determine total applied

An application depth of 1mm = 10$m^3$ effluent applied per hectare. So, for example, if the average application depth was 18mm:

| **Average application depth** | | **$m^3$ applied/hectare** |
|---|---|---|
| 18mm | **x 10 =** | 180$m^3$/ha |

## Step 2. Calculate loading

For this example, assume the nutrient concentration from the lab is 0.42kg nitrogen/$m^3$
*(If your lab results are recorded in g/$m^3$, divide by 1000 to get kg/$m^3$)*

| **$m^3$ applied/hectare** | **X Nutrient concentration(Kg N/$m^3$) (from the lab results)** | **=** | **Nutrient loading in this irrigation event (Kg nutrient/ha)** |
|---|---|---|---|
| 180$m^3$/ha | 0.42kg N/$m^3$ | | 75kg N/ha |

### Step 3. Compare

Compare the nutrient loading against the recommended loading, e.g. on your consent, permitted activity rules or Compliance Checklist.

DairyNZ good practice is to aim for **less than 50 Kg N/application** for optimum pasture utilisation and uptake, and to balance annual K application with the maintenance fertiliser application requirements (based on an OVERSEER nutrient budget).

In the example for Steps 1 and 2 above, the loading rate of 75 kg N/ha is too much in one pass of the traveller for pasture to utilise the N. Timing of the traveller would need to be adjusted (faster gear) to reduce N loading.