NSW Agriculture

Introduction to Irrigation Management

Evaluating your surfaceirrigation system

WATERWISE ON THE FARM

WORKBOOK

Evaluating your surface system: workbook

This workbook is part of the WaterWise on the Farm education program *Introduction to Irrigation Management*. It contains the activities referred to in the notes 'Evaluating your surface system'. This program was developed by staff from the water management subprogram of NSW Agriculture. ww0321

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Contents

Activity 1: Principles of surface irrigation

What do you consider to be the important principles of surface irrigation?

Activity 2: Available irrigation area

The system's efficiency and the readily available water (RAW) of the soil affect how large an area can be irrigated.

To calculate available irrigation area, you need to:

- calculate flow required per shift

Flow required per irrigation (shift) = soil water volume × area ÷ efficiency

- calculate area that can be irrigated with this flow

Area that can be irrigated per shift = flow × efficiency ÷ soil volume

Worked example: flow required per shift

Rootzone RAW (or, irrigation deficit)	= 100 mm	**A**
Convert RAW into soil water volume (ML).	Soil water volume = **A** ÷ 100 = 100 ÷ 100 = 1 ML	**B**
Area to be irrigated per shift (ha)	= 20	**C**
Estimated combined distribution and field application efficiency %	= 70%	**D**
Flow required for each irrigation (shift)	= soil water volume × area ÷ efficiency = **B** × **C** ÷ **D** = 1 × 20 ÷ 0.70 = 28.5 ML The results can be rounded off to 29 ML.	**E**

Note : 1 ML of water spread over 1 ha covers to a depth of 100 mm.

Note: 0.70 is another way of writing 70%.

Your data: flow required per shift

Rootzone RAW (or irrigation deficit)	= .... mm	**A**
Convert RAW into soil water volume (ML).	Soil water volume = **A** ÷ 100 = ... ÷ 100 = ... ML	**B**
Area to be irrigated per shift	.... ha	**C**
Estimated combined distribution and field application efficiency %	.... %	**D**
Flow required per irrigation	= soil water volume × area ÷ efficiency = **B** × **C** ÷ **D** = ... × .... ÷ .... = ... ML	**E**

In the next part of the activity, you work out how many hectares you can irrigate with the water available.

Worked example: area that can be irrigated

Flow available per day (or per set)	= 29 ML	**E**
Combined distribution and field application efficiency %	= 70%	**D**
Readily available water (RAW) (irrigation deficit)	= 100 mm	**A**
Convert RAW into a soil water volume.	Soil water volume = **A** ÷ 100 = 100 ÷ 00 = 1 ML	**B**
Area that can be irrigated	= flow × efficiency ÷ soil volume = **E** × **D** ÷ **B** = 29 × 0.70 ÷ 1 = 20.3 (This can be rounded off to 20 hectares.)	**C**

Your data: area that can be irrigated

Flow available per day (or per set)	= ....ML	**E**
Combined distribution and field application efficiency %	= .... %	**D**
Readily available water (RAW) or irrigation deficit	= .... mm	**A**
Convert RAW into soil water volume.	= **A** ÷ 100 = ... ÷ 100 = ... ML	**B**
Area that can be irrigated	= flow × efficiency ÷ soil volume = **E** × **D** ÷ **B** = ... × .... ÷ .... = ... ha	**C**

You may wish to see how changing the irrigation efficiency changes the area you can irrigate.

Activity 3: Supply flow rate

To measure water delivered:

Water delivered = reading after irrigation – reading before irrigation

Worked example: supply flow rate, propeller meter

Reading before irrigation	= 3764.3 ML	**A**
Reading after irrigation	= 3790.3 ML	**B**
Water delivered	= reading after irrigation – reading before irrigation = **B** – **A** = 3790.3 – 3764.3 = 26 ML	**C**
Convert this to ML/day:		
Delivery time	20 hours	**D**
Flow rate per day	= water delivered ÷ delivery time × 24 h = **C** ÷ **D** × 24 h = 26 ÷ 20 × 24 h = 31.2 ML	

Your data: supply flow rate

Type of meter	....	
Reading before irrigation	= .... ML	**A**
Reading after irrigation	= .... ML	**B**
Water delivered	= **B** – **A** = ... – .... = ... ML	**C**
Convert this to ML/d:		
Delivery time	= .... h	**D**
Flow rate per day	= water delivered ÷ delivery time × 24 h = **C** ÷ **D** × 24 h = ... ÷ .... × 24 h = ... ML	

Activity 4: Command

Measure the total head loss through the channels, and structures.

- at the Dethridge wheel or water meter.
- through pipes and culverts.
- in the channels. (Take note of any weeds restricting flow.)

Record all of the measurements, and then add up the losses.

Worked example: total head loss

Type of structure	**Head loss (mm)**	
Dethridge wheel	80 (large wheel: 12 ML/d)	**A**
Culvert	35 (pipe diameter 525 mm, 10 ML/d)	**B**
Channel check	35 (opening width 0.6 m, 10 ML/d)	**C**
Channel losses	50 (slope of 1:10000, distance 500 m)	**D**
Total head loss (m)	= **A** + **B** + **C** + **D** = 80 + 35 + 35 + 50 = 200 mm (0.2 m)	**E**

To work out the command over the fields, measure the difference in levels between the supply point and the field or bay, and subtract the total head loss.

Available command = supply level – field/bay level – total head loss

Worked example: available command

Supply level	10.0 m	**F**
Field/bay level	9.5 m	**G**
Available command (m)	= **F** – **G** – **E** = 10.0 – 9.5 – 0.2 = 0.3	

Your data: total head loss and available command

Type of structure	Head loss (mm)	
Dethridge wheel	....	**A**
Culvert	....	**B**
Channel check	....	**C**
Channel losses	....	**D**
Total head loss (m)	= **A** + **B** + **C** + **D** = ... + ... + ... + ... = ...	**E**
Available command		
Supply level	.... m	**F**
Field/bay level	.... m	**G**
Available command (m)	= **F** – **G** – **E** = ... – .... – .... = ...	

Activity 5: Determining flow rate onto the field

To measure flow rate through field or bay outlets:

1. Measure the head over the field/bay.
2. Note the internal diameter of the outlet.
3. Use the following tables to find the flow rate for this diameter and head.
4. Calculate the total flow by multiplying this flow rate by the number of outlets operating.

Total flow from outlet = flow through outlets × number of outlets operating

Table 1. Theoretical flow from siphons in litres per second

Nominal siphon length = 4 metres

Head (mm)	**Siphon diameter (mm)**		
	50 (outside diameter) 45.5 (inside diameter)	63 (outside diameter) 57.5 (inside diameter)	75 (outside diameter) 68.5 (inside diameter)
100	1.7	2.2	2.9
150	2.1	2.6	3.5
200	2.4	3.0	4.1
250	2.7	3.4	4.6
300	3.0	3.7	5.0
350	3.2	4.0	5.4
400	3.4	4.3	5.8
450	3.6	4.6	6.1
500	3.8	4.8	6.5

Adapted from P Dalton, University of Southern Queensland.

Table 2. Pipe outlet flow in litres per second
Note: Flow controlled at inlet.

Head (mm)	Pipe diameter (mm)					
	150	**200**	**225**	**300**	**380**	**450**
100	16	29	38	70	114	162
150	19	36	46	85	140	199
200	22	42	54	99	162	229
250	25	46	60	110	181	256
300	27	51	66	121	198	281

Table 3. Door outlet flow in litres per second

Head (mm)	Opening width (mm)					
	300	**450**	**525**	**600**	**750**	**900**
100	18	26	31	35	44	52
150	32	48	56	64	80	96
200	49	74	86	99	123	148
250	69	104	121	138	173	207
300	91	136	159	181	227	272

Worked example: total flow, siphons

Average head over field/bay	350 mm	**A**
Outlet size (internal diameter)	57.5 mm	**B**
Flow through outlet (from Tables 1 to 3)	4.0 L/s	**C**
Number of outlets operating	60	**D**
Total flow (L/s)	= **C** × **D** = 4.0 × 60 = 240 L/s	**E**
Total flow (ML/d) = total flow × 60 × 60 × 24 ÷ 1 000 000 = **E** × 60 × 60 × 24 ÷ 1 000 000 = 240 × 60 × 60 × 24 ÷ 1 000 000 = 20.88 ML/d		

Your data: total flow

Average head over field/bay	.... mm	**A**
Outlet size (internal diameter)	.... mm	**B**
Flow through outlet (from Tables 2 to 4)	.... L/s	**C**
Number of outlets operating	....	**D**
Total flow (L/s)	= **C** × **D** = ... × .... = ...L/s	**E**

Total flow (ML/d) = total flow × 60 × 60 × 24 ÷ 1 000 000

= **E** × 60 × 60 × 24 ÷ 1 000 000

= .... × 60 × 60 × 24 ÷ 1 000 000

= .... ML/d

Activity 6: Distribution efficiency

Water delivered to field = flow × irrigation time × number of irrigations

Distribution efficiency = water delivered to field ÷ supply flow rate

Worked example: distribution efficiency

Flow onto the field (from Activity 5)	= 20.88 ML/d	**A**
Operation time *(the time that outlets are operating)*	= 8 hours	**B**
Irrigation time (in days)	= operation time ÷ 24 = **B** ÷ 24 = 8 ÷ 24 = 0.33	**C**
Number of ‘irrigations’ per day (These may also called ‘shifts’ or ‘sets’.)	= 3 sets	**D**
Water delivered to field	= flow × irrigation time × number of irrigations = **A** × **C** × **D** = 20.88 × 0.33 × 3 = 20.88 ML	**F**
Distribution efficiency		
Supply flow rate (from activity 3)	= 31.2	**E**
Water delivered compared with supply flow rate	= water delivered to field ÷ supply flow rate = **F** ÷ **E** = 20.88 ÷ 31.2 = 0.67	**G**
Multiply this result by 100 to convert your result into a percentage.		
Distribution efficiency %	= **G** × 100 = 0.67 × 100 = 67%	

Your data: distribution efficiency

Flow rate onto the field	= .... ML/h	**A**
Operation time	= .... hours	**B**
Irrigation time (in days)	= operation time ÷ 24 = **B** ÷ 24 = ... ÷ 24 = ...	**C**
Number of irrigations per day	=	**D**
Water delivered to field	= flow × irrigation time × number of irrigations = **A** × **C** × **D** = ... × .... × .... = ... ML	**F**
Distribution efficiency		
Supply flow rate (from Activity 3)	=	**E**
Water delivered compared with supply flow rate	= water delivered to field ÷ supply flow rate = **F** ÷ **E** = ... ÷ .... = ... Multiply this result by 100 to convert your result into a percentage.	**G**
Distribution efficiency %	= **G** × 100 = ... × 100 = ...%	

Activity 7: Depth of irrigation

To calculate the application depth you need to know:

- the volume applied to the field (as calculated using the flow rates). We have calculated this in the previous example (calculation 8) as 20.88 ML/d
- the amount of run-off. For this example, 6.26 ML (approximately 30% of the volume applied), from the calculation: 20.88 × 30 % = 6.26
- the area being irrigated. This may be obtained by direct measurement of the field/bay or by calculating area from a surveyed plan or an aerial photo. For this example, we use 12.6 ha.

Worked example: depth of irrigation

How much water is left after run-off?		
Water delivered to field	= 20.88 ML (from Activity 6)	**A**
Estimated run-off %	= 30%	**B**
Run-off amount	= water delivered × estimated run-off (%) = **A** × **B** = 20.88 × 0.30 = 6.26 ML	**C**
Water remaining after run-off	= water delivered – run-off = **A** – **C** = 20.88 – 6.26 ML = 14.62 ML	**D**
How much is this per hectare?		
Area irrigated	= 12.6 ha	**E**
Volume applied per hectare	= water remaining ÷ area irrigated = **D** ÷ **E** = 14.62 ML ÷ 12.6 ha = 1.16 ML/ha	**F**
One megalitre, when spread over one hectare, covers to a depth of 100 mm. Knowing the volume of water applied per hectare allows you to easily convert this to the depth of water applied on the field.		
What depth of irrigation is this?		
Depth of water applied (mm)	= volume × 100 = **F** × 100 = 1.16 × 100 = 116 mm	

If the correct amount of water has been applied, this figure should be close to the RAW amount worked out in a soil pit survey.

Your data: depth of irrigation

<table>
<tr><td colspan="3">How much water is left after run-off?</td></tr>
<tr><td>Water delivered to field</td><td>= ....ML
(from your data, Activity 6)</td><td>A</td></tr>
<tr><td>Estimated run-off %</td><td>= .... %</td><td>B</td></tr>
<tr><td>Run-off amount</td><td>= water delivered × estimated run-off%
= A × B
= .... × ....
= .... ML</td><td>C</td></tr>
<tr><td>Water remaining after run-off</td><td>= water delivered – run-off
= A – C
= .... – .... ML
= .... ML</td><td>D</td></tr>
<tr><td colspan="3">How much is this per hectare?</td></tr>
<tr><td>Area irrigated</td><td>= .... ha</td><td>E</td></tr>
<tr><td>Volume applied per hectare</td><td>= water remaining ÷ area irrigated
= D ÷ E
= .... ML ÷ ....ha
= .... ML/ha</td><td>F</td></tr>
<tr><td colspan="3">One megalitre, when spread over one hectare, covers to a depth of 100 mm.
Knowing the volume of water applied per hectare allows you to easily convert this to the depth of water applied on the field.</td></tr>
<tr><td colspan="3">What depth of irrigation is this?</td></tr>
<tr><td>Depth of water applied</td><td colspan="2">= volume (ML/ha) × 100
= F × 100
= .... × 100
= .... mm</td></tr>
</table>

Activity 8: Field application efficiency

Calculations for field application efficiency:

Total crop water use (CWU) between irrigations = daily CWU × area irrigated × days between irrigations

Field application efficiency = total CWU ÷ water delivered to field

A. Without recycling

Worked example: field application efficiency, without recycling

What is the total water used by the crop between irrigations?		
CWU (per day)	= 8 mm/ha	**A**
	Divide CWU figure by 100 to convert mm into ML. = **A** ÷ 100 = 8 ÷ 100 = 0.08 ML/ha	**B**
Area irrigated (ha)	= 12.6	**C**
Days between irrigations	= 10	**D**
Total CWU (ML)	= daily CWU × area irrigated × days between irrigations = **B** × **C** × **D** = 0.08 × 12.6 × 10 = 10.08 ML	**E**
What is the field efficiency of the water applied?		
Water delivered to field	= 20.88 ML	**F**
Total crop water use compared with delivered water	= total CWU ÷ water delivered to field = **E** ÷ **F** = 10.08 ÷ 20.88 = 0.48 Multiply by 100 to convert your answer into a percentage.	**G**
Field application efficiency	= **G** × 100 = 0.48 × 100 = 48%	

Your data: field application efficiency, without recycling

What is the total water used by the crop between irrigations?		
CWU (per day)	= .... mm/ha	**A**
	Divide CWU figure by 100 to convert mm into ML. = **A** ÷ 100 = ... ÷ 100 = ... ML/ha	**B**
Area irrigated (ha)	=	**C**
Days between irrigations	=	**D**
Total CWU (ML)	= daily CWU × area irrigated × days between irrigations = **B** × **C** × **D** = ... × .... × .... = ... ML	**E**
What is the field efficiency of the water applied?		
Water delivered to field	= .... ML	**F**
Total crop water use compared with delivered water	= total CWU ÷ water delivered to field = **E** ÷ **F** = ... ÷ .... = ... Multiply by 100 to convert your answer into a percentage.	**G**
Field application efficiency	= **G** × 100 = ... × 100 = ...%	

B. With recycling

For these two exercises, we assume that the run-off is recycled.

Worked example: field application efficiency, with recycling

What is the total water used by the crop between irrigations?		
CWU (per day)	= 8 mm/ha	**A**
	Divide CWU figure by 100 to convert mm into ML. = **A** ÷ 100 = 8 ÷ 100 = 0.08 ML/ha	**B**
Area irrigated (ha)	= 12.6	**C**
Days between irrigations	= 10	**D**
Total CWU (ML)	= daily CWU × area irrigated × days between irrigations = **B** × **C** × **D** = 0.08 × 12.6 × 10 = 10.08 ML	**E**
How much water is left after run-off?		
Water delivered to field	= 20.88 ML (from Activity 6)	**F**
Estimated run-off %	= 30% (can be written 0.30)	**G**
Run-off amount	= water delivered × estimated run-off (%) = **F** × **G** = 20.88 × 0.30 = 6.26 ML	**H**
Water remaining after run-off	= water delivered – run-off = **F** – **H** = 20.88 – 6.26 ML = 14.62 ML	**K**
What is the field efficiency of the water applied?		
Field application efficiency	= total CWU ÷ water remaining on field = **E** ÷ **K** = 10.08 ÷ 14.26 = 0.69 Multiply the result by 100 to convert to a percentage. = **L** × 100 = 0.69 × 100 = 69%	**L**

Your data: field application efficiency, with recycling

What is the total water used by the crop between irrigations?		
CWU (per day)	= .... mm/ha	**A**
	Divide CWU figure by 100 to convert mm into ML. = **A** ÷ 100 = ... ÷ 100 = ...ML/ha	**B**
Area irrigated (ha)	=	**C**
Days between irrigations	=	**D**
Total CWU (ML)	= daily CWU × area irrigated × days between irrigations = **B** × **C** × **D** = ... × .... × .... = ... ML	**E**
How much water is left after run-off?		
Water delivered to field	= .... ML (from Activity 6)	**F**
Estimated run-off %	= .... %	**G**
Run-off amount	= water delivered × estimated run-off (%) = **F** × **G** = ... × .... = ... ML	**H**
Water remaining after run-off	= water delivered – run-off = **F** – **H** = ... – .... ML = ... ML	**K**
What is the field efficiency of the water applied?		
Field application efficiency	= total CWU ÷ water remaining on field = **E** ÷ **K** = ... ÷ .... = ...	**L**
	Multiply the result by 100 to convert to a percentage. = **L** × 100 = ... × 100 = ...%	

Activity 9: Irrigation system checklist

Have a look at your irrigation system and tick 'Yes', 'No', or 'Unsure' for each of the questions.

The supply system

	Yes	No	Unsure
1. a) Do you know the usual flow rate to your property?			
b) Can you measure the supply of water to your property?			
c) Have you ever measured or obtained the flow rate to your property?			
2. Is the head loss in your system within acceptable limits?			
3. Are channels and drains weed-free?			
4. Do all the channels have a minimum 0.15 m freeboard above operating level?			
5. a) Is it as easy to water all the paddocks as it used to be?			
b) Are the distant ones as easy to water as the closer ones?			
6. Have structures been designed and installed to minimise erosion, leakage and silting?			
7. Do all the culverts operate full without sucking air?			
8. Do culverts have headwalls?			
9. Can the supply system be drained at the end of an irrigation?			
10. Where earthen channels cross permeable soils, have they been lined?			
11. Can you access control structures and fields easily?			
12. Can you easily and reliably use the structures to control the flow and level of water?			

The irrigated field

Border check

	Yes	No	Unsure
1. Do you use flow rates between 0.1 to 0.25 ML per day per metre width of bay?			
2. Are the check banks high enough to stop water crossing them?			
3. Do all the bays water evenly and adequately?			
4. Do all the bays drain completely (without pools of water remaining)?			
5. Is the crop even with no areas showing signs of crop stress due to over-irrigation or under-irrigation?			
6. Do you open the same number of bay outlets whether the crop is sparse or dense?			
7. Can you estimate the volume of water applied to a bay?			
8. Are your bays landformed?			
9. Are the bay outlets running full?			
10. Is surplus water able to get off the bay surface within: a) 24 hours?			
b) 12 hours?			

Furrow/bed

	Yes	No	Unsure
1. Are the furrow lengths suitable for your soil type?			
2. Do all furrows in a set irrigate in similar times?			
3. Does the water stay within the furrow?			
4. Are all furrows able to drain at all times?			
5. Are the furrows irrigating without significant erosion?			
6. Is infiltration into the root zone adequate?			
7. Is your irrigation set time less than 12 hours?			
8. Are your fields landformed?			
9. Is surplus water able to get off the field within a) 24 hours?			
b) 12 hours?			
10. Is the taildrain of a suitable size and depth to remove irrigation and storm water from furrows?			

Contour

	Yes	No	Unsure
1. Can you fill your bays in 12 hours or less?			
2. Do they fill and drain in 24 hours?			
3. Are all toe furrows able to drain at all times of the year?			
4. Is there a separate inlet into each bay? (except, perhaps, the last bay)			
5. Is the taildrain deep enough to remove water from the toe furrows?			
6. Is the contour interval suited to the crop?			
7. If the contour banks are longer than 450 m, do they have multiple outlets?			
8. Are the outlets between bays big enough and set well enough below ground level to allow rapid drainage?			

The drainage system

	Yes	No	Unsure
1. Does your drainage system allow the retention of all irrigation tailwater on the farm?			
2. Does your drainage system meet EPA requirements for the retention of contaminated stormwater?			
3. Has the taildrain the capacity and depth to remove the irrigation and stormwater without backing up into the fields?			
4. Is the taildrain free from silting and erosion at the bottom of the field and at structures?			
5. Can all water be removed from the taildrain?			
6. Are the drains free of weeds?			
7. Does your system include a recycling system?			
8. Does the system allow collection of drainage water from all parts of the farm?			
9. Does the system allow recycling of drainage water over the majority of the farm?			
10. a) Has the tail drain the capacity to supply the recycling pump?			
b) Is there a buffer storage large enough and near enough to the pump for the pump to operate efficiently?			
11. Can your taildrain system handle trash?			
12. Can you adequately store surplus irrigation rainfall and run-off for later re-use?			
13. Is the recycling system easy to use and maintain?			
14. Are the drain culverts operating fully submerged and without silting?			

If you answered 'No' or 'Unsure' to any of the above questions, there may be room for improvement in your irrigation system and management.

Blank data sheets

flow required per shift

Rootzone RAW (or irrigation deficit)	= .... mm	**A**
Convert RAW into soil water volume (ML).	Soil water volume = **A** ÷ 100 = ... ÷ 100 = ... ML	**B**
Area to be irrigated per shift	.... ha	**C**
Estimated combined distribution and field application efficiency %	.... %	**D**
Flow required per irrigation	= soil water volume × area ÷ efficiency = **B** × **C** ÷ **D** = ... × .... ÷ .... = ... ML	**E**

area that can be irrigated

Flow available per day (or per set)	= ....ML	**E**
Combined distribution and field application efficiency %	= .... %	**D**
Readily available water (RAW) or irrigation deficit	= .... mm	**A**
Convert RAW into soil water volume.	= **A** ÷ 100 = ... ÷ 100 = ... ML	**B**
Area that can be irrigated	= flow × efficiency ÷ soil volume = **E** × **D** ÷ **B** = ... × .... ÷ .... = ... ha	**C**

supply flow rate

Type of meter	....	
Reading before irrigation	= .... ML	**A**
Reading after irrigation	= .... ML	**B**
Water delivered	= **B** – **A** = ... – .... = ... ML	**C**
Convert this to ML/d:		
Delivery time	= .... h	**D**
Flow rate per day	= water delivered ÷ delivery time × 24 h = **C** ÷ **D** × 24 h = ... ÷ .... × 24 h = ... ML	

total head loss and available command

Type of structure	Head loss (mm)	
Dethridge wheel	....	**A**
Culvert	....	**B**
Channel check	....	**C**
Channel losses	....	**D**
Total head loss (m)	= **A** + **B** + **C** + **D** = ... + ... + ... + ... = ...	**E**
Available command		
Supply level	.... m	**F**
Field/bay level	.... m	**G**
Available command (m)	**= F – G – E** = ... – .... – .... = ...	

total flow

Average head over field/bay	.... mm	**A**
Outlet size (internal diameter)	.... mm	**B**
Flow through outlet (from Tables 2 to 4)	.... L/s	**C**
Number of outlets operating	....	**D**
Total flow (L/s)	= **C** × **D** = ... × .... = ...L/s	**E**
Total flow (ML/d = total flow × 60 × 60 × 24 ÷ 1 000 000 = **E** × 60 × 60 × 24 ÷ 1 000 000 = ... × 60 × 60 × 24 ÷ 1 000 000 = ... ML/d		

distribution efficiency

Flow rate onto the field	= .... ML/h	**A**
Operation time	= .... hours	**B**
Irrigation time (in days)	= operation time ÷ 24 = **B** ÷ 24 = ... ÷ 24 = ...	**C**
Number of irrigations per day	=	**D**
Water delivered to field	= flow × irrigation time × number of irrigations = **A** × **C** × **D** = ... × .... × .... = ... ML	**F**
Distribution efficiency		
Supply flow rate (from Activity 3)	=	**E**
Water delivered compared with supply flow rate	= water delivered to field ÷ supply flow rate = **F** ÷ **E** = ... ÷ .... = ... Multiply this result by 100 to convert your result into a percentage.	**G**
Distribution efficiency %	= **G** × 100 = ... × 100 = ...%	

depth of irrigation

How much water is left after run-off?		
Water delivered to field	..................ML (from your data, Activity 6)	**A**
Estimated run-off %	.... %	**B**
Run-off amount	= water delivered × estimated run-off% = **A** × **B** = ... × .... = ... ML	**C**
Water remaining after run-off	= water delivered – run-off = **A** – **C** = ... – ....ML = ... ML	**D**
How much is this per hectare?		
Area irrigated	= .... ha	**E**
Volume applied per hectare	= water remaining ÷ area irrigated = **D** ÷ **E** = ... ML ÷ ....ha = ... ML/ha	**F**
One megalitre, when spread over one hectare, covers to a depth of 100 mm. Knowing the volume of water applied per hectare allows you to easily convert this to the depth of water applied on the field.		
What depth of irrigation is this?		
Depth of water applied	= volume (ML/ha) × 100 = **F** × 100 = ... × 100 = ... mm	

field application efficiency, without recycling

What is the total water used by the crop between irrigations?		
CWU (per day)	= .... mm/ha	**A**
	Divide CWU figure by 100 to convert mm into ML. = **A** ÷ 100 = ... ÷ 100 = ... ML/ha	**B**
Area irrigated (ha)	=	**C**
Days between irrigations	=	**D**
Total CWU (ML)	= daily CWU × area irrigated × days between irrigations = **B** × **C** × **D** = ... × .... × .... = ... ML	**E**
What is the field efficiency of the water applied?		
Water delivered to field	= .... ML	**F**
Total crop water use compared with delivered water	= total CWU ÷ water delivered to field = **E** ÷ **F** = ... ÷ .... = ... Multiply by 100 to convert your answer into a percentage.	**G**
Field application efficiency	= **G** × 100 = ... × 100 = ...%	

field application efficiency, with recycling

What is the total water used by the crop between irrigations?		
CWU (per day)	= .... mm/ha	**A**
	Divide CWU figure by 100 to convert mm into ML. = **A** ÷ 100 = ... ÷ 100 = ...ML/ha	**B**
Area irrigated (ha)	=	**C**
Days between irrigations	=	**D**
Total CWU (ML)	= daily CWU × area irrigated × days between irrigations = **B** × **C** × **D** = ... × .... × .... = ... ML	**E**
How much water is left after run-off?		
Water delivered to field	= .... ML (from Activity 6)	**F**
Estimated run-off %	= .... %	**G**
Run-off amount	= water delivered × estimated run-off (%) = **F** × **G** = ... × .... = ... ML	**H**
Water remaining after run-off	= water delivered – run-off = **F** – **H** = ... – .... ML = ... ML	**K**
What is the field efficiency of the water applied?		
Field application efficiency	= total CWU ÷ water remaining on field = **E** ÷ **K** = ... ÷ .... = ... **L** Multiply the result by 100 to convert to a percentage. = **L** × 100 = ... × 100 = ...%	**L**