Effective Use Of Water On Dairy Farms

The Dairy Farm DIY Full Water Audit Pack

DairyCo

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The Dairy DIY Full Water Audit Pack

Your name

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Address

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Date competed

Date for next review

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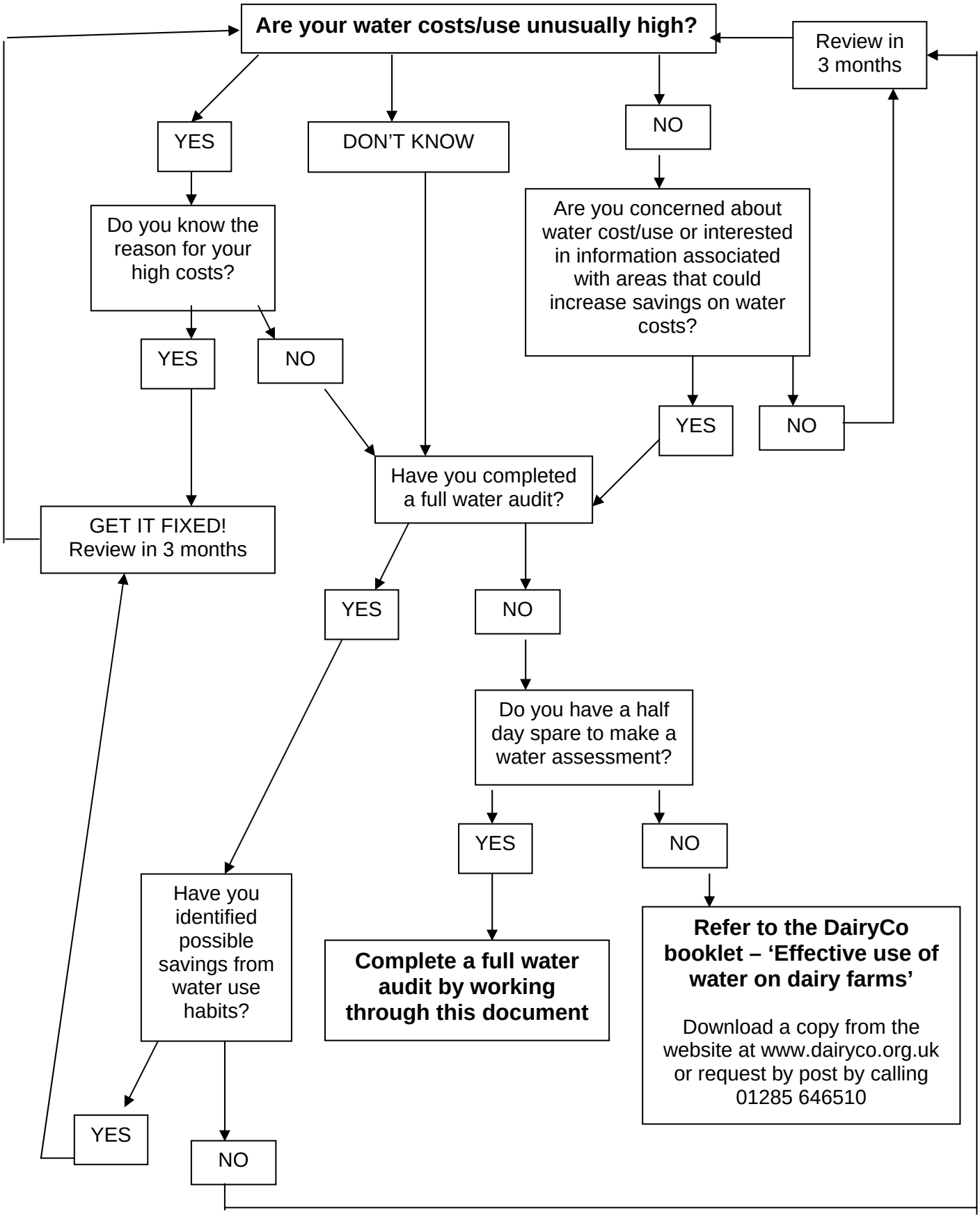
Section 1: How does your water flow?



Section 2: How to do a water audit on your farm

Introduction

The sections in this document are intended to help you work through the full water audit process. The number of sections may look a little intimidating but don't panic - the document is designed to accommodate different situations on different farms, and on many farms you will not need to complete every section!

Follow this step-by-step guide and use the templates within the sections to record your information.

Step 1
Identify all your current water supply sources and their cost
Go to **Section 4 – Your water supply and cost**

Step 2
Where, what for and how much water are you using on your farm?
Go to **Section 5 – Water use on your farm** and estimate the water use on your farm

Step 3
Work out your water disposal costs
Go to **Section 12 – Water disposal – Cost calculator**

Step 4
Compare your water supply volumes and costs with your estimated water use
Go to **Section 7 – Summary of water use**

Step 5
Identify current and potential areas for water efficiency savings on your farm
Go to **Section 8 – Your current or potential savings in water supply, use and disposal**

Step 6
Make an action list of items to address
Go to **Section 14 – Your water action plan**

Information you will need:

- Draw a simple sketch map of your farm/buildings, marking water supply sources and water outlets. Note key items such as meters, stop valves, tanks, pumps, taps, parlour, plate cooler, water troughs etc

- You will need to know approximate average stock numbers/types over the period of the audit

- You will need to know the flow rates of some of your key water outlets i.e. pressure washer, parlour hose, volume washer etc. *Go to* **Section 3** to workout flow rate

- You will need to make your best estimate of time of operation of your various water outlets eg,, how many minutes per day do you use your parlour volume hose?

- **You will need** water bills or meter readings for at least a 12 month period, to annualise water use

Section 3: Water flow rates

How to work out water flow rates

To measure flow rates of water outlets eg, taps, pressure washers, volume hose etc follow the steps below:

You will need:

1. Bucket or container of known volume
2. Watch with a second hand or timer
3. Pen, paper and calculator

Follow these steps:

1. Find a bucket or container of known volume and note down the volume. A container of 10 to 30 litres is ideal (2 to 6 gallons).
2. Record the time it takes to fill your container. Note down the time.
3. Calculate flow rate in litres/min.
   Volume (litres) divided by time (sec) = flow rate in litres/second
   Then multiply by 60 = flow rate in litres per minute.
4. Note the different flow rates for different appliances used on your farm. eg, parlour hose, pressure washer, collecting yard volume washer, dairy tap etc.

Conversion factors:

1 cubic metre (m^3) = 220 gallons (gal)
1 cubic metre (m^3) = 1000 litres (l)
1 gallon = 4.55 litres (l)
Pi = 3.143

To work out volumes of containers:

Length x width x depth = volume

Cylindrical containers:

(Pi x radius^2) x depth = volume of cylinder

Typical water flow rate from different appliances

Item	Typical flow rates	Notes/your figures
Low pressure udder washing in parlour	1.5 litres/min	
Typical mains pressure tap	15 to 30 litres/min	
Pressure washer	8 to 15 litres/min	
High capacity volume washer	40 to 85 litres/min	
Your figures		
Your figures		
Your figures		

Section 4: Your water supply and cost

List below all your water supply sources with estimated volumes and costs of supply.

These water sources are likely to include:

4.1 Mains water supply from one or more meters
Work out recent annualised use from recent bills for meter readings. The longer the period the more accurate your annualised reading will be (assuming no major changes in stock numbers or water use etc have occurred since)

4.2 Un-metered water troughs
If you have un-metered mains supply water troughs record the cost. It is unlikely you would want to, or be able to, estimate water use from these troughs

4.3 Abstracted water supply
If you have any abstracted water from wells, springs, bore holes, rivers, lakes, canals, record what information you have. Section 11 can be used to estimate the cost of the water from these sources

4.4 Rain water harvest
If you collect water from roofs or other areas, record this information. *Go to* Section 9 and 10 to calculate your volumes and costs of collected water

4.5 Other water supply information
Record any other costs relating to water supply

Water source, location and type	Notes	Annualised use m^3/yr	£/m^3	Total cost £
eg, dairy meter	*15/9/05 - 01552m3; 10/12/06 – 05853m^3. 421 days 4301m^3*	*3729*	*0.95*	*3543*
Total of all water sources				

Section 5: Water use on your farm

5.1 Livestock drinking water

Enter your stock numbers, ages and type of stock and the average daily water use from the stock-drinking sheet on the next page

Type and age of stock	Average number of head	Use/head/ day (litres/head/day)	No. of days drinking	Total m^3/yr	Water use %	Source of water eg, mains, borehole, river etc
Example: Dairy cows	*130*	*70*	*365*	*(130x70x 365)/1000 = 3322m^3*	*% of total use*	*Mains, river and borehole water*
Total of livestock drinking water						

Typical livestock drinking water use

Enter the stock drinking figures for your type and age of stock in Section 5.1.

Type and age of stock	Your notes	Use/head/day (litres/head/day)
Dairy/beef		
Milking cows or 3.5 x daily milk yield		70
Dry cows		35
Suckler cows		40
Dairy/beef young stock up to 6 months		20
Dairy/beef young stock 6 to 12 months		30
Dairy/beef young stock 12 to 24 months		40
Dairy young stock 24 m +		45
Sheep		
Ewes		2.75
Indoor housed pigs		
Weaners		2
Growers		4
Finishers		5.5
Dry sows and boars		6
Farrowing sow with young litter		9
Farrowing sow with older litter		35
Outdoor pigs		Add 50% to above figures for following
Indoor housed poultry		
Layers		0.25
Fattening		0.13
Turkey fattening		0.6
Your notes for other stock		

Stock drinking water requirements are based on weight, live weight gain, milk yield (approximately 3.5 x milk yields for dairy cows), dry matter of the diet and temperature. Stock on a particularly dry diet eg, young stock reared on a straw and concentrate based ration will require nearly twice as much water as those on a wet grass silage diet.

5.2 Other water use on your farm

Water use associated with milking plant and dairy, including plant cleaning, udder cleaning, parlour wash down, pre, during and after milking is often one of the most variable items from farm to farm, so do spend time to make your best estimate of this water use. Typical figures are listed for some items if you have no other information. See Section 3: How to calculate flow rates on farm.

Item	Your notes and calculations	Water use m^3 per year	% water use	Vol. Of water reused or recycled m^3/yr	% reuse or recycled	Vol. Of waste water to dispose of m^3/yr	% of waste water
Milking plant cleaning	Typical figures 18 to 25 litres/unit/wash						
Bulk tank cleaning	Typical figures 2% to 10% of bulk tank vol. per wash						
Milking time water use - pre milking damp down	eg, litres/min x no. min/day x no day/yr.						
Milking time water use - during milking eg, udder washing							
Milking time water use – eg,, dung washing during milking							
Milking time water use - Post milking eg, parlour wash down							
Milking time water use - Post milking eg, cluster washing							
Milking time water use - Post milking eg, collecting yard wash down							
Plate cooler water use	Ideal ration is 2 water : 1 milk, but typically it is only 1:1						
Milking plant 'deep clean' eg, you perhaps pressure clean your plant once per week or per month?	Flow rates x time per yr.						
Footbath use	eg, vol. of footbath x frequency of use						
General tap use eg, washing calf feeding buckets	eg, flow rates x time of use						
General pressure washer use eg, cleaning calf pens, machinery etc							
Sub total of this page							

Item	Your notes and calculations					Water use m^3 per year	% water use	Vol. of water reused or recycled m^3/yr	% reuse or recycled	Vol. Of waste water to dispose of m^3/yr	% of waste water	Notes on waste water disposal
Total carried forward from previous page												
Crop sprayer use Typically spray rates are 220l/ha, but specialist arable operator or contractors may use lower rates of between 100 to 150l/ha	Crop	Ha	Av. Application rate l/ha	No. of applications per yr	Total use per year							
	Totals											
Sheep dipping water use												
Other water use eg, pig or poultry shed cleaning												
Domestic water use eg, use by farmer, staff and families	Typical figures are 149 litres/head/day											
Other water use												
Other water use												
Totals of other water use												

Section 6: Summary of your supply and cost

Item	Figures transferred from section…	Volumes m^3	Cost	% of cost	Notes
Mains water	4.1				
Unmetered troughs	4.2				
Abstracted water	4.3				
Rain fall harvest	4.4				
Other supply	4.5				
Totals					

Section 7: Summary of your water use

Item	Transferred from section ….	Volume used m^3	Volume reused m^3	Volume to waste m^3	Notes
Livestock drinking	**5.1**				
Other water use	**5.2**				
Sub total					
Less reuse vol.					
Total					
Difference above or below your estimates of supply volumes m^3					

If your water supply costs/use are significantly higher than your best estimates of water use you need to follow the flow chart in Section 1 to help identify the reasons why and refer back to the main booklet – 'Effective Use Of Water On Dairy Farms'. It can be downloaded from the website at www.dairyco.org.uk or call DairyCo on 01285 646500.

Section 8: Your current or potential savings in water supply, use and disposal

Item	Notes	Estimated volume saved m^3	£/m^3	£
Water supply cost				
Water disposal cost	See Section 12			
Total supply and disposal cost of water				
Potential or current savings:-				
Leak reduction	Have you identified any leaks?			
Change of use habits	eg, can you change your 'hose happy' habits?			
Water reuse	eg, Are you effectively using plate cooler water? Can you collect plant and tank washing to reuse for collecting yard wash down? A double saving! Saving in supply cost and disposal cost			
Rain water harvest	Which roofs can you collect water from?			
Total potential or actual saving				
Your future water saving cost if you action all the above				

Go to **Section 14** to summarise your water action plan, where you can turn these potential savings into an action plan to start making a real saving, then continue with Section 9 if your situation involves rain water harvest.

Section 9: Rain water harvest volume calculator

Roof area or yard area	length	width	area m^2
Sub total of areas m^2			
Annual Rainfall est. (mm)			
Annual Rainfall est. (metres)	Rainfall/1000		
Total potential annual rain water harvest (m^3)			
Less run off factor losses (see below)	eg, x 0.9		
Sub total			
Less filter efficiency factor (see below)	eg, x 0.9		
Total harvested water available (m^3)			

Drainage coefficient

It is difficult to collect every drop of rain and convey it to the store. Light rainfall will only wet the roof and then evaporate. Heavy rainfall can overflow from the gutters and therefore not be captured. A 'drainage coefficient' is used to adjust the volumes to allow for this. The table below shows which drainage coefficient (also known as the "run-off factor") to use for different roof types.

Drainage coefficient (run off factor)

Roof type	Drainage coefficient
Pitched roof - tiles or fibre cement corrugated sheets (typical of most agricultural buildings)	0.75 – 0.9
Flat roof smooth tiles	0.5
Flat roof with gravel layer	0.4 – 0.5

Filter efficiency: If you have a filter, the amount of water captured also depends on the efficiency of the filter. Not all the water in gutters will reach the holding store. Most manufacturers recommend that a filter efficiency factor of 90% of the potential input be used. This means that a factor of 0.9 is included in the calculation.

Section 10: Rain water harvest - cost calculator

The tables below are to help you calculate the capital or one off cost of a rainwater harvest system plus any annual running costs. Fill in your own figures below and transfer back to Section 4.

Rain water harvest - Capital/one-off item costs

Typical capital/ one off items:	**Notes**	**£**
Alteration of gutters and down pipes		
Filters for down pipes		
Laying and diverting rainwater pipes to rain water store		
Rain water store eg, tank or lagoon		
Pump shed		
Electrics, tanks, pumps, pressure vessels, pipe work, filters etc		
Other one off costs		
Total one off costs		
Annual depreciation cost	*eg, total capital £5000/25 years = £200/yr*	
Average annual interest charge on capital spent	*Use amortisation tables, or cost of interest on half the capital spend eg, £2500 @ 7% =£175*	
Average annual depreciation and interest cost	Transfer to table below eg, £375/yr	

Rain water harvest - Annual running costs

Typical annual running costs:	**Notes**	**£**
Average annual depreciation and interest cost	*Transferred from table above*	
Cost of electricity to run pumps	*Pump kw x cost £/ kwh* *eg, 2kw x 0.085 = £0.17/hr run time x 5hr/wk = £44.20/yr*	
Cost of disposable filters		
Service and maintenance requirements		
Labour input to maintain	*eg, 6 days/yr. x £8/hr = £48/yr*	
Other annual running costs		
Total annual cost		
Estimate of rainwater harvest m^3	*From Section 9*	
Average cost per m^3 of harvested rainfall	*Annual cost/m^3* *Transfer back to Section 4*	

Section 11: Water abstraction - cost calculator

Water abstraction capital and one off costs

Fill in your own figures below and transfer back to Section 4.

Typical capital and one off costs:	Notes Typical range of costs	£
Geologist's report	*500 – 1000*	
Test bore	*500 – 1500*	
Main borehole	*5000 - 10,000*	
Borehole pump	*500 – 1000*	
Pump shed	*150 – 500*	
Pipe line from supply to farm	*£1 to 3/m run*	
Electrics, tanks, pumps, pressure vessels, pipe work, filters etc	*2000 - 5000*	
EA abstraction license application fee	*Currently £135*	
EA advertising admin charge	*Currently £100*	
Cost of local advert payable by the applicant	*Estimate £500*	
Other costs		
Other costs		
Other costs		
Other costs		
Total one off costs		
Annual depreciation cost	*eg, total capital £5000 divided by say 25 years = £200/yr*	
Average annual interest charge on capital spent	*Use amortisation tables, or cost of interest on half the capital spend eg, £2500 @ 7% =£175*	
Average annual depreciation and interest cost	*Transfer to table below*	

(continued - Water abstraction - annual running costs)

Fill in your own figures below and transfer back to Section 4.

Typical annual running costs:	Notes Typical range of costs	£
Average annual depreciation and interest cost	*Transferred from table above*	
E.A. annual abstraction license fee	*£110 to £2200 depending on type of license*	
Pump service/maintenance cost per year		
Labour costs to maintain	*hrs/yr. x £/hr*	
Electricity running cost		
Pump size Kw	*3 to 5 kw*	
Motor efficiency %	*Small pumps(less than 1kw) 70% efficient; larger pumps 15kw up to 95% efficient)*	
Cost of electricity £/kwhr	*eg, 8.5/kwh*	
Pump running cost £/hr	*Pump kw x cost kWh* *eg, 3kw x 8.5 = £0.26/hr run time*	
Pump run time	*eg, 5hrs/day x 360 days = 1800hrs*	
Electrical cost of abstraction	*Total hrs x cost per hr* *eg, 1800hrs x 0.26 = £468/yr*	
Total annual cost of abstraction		
Estimate of abstracted water vols. m^3		
Average annual cost per m^3 of abstracted water (£/m^3)	*Annual cost £/m^3*	

Section 12: Waste water disposal – cost calculator

The hidden costs!

The cost of waste water disposal can vary enormously but certainly range from £0.25/m^3 to £2/m^3

To work out your waste water disposal cost you will need to consider the one off capital cost such as of a dirty water irrigator system or a vacuum tanker, plus the annual running cost eg, electricity for a dirty water pump, fuel, labour and maintenance for a slurry tanker. The table below will allow you to work out costs either based on typical averages or to work out your own costs in more detail.

Waste water disposal costs

Method of disposal	Notes	Typical cost £/m^3
Low rate irrigator		0.25 to 0.5
Own slurry tanker	Depending on capital costs and work rates	0.75 to 1.5
Contractor slurry tanker	Depending on charge rate and work rates	0.75 to 1.5
Umbilical cord contractor		0.75 to 1.00

Dirty water disposal via irrigator – capital costs

Typical capital and one off costs:	Notes Typical range of costs	£
Capital cost of irrigator system	*£3000 to 15000*	
Capital cost of pump	*500 – 1500*	
Other one costs		
Total one off costs		
Annual depreciation cost	*eg, total capital £5000 divided by say 25 years = £200/yr*	
Average annual interest charge on capital spent	*Use amortisation tables, or cost of interest on half the capital spend eg, £2500 @ 7% =£175*	
Average annual depreciation and interest cost	*Transfer to table below*	

Dirty water disposal via irrigator - annual running costs

Typical annual running costs:	Notes Typical range of costs	£
Average annual depreciation and interest cost	*Transferred from table above*	
Annual maintenance costs	*£110 to £2200 depending on type of license*	
Labour costs to maintain	*Hrs/yr. x £/hr*	
Electricity running cost		
Pump size kW	*0.75 to 3 kW*	
Motor efficiency %	*Small pumps(less than 1kw) 70% efficient; larger pumps 15kw up to 95% efficient)*	
Cost of electricity £/kWh	*eg, 8.5/kwh*	
Pump running cost £/hr	*Pump kW x cost kWh* *eg, 3kw x 8.5 = £0.26/hr run time*	
Pump run time	*eg, 5hrs/day x 120 days = 600hrs*	
Electrical cost of pumping	*Total hrs x cost per hr* *eg, 600hrs x 0.26 = £156/yr*	
Total annual cost		
Estimate of total water disposed of per year m^3	*Flow rates x pump time or estimated from other sources*	
Average cost of disposal (£/m^3)	*Annual cost £/m^3*	

Dirty water disposal via vacuum tanker – capital costs

Typical capital and one off costs:	Notes Typical range of costs	£
Capital cost of tanker less any resale value	*£3000 to 15000*	
Other one off costs		
Total one off costs		
Annual depreciation cost	*eg, total capital £5000 divided by say 25 years = £200/yr*	
Average annual interest charge on capital spent	*Use amortisation tables, or cost of interest on half the capital spend eg, £2500 @ 7% =£175*	
Average annual depreciation and interest cost	*Transfer to table below*	

Dirty water disposal via vacuum tanker – annual running costs

Typical annual running costs:	Notes Typical range of costs	£
Average annual depreciation and interest cost	*Transferred from table above*	
Annual maintenance costs		
Tractor and tanker running costs (to cover fuel and repairs)	*Typical running costs £6 to 10/hr*	
Labour costs per year for worker on tanker	*Eg, £8/hr for 100hr/yr = £800*	
and/or contractor charges	*Eg, £25/hr for 100 hrs = £2500*	
Total annual cost		
Estimate of total waste disposed of per year by vacuum tanker (m^3)	*Tanker loads/yr. x tanker capacity or estimated from other sources*	
Average cost of disposal (£/m^3)	*Annual cost £/m^3*	

Section 13: Leak detection

A step-by-step approach to detecting a leak

1. **Make a sketch map of your farm water supply**. Note location of pipes, meters, stop valves, troughs, taps and other outlets. You may need to ask for help from family, existing and retired farm workers, previous occupants or companies/contractors that may have installed pipework.
   - Keep a record of this map even if it is not 100% complete. Others may be able to add to it later.

2. **Read and note down your water meter readings**, including the date. Regularly read the meter at least until you believe the leak is found and fixed. Ideally read your meter every 1 to 3 months.

3. **Check your meter at a time of low or no use**. Unfortunately this is likely to be during the very early hours of the morning when no equipment is using water and minimal stock will be drinking. Be prepared; clear the manhole cover, have a torch handy, ensure the meter is not submerged in water, have a pen and notebook to record the reading. If you find the meter running when you would expect no water use this may indicate a leak. A digital camera with a flash can also be a useful tool to take a meter reading in a dark inaccessible manhole.

4. **Isolate sections of your supply**. If you have stop valves to shut off sections of your supply, try to identify which section may have a leak.

5. **Walk your water supply route**. Make use of your sketch map to walk your system looking for tell tale signs of leaks. Try to do this after a dry period then: look for damp patches in fields, is the grass/crop growing particularly well? Why is that corner of the yard always flooded? Why is that ditch or drain always damp or running even after no rain?

6. **Contact your local water company**. If after trying all the above you still cannot detect a leak but still believe you have one, contact the local water company. Some of the water companies do provide free leak detection eg, Wessex Water will check for a suspected leak once in five years on your side of the supply. Anglia provides a free service if the farmer has already tried to detect and failed. Southwest Water provides an hour of free time.

7. **Hire leak detection equipment or find a company specialising in leak detection**. Commercial companies also provide leak detection services, but obviously charge for these services. Leak detection equipment can also be hired from most hire centres. To make effective use of these services or equipment you need to have a fairly clear idea of where your pipes run (having a map of your pipe network is important).

8. **Water use data logger.** This device can be connected to some types of meter to record flow rates. More information about data loggers is in the sub section below. Also, see case study in the DairyCo Effective use of water on dairy farms booklet.

9. Planning for the future

- Make meters easy to read. If your meter is in a manhole under a hedge surrounded by nettles and bramble and with a foot of ground water covering the meter, you will be unlikely to take regular meter readings! You may want to install your own meter in an easy to read position
- When installing new pipe work or putting in new troughs always install a stop valve to isolate sections but do record where it is and ensure it is easy to access. If it is not easy to turn on or off the chances are it will be left on.

Section 14: Your water action plan

Having spent the time and effort to do this detailed water audit make yourself an action list so you can turn your ideas in to real savings.

Action	Notes	Whose task?	When by?
eg, Fix leak	Call 'Fred' to fix leak in top paddock	Me/Fred	Urgent
eg, Dig pond for rain water collection	Speak to council regarding planning permission	Digger man	Autumn 2007