Case Study

IRRIGATION SYSTEM AUDIT: PUMP EFFICIENCY EQUALS ELECTRICITY SAVINGS

An irrigation system audit has found that many pumps used by horticultural growers in the Northern Wet Tropics region are operating inefficiently and costing more than necessary.

Pumping efficiency tests have been completed as part of the Rural Water Use Efficiency Irrigation Futures (RWUE-IF) initiative in the North Johnstone and Herbert Catchments by Growcom's Land and Water staff.

The most common reasons for inefficient pump operation found on participating farms included worn impellers, poor pump selection, improper motor size and changes to the application system (drip to micro-sprinkler).

Many of the growers who took part in an irrigation system assessment were unaware that the initial purchase price of a pump typically represents only 5 per cent of the total cost over a ten year period for electrical driven units. The results of the pump assessments have highlighted the significant savings to be made through improved pump efficiency.

Pump efficiency is often represented as a percentage and is a measurement of how well a pump converts input power into water delivery (both pressure and volume). The electricity consumption, discharge rate, pump operating pressure and electricity tariff are then used to determine the pumping cost and the pump's efficiency.

How much is your pump costing you?

An audit was completed on a 25 ha banana farm in the Wet Tropics, where the pump was found to be oversized and performing below 50 per cent efficiency.

The audit was conducted on a Southern Cross 100 x 65-250 centrifugal pump fitted to a 55 kW motor. Together they deliver a flow rate of 17.5 L/s and a total dynamic head (TDH) of 86.6 m, consuming 34.6 kW per hour. This equates to 6.34 kWh/ML/m, which is above the target of 5 kWh/ML/m.

SYSTEM AUDIT: THE EXISTING PUMP	
Southern Cross 100 x 65-250 centrifugal	Flow rate: 17.5 L/s
Impeller diameter: 271 mm	Total dynamic head: 86.6 m
2950 RPM, 50kW motor	Energy/volume/head: 6.34 kWh/ML/m
Energy consumption per hour: 34.6 kW	Off-peak cost (Tariff 65, 19.048 c/kWh): $104.61 / ML Peak cost (Tariff 65, 34.582 c/kWh): $189.93 / ML
ANNUAL OPERATING COST: (Peak cost $/ML x 30 ML) + (Off-peak cost $/ML x 90 ML) = **$15 112.80**	

On the day of the pump assessment, the irrigation system was being operated with a pumping cost of $189.93 /ML. This represents a significant cost for the grower, who pumps an average of 120 ML a year.

The irrigation system primarily runs on the off-peak Tariff 65 rate which equates to $104.61 /ML. Approximately one quarter of the annual 120 ML irrigation incurs the peak electricity tariff for which the grower pays $189.93 /ML.

With electricity prices on the rise there is an opportunity for the grower to make considerable electricity savings simply by improving his pump efficiency.

One option is explored in more detail below.

Based on the irrigation schedule in place on the day of the assessment, the pump unit was found to be oversized for the required duty. The high head and low flow rate delivered by the existing pump unit sits well outside the efficient operating range according to pump performance data. The pump selection chart for this range of pumps shows the operating conditions (flow rate and TDH) can be met with a smaller pump and motor that consume 22 kW instead of the current 34 kW usage. By replacing the current pump unit (pump and motor) with a more efficient unit that matches the duty, the grower can expect a two year pay back period through reduced electricity consumption and resultant energy cost savings.

How much can an efficient pump save you?

Manufacturer curves for different pump and impeller sizes are used to select a combination of pump and impeller sizes that gives the best efficiency for the required operating conditions. This replacement is one of many options which should be explored in more detail by the grower, who may also wish to investigate irrigation design or schedule changes to improve system efficiency.

In this case, the system efficiency is improved by delivering the same flow rate and TDH with less energy required, which results in electricity savings. From the same range of Southern Cross centrifugal pumps, an 80 x 50-250 model was selected for its ability to meet the system requirements more efficiently. The quote for this pump including 30 kW motor and plate is in the range of $6600.

REPLACEMENT PUMP OPTION	
Southern Cross 80 x 50-250 centrifugal	Flow rate: 17.5 L/s
Impeller diameter: 250 mm	Total Dynamic Head: 86.6 m
2955 RPM, 30 kW motor	Energy/Volume/Head: 4.03 kWh/ML/m
Energy consumption per hour: 22 kW	Off-peak cost (Tariff 65, 19.048c/kWh): 66.52 $/ML Peak cost (Tariff 65, 34.582 c/kWh): 120.76 $/ML
ANNUAL OPERATING COST: (Peak cost $/ML x 30 ML) + (Off-peak cost $/ML x 90 ML) = **$9609.60**	

The electricity costs for operating the replacement pump are significantly lower and maintenance and repairs costs are expected to remain the same. The existing pump operation cost is $15 112.80 per year. Assuming the irrigation schedule remains the same, the replacement pump operating costs are calculated on the current practice of pumping 90 ML during off peak and 30 ML during peak hours each year. The replacement pump delivers the required flow rate and TDH more efficiently with a total annual operating cost of $9609.60.

Costing and payback

The purchase price for the replacement pump is approximately $6600. This does not include installation costs. These may vary considerably for any given farm location. A generous estimate of $1000 has been budgeted for installation. Based on these figures the purchase price and installation could be recuperated through the reduction in operating costs in the first two years. Following this, the grower can expect electricity savings of $5503 annually.

This pump replacement option has sparked interest from the grower, who is keen to secure ongoing electricity savings and a return on investment within the first two years. Not taking into account future electricity price increases, this could amount to $47 430 over the next 10 years.

This replacement option is just one of many possible system upgrades. Pump efficiency tests completed as part of RWUE-IF have given growers a valuable insight into their irrigation system operation costs and the effect that pump efficiency may have. Armed with this knowledge, pump selection and irrigation system efficiency are set to become a priority for this grower in 2015.

Growcom is delivering services to horticulture growers in the North Johnstone and Herbert Catchments, under the RWUE-IF initiative with the support of the Queensland Department of Natural Resources and Mines.

The project is focused on assisting Queensland growers to better manage water resources within the new Government planning guidelines. Services to growers include irrigation system evaluations, farm water use reports, on farm technical advice and training in irrigation scheduling and fertigation.

For more information, contact the Growcom Land and Water Field Officer on 07 3620 3844.

	EXISTING PUMP	REPLACEMENT PUMP	REDUCTION IN PUMP OPERATING COSTS
Annual pump operating cost	$15 112	$9609	
Purchase price		$6600	
Installation		$1000	
Pump operating costs for the first two years	$30 224	$26 818	$3406
Annual pump operating cost for years 3 to 10	$15 112	$9609	$5503
Total pumping cost for 10 years	**$151 120**	**$103 690**	**$47 430**

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Queensland Government

RURAL WATER USE EFFICIENCY INITIATIVE

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