# Willingness to Pay

## WaterNSW Prices for NSW Rural Bulk Water Services from 1 July 2017:

## Willingness to Pay study

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All amounts referred to in this document are expressed in Australian Currency unless otherwise indicated.

# Executive Summary

Agripath has been contracted to estimate the Willingness to Pay for WaterNSW's Rural Bulk Water Services in the North Coast and South Coast valleys. This information is aimed to be used as part of IPART's Determination of water prices in these areas from 1st July 2017.

The dairy industry is the predominant irrigation user in both the North Coast and South Coast. The dairy farmer's management decisions in a given year is largely centred around how much feed will be *home grown,* and how much feed will be *bought in*. *Home grown feed* includes grass, fodder crops but also fodder preserved in the way of silage and to a lesser extent, hay or grain.

Generally speaking, a dairy herd will be fed predominantly grass with a smaller percentage of the diet consisting of grain and/or hay or silage.

The economics of dairy farming is such that generally speaking, home grown grass is the cheapest form of feed followed by hay and silage, then grain, with market forces determining the relative cost of each over time. The grain component is to balance the diet with starch, energy and/or protein and therefore plays a separate role to the bulk component of the diet, which is the focus of this analysis. Grain is also not widely grown in these coastal valleys, due to climatic constraints.

Hence, the approach Agripath has taken is to quantify the cost of irrigated pasture production per kilogram of dry matter ($/kgDM), as opposed to the cost per kilogram of dry matter of bought-in feed such as hay or silage. **Where these costs of producing home grown feed under irrigation reach parity with the cost of feeding the herd *bought-in feed*, this is the point at which the irrigator is no longer willing to pay for irrigation water.** The dairy farmer is motivated to grow feed under irrigation when irrigating pastures is cheaper in $/kgDM than bought-in feed.

To estimate this, Agripath has collated data relating to irrigated pasture production such water costs, electricity and pumping costs, depreciation, labour and water use efficiency of pastures. This has been compared to bought-in feed both at current and proposed WaterNSW prices. ***Agripath's findings at current costs suggest there is only eight cents difference per kilogram of dry matter between the cost of irrigated pasture production and bought-in feed.***

As there will be a range of efficiency of irrigated pasture production from farm to farm, there will also be a range of *willingness to pay* for irrigation water accordingly. Similarly, there will be a range of efficiency of use of bought-in feed, which will also affect a farmer's willingness to pay for irrigation water versus buying in feed. If the proposed water prices are taken up for the period from 2017-2021, Agripath's modelling suggests that the cost of home-grown feed (irrigated pasture) and the alternative of bought-in feed, are very close to one another.

The other key premise is that it is actually economical to feed the herd (home grown or bought-in feed) rather than sell down some of the herd. In practise, dairy farmers may be willing to feed or grow where it is not economical to do so due to the short-term nature of the situation, for example drought. Strategically the dairy farmer then must decide the extent of the loss they are willing to incur, to maintain the herd for the future.

It is noted that there are qualitative factors involved in the longer-term *willingness to pay* which are reflected in irrigator behaviour. Examples of these other influences include the lack of investment in irrigation infrastructure due to the uncertainty around the future cost/viability of irrigating pastures. Similarly, the individual irrigator is not consistently reliant on irrigation and go for long periods where little or no irrigation water is required to grow pastures.

Overcoming such factors will require either:

1) incentivising higher usage by current licence-holders,
2) attracting new users, in order to decrease the per megalitre operating and capital costs of the dams,
3) reviewing the cost of operating and maintaining the dam infrastructure,
4) and/or changing the pricing structure between the cost of holding licenses and usage charges.

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# Glossary of Terms

| | |
|---|---|
| c | Cents |
| CP | Crude protein |
| CSO | Community Service Obligation |
| DM | Dry matter |
| EBIT | Earnings before interest and tax |
| GS | General Security |
| Ha | Hectare |
| HS | High Security |
| IPART | Independent Pricing and Regulatory Tribunal |
| kgDM | Kilograms of dry matter |
| kgMS | Kilograms of milk solids |
| kW | Kilowatt |
| kWh | Kilowatt hours |
| ME | Metabolisable energy |
| MJME | Megajoules of metabolisable energy |
| ML | Megalitres |
| mm | Millimetre |
| tDM | Tonnes of dry matter |
| TOU | Time of Use |
| WAL | Water Access Licence |
| WTP | Willingness to pay |

# Introduction

## Objectives

Agripath has been engaged by IPART to provide estimates of water users' willingness to pay for WaterNSW's rural bulk water service in the North Coast and South Coast valleys. This information is intended for use in IPART's Draft Determination and Draft Report of WaterNSW's prices. This draft is due for release in March 2017, with the Final Determination released June 2017, which will set WaterNSW's prices for four years from 1 July 2017.

As the irrigation systems for both the North and South Coast districts of New South Wales are currently in a situation where revenues are below full cost recovery, an alternative price setting mechanism is required. An important consideration for decisions on pricing is to understand the water user's *willingness to pay*. Specific tasks outlined by IPART include:

- Task 1: Outline the typical water users, and specifically farm businesses, to be used as the basis for estimating willingness to pay for rural bulk water services in the North Coast and South Coast valleys.
- Task 2: Estimate the marginal value of regulated irrigation water (or rural bulk water services) in the North Coast and South Coast valleys for typical users.
- Task 3: Compare outcomes with other studies and sources of information, including market prices for allocation water in valleys with similar characteristics.
- Task 4: Prepare a Draft Report that identifies the willingness to pay for rural bulk water services in the North Coast and South Coast valleys.
- Task 5: Prepare a Final Report that identifies the willingness to pay for rural bulk water services in the North Coast and South Coast valleys, in a form that may be released for public comment.
- Task 6: Attend at a workshop with stakeholders in Sydney if required.

This report both explains the rationale behind our findings and outcomes of the above Tasks, and identifies sources, approaches and key assumptions utilised. All values are in $2016-17 unless otherwise noted.

## Background

In the North and South Coast valleys, this analysis is aimed at estimating the willingness to pay for irrigation water. Due to a variety of factors such as available land (and water) uses, the lack of a critical mass of users means that the cost of providing bulk water services is above the economic value of water, or the value a rational user is willing to pay for the supplied water resource.

Currently, both coastal valleys are generating revenue below cost recovery. In the 2010 Determination, IPART capped price increases in the North and South Coast to 10% per annum, as full cost recovery of the user share of efficient costs was deemed excessive.

Despite the low levels of cost recovery, bulk water prices in the North and South Coast and the highest and second highest across NSW. Estimating willingness to pay for water is important information for consideration when setting the bulk water prices for the 2017 Determination.

## Method

Agripath is estimating the willingness to pay for rural bulk water by finding the marginal value of water based on the cost of producing one kilogram of dry matter of irrigated pasture. As most the water

users in the North Coast and South Coast valleys are dairies, Agripath has modelled the willingness to pay on a dairy system.

Comparing this to the cost per kgDM for bought-in feed, as would be supplemented in dairies in times of home-grown feed shortages, aims to find the balance where irrigation becomes equal in cost to bought-in feed. Past this point, the willingness to pay for such irrigational water could be considered very low, due to there being a cheaper, alternative feed source which would be utilised to fill feed gaps.

# Typical water users

## North Coast

The North Coast region covers approximately 60,000 square kilometres, from the top of the Manning Catchment to the Queensland border, bordered by the Great Dividing Range. Toonumbar Dam is the only regulated waterway in the region, with the Richmond Regulated Water Source licences seen in Table 1 below.

*Table 1: Richmond Regulated Water Source Water Access Licences (WAL), megalitres (ML) and use, as listed on the NSW Water Register website for 2015-16.*

| 2015-16 | *Richmond Regulated Water Source (North Coast)* | | | | | |
|---|---|---|---|---|---|---|
| | **WALs** | **WAL ML** | **ML Available** | **ML Used** | **% Used** | **Av. ML/WAL** |
| Domestic & Stock (Domestic) | 4 | 6 | 6 | - | 0% | 1.50 |
| Domestic & Stock (Stock) | 2 | 8 | 8 | - | 0% | 4 |
| General Security | 58 | 9,531 | 9,531 | 405 | 4% | 164 |
| High Security | 7 | 123 | 123 | 10 | 8% | 18 |
| Total | 71 | 9,668 | 9,668 | 415 | | |

Most irrigation water in the North Coast valley is used for dairy production, namely irrigation of pasture. Typical irrigation systems include *travelling* irrigators and the more labour intensive but less capital intensive *bike shift systems*.

## South Coast

The South Coast irrigation area is a section of the larger Sydney-South Coast region, with the Bega Catchment at 2,850 sq.km in size. The Brogo River is regulated downstream of Brogo Dam, and the Bega River after its confluence with the Brogo, forming the Bega and Brogo Regulated Rivers Water Source. The main use of this irrigation water is irrigated pastures for dairy.[1]

*Table 2: Bega & Brogo Regulated Water Source Water Access Licences (WAL), megalitres (ML) and use, as listed on the NSW Water Register website for 2015-16.*

| 2015-16 | *Bega & Brogo Regulated Rivers Water Source (South Coast)* | | | | | |
|---|---|---|---|---|---|---|
| | **WALs** | **WAL ML** | **ML Available** | **ML Used** | **% Used** | **Av. ML/WAL** |
| Domestic & Stock | 6 | 32 | 32 | 6 | 19% | 5 |
| Domestic & Stock (Domestic) | 9 | 17 | 17 | 6 | 36% | 2 |
| Domestic & Stock (Stock) | 1 | 5 | 5 | - | 0% | 5 |
| General Security | 81 | 14,524 | 6,415 | 1,644 | 11% | 179 |
| High Security | 29 | 422 | 422 | 101 | 24% | 15 |
| Supplementary | 18 | 1,300 | 1,300 | 45 | 3% | 72 |
| Total | 144 | 16,299 | 8,190 | 1,801 | | |

[1] Hope, M. & O'Connor, J. (2003). *Sydney-South Coast Region Irrigation Profile* (Water Use Efficiency Advisory Unit). Dubbo, NSW: NSW Agriculture.

## Dairy Performance

Based on the 2015-16 Dairy Farm Monitor Project for NSW, the following table indicates the performance of dairies, in $/kg milk solid (kgMS) expanded to whole farm dollars per the example, in northern and southern NSW as background to the willingness to pay study.

*Table 3: NSW Dairy Farm Monitor Project farm performance.[2]**

| *Dairy Farm Monitor Project NSW 2015-16 farm performance* | | | | |
|---|---|---|---|---|
| *$/kgMS* | **North** | | **South** | |
| | *Average* | *Top 25%* | *Average* | *Top 25%* |
| Income | 8.47 | 8.45 | 7.94 | 8.22 |
| Total Operating Costs | 7.84 | 6.86 | 6.23 | 5.41 |
| **EBIT** | **0.62** | 1.59 | **1.72** | 2.81 |
| Interest, Leasing | 0.53 | 0.50 | 0.55 | 0.48 |
| **Net Farm Income** | **0.09** | 1.09 | **1.17** | 2.33 |
| | | | | |
| Number of cows | 289 | | 425 | |
| kgMS/cow | 463 | | 552 | |
| | | | | |
| | *Average $* | | *Average $* | |
| Income | 1,133,345 | | 1,862,724 | |
| Total Operating Costs | 1,049,047 | | 1,461,558 | |
| **EBIT** | **82,960** | | **403,512** | |
| Interest, Leasing | 70,918 | | 129,030 | |
| **Net Farm Income** | **12,043** | | **274,482** | |

The above figures of Earnings Before Interest and Tax (EBIT) indicate there is little room to move with current costs and gross income levels. Dairies with debt servicing requirements such as interest and leasing costs have even smaller returns – the average for northern NSW dairies in 2015-16 after debt servicing is a net farm income of $0.09/kgMS, or $12,000 in whole farm terms. This whole farm performance will affect the *willingness to pay* for irrigation water.

[2] Kempton, K & Nelson, N. (2016). Dairy Farm Monitor Project: New South Wales annual report 2015-16. Dairy Australia.

* Please note the 19 northern and 16 southern farms include dairies not on the coast and not all irrigate.

## Current water pricing

At a state-wide level, recent pricing of water has aimed at achieving cost recovery, or in the case of the North Coast and South Coast, at least moving towards cost recovery of the operational and capital expenditure of the storage dam (i.e. Toonumbar and Brogo Dams). Table 4 below indicates the operating and capital expenses of these dams.

*Table 4: Current and proposed operational and capital expenditure for North Coast and South Coast irrigation valleys.*[3]

| Current and proposed expenditure from 1 July 2017 (WaterNSW) | | | |
|---|---|---|---|
| *Operating Expenditure ($)* | | North Coast | South Coast |
| *Current* | 2016-17 | 517,000 | 550,000 |
| *Proposed* | 2020-21 | 610,000 | 625,000 |
| *Capital Expenditure ($)* | | | |
| *Current* | 2016-17 | 12,000 | 41,000 |
| *Proposed* | 2020-21 | 41,000 | 366,000 |

The North Coast is currently on a 60% fixed: 40% usage pricing formula. The South Coast is on 40% fixed: 60% usage pricing. Each valley's water pricing per megalitre for 2016-17 is show in Table 5 below.

*Table 5: WaterNSW Regulated River prices for High Security (HS) & General Security (GS) licences, and usage fees per ML.*

*Water Administration Ministerial Council (WAMC) fees collected by WaterNSW for DPI Water.*[4]

| WaterNSW Regulated River prices for 1 July 2016 to 30 June 2017 | | | | | |
|---|---|---|---|---|---|
| | WaterNSW | | | WAMC | |
| | **HS** | **GS** | **Usage** | **H & GS** | **Usage** |
| North Coast | $9.54 | $7.25 | $45.04 | $3.76 | $5.80 |
| South Coast | $21.12 | $10.09 | $40.38 | $3.17 | $5.04 |

[3] IPART (2016). *Review of prices for WaterNSW: Rural bulk water services from 1 July 2017* (Issues Paper). Retrieved from Independent Pricing and Regulatory Tribunal website: www.ipart.nsw.gov.au/Home/Industries/Water/Reviews/Rural-Water/Prices-for-WaterNSW%E2%80%99s-Rural-Bulk-Water-Services-from-1-July-2017-formerly-State-Water-Corporation?qDh=2

[4] WaterNSW Regulated River prices for 1 July 2016 to 30 June 2017. Retrieved from WaterNSW: www.waternsw.com.au/customer-service/pricing/rural/regulated-charges

# Marginal water value

Marginal water value to users is on face value, the cost of the licence itself and the cost of usage. This study considers the end user's *value* in terms of the cost of producing the end product, which for a dairy farmer is a unit (kg) of *dry matter* of feed grown. Agripath has researched published papers and liaised with water users to calculate the cost of producing irrigated pasture, per kilogram of dry matter (kgDM).

Costs have been determined as follows:

## Water

Water costs for 2016-17, as above (Table 5).

## Electricity & Pumping Costs

Table 6 lists Origin Energy's pricing for electricity (from Essential Energy), which is a provider on both the North Coast and South Coast. Time of Use (TOU) fees are listed as a commonly used contract, though it is noted that not all irrigators are solely paying this tariff.

*Table 6: Origin Energy supply from Essential Energy in NSW, Time of Use (TOU) prices.*[5]

| ***Origin Supply - Electricty Tariffs, New South Wales*** | | | | |
|---|---|---|---|---|
| **Zone** | **Tariff Description** | **Price List** | **Units** | **Rate (GST ex.)** |
| Essential Energy | Domestic TOU | Supply Charge | c/day | 130.82 |
| | | Shoulder Usage (9am-5pm & 8pm-10pm weekdays) | c/kWh | 26.85 |
| | | Peak Usage (7am-9am & 5pm -8pm weekdays) | c/kWh | 26.85 |
| | | Off-Peak Usage (all other times) | c/kWh | 14.51 |

To determine the cost of pumping, collation of data on kW used to pump one megalitre of water was made from irrigators and published sources. This was adjusted for current electricity price (as above) to estimate power costs per ML pumped.

[5] Origin Energy (2016). Multi-site pricing booklet. Retrieved from Origin website: www.originenergy.com.au/for-home/electricity-and-gas.html

*Table 7: Estimates of electricity use for pumping 1ML of water from different sources, and with current electricity prices.*[4,5]

| ***Estimates of electricity use for pumping 1 ML water*** | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **kW** | **hours** | **kWh** | **$/kWh** | **Supply Cost** | **$/ML** |
| Pivots | | | 123 | 0.20 | | 24.60 |
| Side-rolls | | | 329 | 0.20 | | 65.80 |
| Traveller 1 | | | 405 | 0.20 | | 81.00 |
| Hand-shift | | | 429 | 0.20 | | 85.80 |
| Average power use | | | 260 | 0.20 | | 52.00 |
| | Ernst, C. (2014). *Irrigate or supplement?* Parmalat Milk News. | | | | | |
| Traveller 2 | 30.19 | 18.52 | 559 | 0.14 | 0.12 | 80.47 |
| | Tonge, F. (2016). Unpublished, irrigation costs spreadsheet. | | | | | |
| ***Using each as above, with current prices.*** | | | | | | |
| Pivots | | | 123 | 0.15 | 1.31 | 19.16 |
| Side-rolls | | | 329 | 0.15 | 1.31 | 49.05 |
| Traveller 1 | | | 405 | 0.15 | 1.31 | 60.07 |
| Hand-shift | | | 429 | 0.15 | 1.31 | 63.56 |
| Average power use | | | 260 | 0.15 | 1.31 | 39.03 |
| Traveller 2 | 30.19 | 18.52 | 559 | 0.15 | 1.31 | 82.43 |
| | | | | Min $/ML: | | 19.16 |
| | | | | Max $/ML: | | 82.43 |

## Depreciation

Assumptions around depreciation of irrigation infrastructure have been made to account for this non-cash item. For example:

- A capital investment in irrigation infrastructure of $60,000 is made
- It fully depreciated over 10 years, using straight line depreciation = $6,000/year
- This depreciation is shared over say 200ML of water used per year = $30/ML

## Labour

Following discussion with various users, an allowance for labour has been made on the assumption it takes 18 to 20 hours for a traveller irrigator to pump 1.5 ML of water, which then takes one hour to move.

Therefore, at $24/hour, $24/1.5ML = $16/ML.

# Water Use Efficiency

Water Use Efficiency (WUE) is a measure of how much dry matter (kgDM) is grown from a unit of water. One hundred millimetres (100mm) per hectare of water is equivalent to 1ML/ha. WUE is influenced by management practices including irrigation logistics, stocking rates and grazing management, supplementary feeding, and nutritive characteristics, almost more so than the irrigation system itself.[6]

Pasture species on coastal dairies are usually kikuyu and ryegrass based. WUE for such pastures range from 1000 to 2000kgDM per ML of water. Table 8 below indicates some such numbers.

*Table 8: Summary of estimated water use efficiencies of irrigated pastures.*

*Sources: Armstrong et al, 2000[7]; Ward, Jacobs & McKenzie, 2006[8]; Martin et al, 2006[9]; FutureDairy Tech Note (Kikuyu and Perennial Ryegrass), 2007[10]; Horizon Farming, 2006[11].*

| *Summary of WUE of irrigated pasture estimates from different sources* | | | |
|---|---|---|---|
| **Pasture Type** | **WUE (kgDM/ha/ML)** | **Notes** | **Source** |
| Pasture | 700 to 1300 | Northern Vic | Armstrong, et al, 2000. |
| Perennial ryegrass, white clover | 1,000 | South west Vic | Ward, Jacobs & McKenzie, 2006. |
| Ryegrass, white clover | 850 to 1,200 | Canterbury, NZ | Martin, et al, 2006. |
| Perennial ryegrass | 2,281 | | FutureDairy Tech Note Perennial Ryegrass, 2007. |
| Kikuyu | 2,071 | | FutureDairy Tech Note Kikuyu, 2007. |
| Pasture | 2,008 | South east SA | Horizon Farming, 2006. |

Considering these samples of WUE vary by over 100%, Agripath has accepted 1000kgDM/ML is likely more of an average, realistic response, with 2000kgDM/ML being the highest potential WUE, achieved only by the best managers of irrigation systems and when conditions are favourable.

[6] Doyle, P.T., Armstrong, D.P., Knee, J.E., Pritchard, K.E., Gyles, O.A. (2000). Feeding systems and water use efficiency in irrigated dairying in Northern Victoria and Southern New South Wales. *Asian-Australian Journal of Animal Science*, 13 Supplement, July 2000, pp 37-39.

[7] Armstrong D. P., Knee J. E., Doyle P. T. , Pritchard K. E. Gyles O. A., (2000). Water-use efficiency on irrigated dairy farms in northern Victoria and southern New South Wales. *Australian Journal of Experimental Agriculture* 40, 643-653.

[8] Ward, G.N., Jacobs, J.L., McKenzie, F.R. (2006). Using limited irrigation water - crops or pasture? *Proceedings of the New Zealand Grassland Association.* 68, pp 173–176.

[9] Martin, R.J., Thomas, S.M., Stevens, D.R., Zyskowski, R.F., Moot, D.J., & Fraser, T.J. (2006). Improving water use efficiency on irrigated dairy farms in Canterbury. *Proceedings of the New Zealand Grassland Association* 68, pp 155–160.

[10] Fulkerson, B. (2007). FutureDairy Tech Note (for Kikuyu and Perennial Ryegrass).

[11] Horizon Farming. (2006). Irrigated Pasture Systems Comparative Project (Stage 3: Final Report).

# Cost of irrigation

## At current water prices (2016-17)

With current water prices and the above inputs (water licence and usage, electricity/pumping, depreciation and labour), a cost of producing irrigated pasture from 1ML water can be calculated as follows, using WUE of 2000kgDM/ML and 1000kgDM/ML. Based on the research undertaken, while 2000kgDM/ML is the potential water use efficiency, 1000kgDM/ML is a more achievable and realistic WUE in a practical situation, given the influence of older on farm irrigation infrastructure and technology and the influence of logistics and other factors in a commercial environment. Refer to Table 8 above for further information.

In the following tables, calculations for cost of production using both High Security (HS) and General Security (GS) are made. Note usage is assumed at 100% of allocation.

*Table 9: Cost of producing pasture at WUE of 2tDM/ML, at 2016-17 water prices.*

| ***Pasture Production & Utilisation @ WUE of 2tDM/ML, at 2016-17 water prices*** | | | | |
|---|---|---|---|---|
| | WUE | 2000 kgDM/ | 1 ML | |
| **Irrigation Costs** | | | **NORTH COAST** | **SOUTH COAST** |
| Fixed HS | $/ML | | 9.54 | 21.12 |
| Fixed GS | $/ML | | 7.25 | 10.09 |
| Usage | $/ML | | 45.04 | 40.38 |
| WAMC (fix) | $/ML | | 3.76 | 3.17 |
| WAMC (use) | $/ML | | 5.80 | 5.04 |
| **Electricity** | kW/ML | | *560* | *560* |
| | $/kW | | *0.15* | *0.15* |
| | Supply $/day | | *1.31* | *1.31* |
| | $/ML | | 82.56 | 82.56 |
| **Depreciation** | Capex $ | | *60,000* | *60,000* |
| | Years | | *10* | *10* |
| | ML/yr | | *200* | *200* |
| | $/ML | | 30 | 30 |
| **Labour** | $/ML | | *16* | *16* |
| **Total Costs** | HS $/ML | | 192.70 | 198.27 |
| | GS $/ML | | 190.41 | 187.24 |
| | **HS $/kgDM** | | **0.10** | **0.10** |
| | **GS $/kgDM** | | **0.10** | **0.09** |
| GS Utilisation @ | 65% | $/kgDM | 0.15 | 0.14 |
| GS Utilisation @ | 70% | $/kgDM | 0.14 | 0.13 |
| GS Utilisation @ | 75% | $/kgDM | 0.13 | 0.12 |
| *Italicised numbers are subject to change with irrigation system.* | | | | |

These costs will change with the efficiency of the irrigation system and its management. For example, a centre pivot uses less power to run and requires much less labour; pumping more each year will decrease the depreciation per ML.

The 'Utilisation' number at the bottom of the table is an indication of the percentage of pasture that is 'harvested' or *utilised* by the animal, relative to the pasture *grown*. Generally, pasture utilisation figures of 65% to 70% are achieved in dairy production systems, dependent on factors including grazing management and pasture species.[12]

At a conversion of 2tDM/ML as seen in Table 9, and with the scenario as assumed above for a travelling irrigator, irrigated pasture production is costing approximately 10c/kgDM. This is a highly efficient system and the literature (mentioned in Table 8) indicates this potential is not commonly achieved by the typical irrigator.

[12] Meat & Livestock Australia (2013). More Beef from Pasture: Pasture Utilisation. Retrieved on 13 January, 2017 from: mbfp.mla.com.au/Pasture-utilisation

*Table 10: Cost of producing pasture at WUE of 1tDM/ML, at 2016-17 water prices.*

| ***Pasture Production & Utilisation @ WUE of 1tDM/ML, at 2016-17 water prices*** | | | | | |
|---|---|---|---|---|---|
| | WUE | | 1000 kgDM/ | | 1 ML |
| **Irrigation Costs** | | | | **NORTH COAST** | **SOUTH COAST** |
| Fixed HS | $/ML | | | 9.54 | 21.12 |
| Fixed GS | $/ML | | | 7.25 | 10.09 |
| Usage | $/ML | | | 45.04 | 40.38 |
| WAMC (fixed) | $/ML | | | 3.76 | 3.17 |
| WAMC (use) | $/ML | | | 5.80 | 5.04 |
| **Electricity** | kW/ML | | | *560* | *560* |
| | $/kW | | | *0.15* | *0.15* |
| | Supply $/day | | | *1.31* | *1.31* |
| | $/ML | | | 82.56 | 82.56 |
| **Depn** | Capex $ | | | *60,000* | *60,000* |
| | Years | | | *10* | *10* |
| | ML/yr | | | *200* | *200* |
| | $/ML | | | 30 | 30 |
| **Labour** | $/ML | | | *16* | *16* |
| **Total Irri Costs** | HS $/ML | | | 192.70 | 198.27 |
| | GS $/ML | | | 190.41 | 187.24 |
| | **HS $/kgDM** | | | **0.19** | **0.20** |
| | **GS $/kgDM** | | | **0.19** | **0.19** |
| GS Utilisation @ | 65% | $/kgDM | | 0.29 | 0.29 |
| GS Utilisation @ | 70% | $/kgDM | | 0.27 | 0.27 |
| GS Utilisation @ | 75% | $/kgDM | | 0.25 | 0.25 |
| *Italicised numbers are subject to change with irrigation system.* | | | | | |

As the efficiency halves to 1tDM/ML, a figure practically achieved in the studies referenced, the cost of producing one kgDM doubles to around 20c. Note that when pasture utilisation is also taken into consideration, the cost per kgDM quickly increases to 25-29c/kgDM.

## Proposed water prices (2017-2021)

The above costings are based on water prices set for 2016-17. The following table illustrates the proposed increases to water prices put forward by WaterNSW to IPART.[13]

*Table 11: WaterNSW's pricing proposal to IPART for 2017-2021, for the North and South Coasts respectively.*

*Price increases are capped at 10% year on year.*

| *North Coast: WaterNSW Pricing Proposal 2017-2021* | | | | | |
|---|---|---|---|---|---|
| **Fixed** | **16-17** | **17-18** | **18-19** | **19-20** | **20-21** |
| **HS** | 9.54 | 10.49 | 11.54 | 12.70 | 13.97 |
| **GS** | 7.25 | 7.98 | 8.77 | 9.00 | 10.61 |
| **Var/Usage** | 45.04 | 49.54 | 54.50 | 59.95 | 65.94 |

| *South Coast: WaterNSW Pricing Proposal 2017-2021* | | | | | |
|---|---|---|---|---|---|
| **Fixed** | **16-17** | **17-18** | **18-19** | **19-20** | **20-21** |
| **HS** | 21.12 | 23.23 | 25.56 | 28.11 | 30.92 |
| **GS** | 10.09 | 11.10 | 12.21 | 13.43 | 14.77 |
| **Var/Usage** | 40.38 | 44.42 | 48.86 | 53.75 | 59.12 |

Such price increases would increase the cost of production by 2c/kgDM over the four years. The following table does not account for inflation or change in any other input listed above.

*Table 12: Changes in cost of irrigated production of dry matter from 2016-17 to 2020-21.*

| *$/kgDM to 2021 with proposed pricing, at 1tDM/ML WUE using GS water* | | | | | |
|---|---|---|---|---|---|
| | **16-17** | **17-18** | **18-19** | **19-20** | **20-21** |
| North Coast | 0.19 | 0.20 | 0.20 | 0.21 | 0.21 |
| South Coast | 0.19 | 0.19 | 0.20 | 0.20 | 0.21 |

[13] WaterNSW. (2016). Pricing proposal to the Independent Pricing and Regulatory Tribunal: Regulated prices for NSW Rural Bulk Water Services from 1 July 2017 to 30 June 2021. Retrieved from WaterNSW website: www.waternsw.com.au/__data/assets/pdf_file/0017/122417/WaterNSW-Pricing-Proposal-to-IPART-2017-2021.pdf

# Cost of bought-in feed

Measuring the cost of each kgDM in a bought-in feed source is a way of comparing different feedstuffs. Common pasture supplements fed to dairy cows in times of pasture or nutritional shortfalls include cereal grains, lucerne hay and/or silage, pasture hay and/or silage and maize silage.

All options have been treated as purchased at market price, to avoid ambiguous data associated with conserving home-grown feed (i.e. making own hay or silage).

Table 13 outlines some characteristics of common pasture supplements. Note these figures are on farm (no freight included) and do not include any costs related to feeding out (labour, machinery use). Leaving out these items is due to the range of costs for such items. Freight is dependent on the distance to suppliers, and most dairies will source as locally as possible to keep freight costs down. Feeding out methods can also vary, which affects both the labour required and wastage occurring as part of feeding. Accounting for such items would increase the cost of dry matter.

As this study is focused on pasture growth under irrigation versus the alternative of buying in feed, the focus is on the price per kgDM of each alternative.

The farmer's decision is complicated by which dietary component is required (e.g. fibre, energy and/or protein). Nutritional demands also play an important part in the decision to purchase bought-in feed and the type of feed purchased. Nutritional levels of different feeds vary, so what might be cheaper per kgDM can be more expensive per megajoule of metabolisable energy (MJME) based on the constitution of the feed. Depending on what is limiting in the animal's diet on any given farm or time of year, a dairy farmer may change the supplement source or mix of sources to better lift the limitation. For example, current grain prices are historically very low, so any deficiency (such as energy) in the diet is likely to be filled first with grain. As fibre becomes limiting, as in the case of pasture shortages, hay or silage is likely to be utilised.

*Table 13: Cost per kgDM for selected hay and silage.*

*Magner, C. (2017)[14]; NSW DPI (n.d.)[15]. Barley is not included in the Average $/kgDM as it is not a substitute for pasture, though a common supplement to a point.*

| ***Cost per kgDM of different feedstuffs (GST exclusive, on farm)*** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Source: Magner, C. (2017)* | | Source: NSW DPI (n.d.) | | | kgDM calculations | | incl. Feed Wastage | |
| | | **$/bale** | **kg/bale** | **% DM** | **ME/kgDM** | **CP** | **kgDM/bale** | **$/kgDM** | **10%** | **20%** |
| Ryegrass | Hay | *90* | *300* | 88 | 8.3 | 6 | 264 | **0.34** | 0.38 | 0.41 |
| | Silage | *90* | *600* | 45 | 10 | 17 | 270 | **0.33** | 0.37 | 0.40 |
| Maize | Silage | 60 | 600 | 33 | 10.4 | 7 | 198 | **0.30** | 0.33 | 0.36 |
| Barley | Grain $/t | 200 | 1000 | 90 | 13 | 11 | 900 | **0.22** | 0.24 | 0.27 |
| Average | $/kgDM | | | | | | | **0.33** | 0.36 | 0.39 |

DairyNZ Supplementary Feed Calculator allows for feed wastage of 10% if feeding on a feed pad. This increases the $/kgDM by an average of 4c/kgDM. Paddock feeding can have 20% wastage.[16]

The Dairy Farm Monitor Project NSW for 2015-16 indicate northern dairy farms spent an average of $0.36/kgDM on silage and $0.32/kgDM of hay, which includes freight. Southern dairy farms spent

[14] Magner, C. (2017). Personal communication, January 3, 2017.
[15] NSW DPI (n.d.) Feed cost calculator. Retrieved from NSW DPI website: www.dpi.nsw.gov.au/animals-and-livestock/nutrition/costs-and-nutritive-value/feed-cost-calculator
[16] Roche, J. (2015) To feed or not to feed: the science behind the DairyNZ Supplementary Feed Calculator. *DairyNZ Technical Series Online*. 27, pp 2.

$0.17/kgDM and $0.29/kgDM on silage and hay respectively. Interestingly, the Top 25% dairies of both northern and southern dairies, as ranked by Return on Assets, had lower home grown feed costs (pasture and/or fodder crops), and excepting those in the northern group feeding hay, no silage or hay was fed by the Top 25% in either group. The lower cost production in these systems for home-grown feed may be outweighing the option of buying in feed.[17]

The willingness to pay for water would shift to less willing/more likely to buy in feed when the cost of producing irrigated pasture reaches parity with the above feed costs, upward of 25 to 30c/kgDM. In times of severe drought, the market for bought-in feed will appreciate dramatically as supply contracts and demand increases.

[17] Kempton, K & Nelson, N. (2016). Dairy Farm Monitor Project: New South Wales annual report 2015-16. Dairy Australia.
* Please note the 19 northern and 16 southern farms include dairies not on the coast and not all irrigate.

# Willingness to Pay

Using current prices as the basis for costing irrigated pasture production in the scenarios as above, there is already only a small margin (approximately 8c/kgDM) of difference between irrigated pasture DM and the cost per kgDM of bought-in feed.

It should be noted, while pivot irrigation is one of the most efficient irrigation systems in terms of water use, electricity/pumping and labour requirements, it is a large capital outlay to invest in such infrastructure. Agripath was informed of current irrigator concern about the feasibility of irrigating, and uncertainty about future irrigation leading to minimal reinvestment in irrigation infrastructure at this point.

Agripath's research also came across discussion on the 'signals' current pricing sends regarding whether to irrigate or not. The fixed to usage split of cost recovery means 60% of revenue in the North should be collected from licences (fixed costs) and the remaining 40% from usage. The opposite (40%:60%) is true in the South Coast.[18]

*Table 14: WaterNSW proposed user share of dam costs for 2017-21, split on current pricing formula.*

| ***Proposed User Share split of costs for 2017-2021*** | | |
|---|---|---|
| | **North Coast** | **South Coast** |
| **Total User Share** | 668,000 | 681,000 |
| Fixed % | 60% | 40% |
| **Fixed $** | 400,800 | 272,400 |
| Usage % | 40% | 60% |
| **Usage $** | 267,200 | 408,600 |

With current usage/variable costs relatively high (currently at $45/ML and $40/ML respectively in the North Coast and South Coast valleys), and licence (fixed) costs relatively low ($7/ML and $10/ML respectively), some licence holders are willing to pay the fixed cost for their licence and not irrigate (known as a sleeper licence). This leaves those who do irrigate to generate the same usage cost (in the above example, $408,600 for the South Coast) across fewer ML of water. The shortfall between revenue from usage costs and full cost recovery then becomes the subject of debate on who is responsible to cover it.

## Comment on other systems

As the findings indicate irrigators are already very close to their willingness to pay, there appears a need to look elsewhere, such as similar valleys, for ideas. Incentivising irrigation by changing the pricing structure is something that has been achieved in the Hunter valley irrigation system. Like the North Coast and South Coast, the Hunter had not been achieving full cost recovery until the pricing structure of the water allocation was adjusted. Market water prices in the Hunter now sit at $14/ML usage and $8/ML fixed. This decrease in price has maintained irrigation, which along with reduction in operational costs around the level of service offered, has meant the Hunter is now achieving cost recovery.

[18] WaterNSW. (2016). Pricing proposal to the Independent Pricing and Regulatory Tribunal: Regulated prices for NSW Rural Bulk Water Services from 1 July 2017 to 30 June 2021. Retrieved from WaterNSW website: www.waternsw.com.au/__data/assets/pdf_file/0017/122417/WaterNSW-Pricing-Proposal-to-IPART-2017-2021.pdf

Looking to other valleys, for example the Lachlan and Victorian Murray-Goulburn areas have a temporary water trade market that is currently around $55 and $70/ML respectively.[19,20] While this is close to the proposed water price for the North Coast and South Coast for 2019-2020, the Lachlan's water costs, at fixed $3.28/ML and usage at $21.12/ML, are half what the coastal valleys pay. Additionally, there is a market demand for irrigation water in the Lachlan and Murray-Goulburn, as examples, that doesn't exist currently in the North Coast and South Coast valleys. There may also be higher competition in the inland valleys due to more varied irrigation users such as for vegetables, cotton, rice. Further work would be necessary to determine dairy-only trade water market trends and the relationship between their price of water and willingness to pay.

## Other considerations

There are other considerations to be had along with the cost comparison of irrigated pasture and bought-in feed.

Based on conversations with the contacts provided by IPART, there may already be losses in efficiency and hence cost-effectiveness of irrigation due to hesitancy to upgrade older irrigation infrastructure. While some systems such as centre pivots are efficient both in irrigation, power usage, and labour requirements, many systems are still older hand-shift type systems, requiring more labour and electricity. South Coast irrigators, for example, indicate most systems are bike shift or travelling irrigators, with 3 or 4 centre pivots in use (pers. comm. Steve Guthrey, December 22, 2016). For infrastructure not used regularly throughout the year, there is little confidence to invest in upgrading infrastructure. While more efficient producers might have a slightly higher willingness to pay, those with less efficient systems will have a lower willingness to pay.

In short, producers need enough confidence that they will recoup their investment in an upgrade to irrigation infrastructure. This lack of confidence in the long-term pricing of water needs to be considered in any future pricing strategy.

If future pricing strategies are to stabilise or lower cost, then changes would need to consider:

- Increasing the amount of water used, to increase revenue. This could be either by incentivising higher usage from current irrigators, or by attracting other industries to irrigation use.
- Changing the running costs of the dam, to decrease costs
- Changing of the pricing structure, to incentivise irrigation

It was raised that current irrigated pasture production $/kgDM versus the $/kgDM of bought-in feed in dairies is secondary or party to the view that the signals for users to irrigate are not very strong, so irrigators are using their licences as little as possible, mainly as a supplementary input in dry seasons.

There is a Pricing Calculator in existence that is being developed by members of the Customer Service Committee of WaterNSW. This concept has the potential to model changes in the current pricing structure and the effects of such. Some possible scenarios include:

- A reduction in the CSO
- An increase in the revenue

[19] Rawlinson & Brown (2017). National Water Exchange: water markets. Retrieved from Rawlinson & Brown website on Jan 10 2017: www.rawbrown.com.au/water-trading.php

[20] Wilks Water (2017). Temporary water. Retrieved from Wilks Water website on Jan 11 2017: www.wilkswater.com.au/temporary-water#LachlanValley

- Changes to fixed and usage prices, the potential effect of a minimum licence charge

Further exploration of this tool could be beneficial as another facet for consideration in the decision making on pricing going forward.

## The range of willingness to pay

It is difficult to nominate a maximum water price that irrigators will be *willing to pay* for irrigation water.

This point would be defined by the price at which the cost of production of irrigated pasture ($/kgDM) will be exactly equal with the cost of bought-in feed ($/kgDM), i.e. the specific price at which supplementary feed is chosen over home-grown irrigated pasture.

This is due to the variation in:

- Individual farm irrigation efficiency (in infrastructure, labour, electricity, technology)
- Individual farm feeding efficiency (in infrastructure, labour, technology)

Consider Table 10 above, with the typical irrigator's cost of production for the given set of assumptions. There will be a range of costs of production of irrigated pasture around these figures, as each farm will have a different efficiency of irrigation and different costs for other inputs such as labour and electricity.

As an example, compare Famer A with Farmer B, remembering the typical irrigator based on Agripath's assumptions is faced with the following alternatives of supplementing the diet:

- Cost of irrigated pasture $0.27/kgDM
- Cost of bought-in feed $0.36/kgDM

Farmer A (an efficient irrigator) may have already invested heavily in the latest irrigation infrastructure, resulting in increased water use efficiency, decreased electricity use and labour requirements, and overall a cheaper cost of production. This farmer may only have modest infrastructure and machinery for dealing with bought-in feed. Such a farmer may have a higher *willingness to pay* threshold for irrigation water, because it is more efficient for this farmer to irrigate than it is to buy in feed.

Farmer A may be therefore faced with the following alternatives:

- Cost of irrigated pasture $0.20/kgDM
- Cost of bought-in feed $0.36/kgDM

Farmer B (an efficient feeder and typical irrigator) may have older irrigation equipment that has a higher electricity demand, higher labour inputs, and is not as efficient in its conversion of water into pasture or utilisation of that pasture. This farmer may also have invested in infrastructure, machinery and technology such as a feed pad or feeding system as part of the dairy shed, resulting in lower wastage and lower labour requirements. For such a farmer, the *willingness to pay* for irrigation water may have a lower threshold, as it is more efficient to feed than it is to irrigate in such a scenario.

Farmer B may be therefore faced with the following alternatives:

- Cost of irrigated pasture $0.27/kgDM
- Cost of bought-in feed $0.30/kgDM

For our example farmers, Farmer A is well below their maximum willingness to pay. The point where the cost of irrigated pasture production is equal to $0.36/kgDM, i.e. the theoretical *willingness to pay,* is $166/ML. However, unless this producer was one of the very top farms, the average dairy farm will be constrained by whole farm economics not the price of water alone (see Table 3), and is not irrigating year-round.

Farmer B is not quite at the maximum willingness to pay for irrigation water, but would likely chose to feed barley as a short-term supplement at $0.22/kgDM. For the irrigated pasture production to be on par with barley per kgDM, the theoretical *willingness to pay* is $17/ML.

Based on the above scenarios, the theoretical *willingness to pay* ranges from **$17/ML to $166/ML**. This indicates the willingness to pay threshold is being approached, and in some cases, will have already been reached at current prices.

# Conclusion

Current water prices mean the cost of producing irrigated pastures is approximately eight cents cheaper per kilogram of dry matter than buying in feed, based on the scenario modelled. If the proposed water pricing from WaterNSW goes ahead, by the end of the four years (2021), the cost of irrigated pasture DM versus bought-in feed DM will be within five cents. Note this assumes no change in other costs associated with irrigating, or bought-in feed, and acknowledges there is a range of production efficiency in any industry. This means while some more efficient water users may be willing to pay more, those with less efficient irrigation may already be at parity for their production system, as discussed above.

Using the proposed prices as below, the cost of production of irrigated pasture is within 5c of the cost of bought-in feed. There are likely already producers who have reached the point at which their *willingness to pay* for irrigation water has been surpassed.

*Table 15: Summary of cost comparison of willingness to pay, based on home-grown versus bought-in feed costs.*

| ***Summary of cost comparison of home-grown & bought-in feed, at GS prices*** | | | | | |
|---|---|---|---|---|---|
| | *Home-grown* | | | | *Bought-in* |
| | North Coast | | South Coast | | |
| | **$/kgDM** | **$/ML** | **$/kgDM** | **$/ML** | **$/kgDM** |
| **2016-17** | **0.27** | 52.29 | **0.27** | 50.47 | **0.36** |
| **2017-18** | 0.28 | 57.52 | 0.27 | 55.52 | 0.36 |
| **2018-19** | 0.29 | 63.27 | 0.28 | 61.07 | 0.36 |
| **2019-20** | 0.30 | 68.95 | 0.29 | 67.18 | 0.36 |
| **2020-21** | **0.31** | 76.55 | **0.30** | 73.89 | **0.36** |
| *Note:* | *Home-grown feed at 1kgDM/ML @ 70% utilisation. $/ML is GS + Usage, excluding WAMC fees. Bought-in feed $/kgDM includes 10% wastage.* | | | | |

On this basis, Agripath finds the perception of irrigators on the North Coast and South Coast being 'priced out' of irrigating to be a relevant concern, as irrigated pasture production is realistically already close to the cost of bought-in feed to be of importance. This study indicates that any future increase in water prices from current levels would be expected to lead to changes in overall usage.

Qualitative factors such as confidence to upgrade irrigation infrastructure needs to be considered. Future pricing strategies should also consider incentivising current customers to increase usage, attracting new industries to using the Rural Bulk Water Service, and looking at dam operational and capital expenses. The option of adjusting the current pricing structure (fixed and usage prices), as has been done in the Hunter Valley, requires further investigation.

For methods and formulas behind the tables in this report, please see the accompanying Excel file.