

# ARE THE FUNDAMENTALS EMERGING FOR MORE SOPHISTICATED WATER MARKET INSTRUMENTS?

**Bjornlund, H.<sup>1</sup> and Rossini, P.**

University of South Australia

<sup>1</sup>Also University of Lethbridge, Alberta, Canada

Corresponding author: [henning.bjornlund@unisa.edu.au](mailto:henning.bjornlund@unisa.edu.au)

## **Abstract**

This paper explores whether the economic fundamentals are emerging to support more sophisticated water market instruments within the Goulburn-Murray Irrigation Districts. There are signs that institutional barriers are being removed and that water users might be changing their perception of the use of such instruments. However, for investors to enter the market and for derivative instruments to emerge markets need to reach a certain level of maturity. This would entail a high level of market activity, a large number of buyers and sellers in the market, a reasonable flow of market information and the existence of market intermediaries. There is evidence that water markets are increasingly liquid, that markets are being adopted by a considerable proportion of water users and that markets starts to have a significant impact on who has access to water resources both in the long and short term. Financial analysis shows that an investment in a water entitlement over a 5 year holding period involving the sale of the annual water allocations and subsequent sale of the entitlement, are in excess of returns from the Australian share market. Cycle analyses show that prices of entitlements and allocations follow the same cyclical pattern, but allocations fluctuate far more within and between seasons. The fundamentals therefore seem to have emerged to support more sophisticated market instruments and mechanisms to be used for the benefit of both investors and water users.

## **Introduction**

Large parts of Australia are emerging from the worst drought year since European settlement and potentially the worst in a thousand years. The socioeconomic impacts within irrigation communities are detrimental. The Federal and State governments are offering drought assistance to affected irrigators and businesses dependent on them. The winter of 2007 failed to provide the significant rains needed to refill the reservoirs. Therefore most irrigators within the Murray-Darling Basin are in the middle of another season of unprecedented low water allocations and most cities in South-eastern Australia are on high or maximum water restrictions. Politicians are struggling to find ways to deal with this situation in the light of long-term climatic changes and increases in demand from non-irrigation sectors. Desalination and water recycling plants are emerging as alternatives in major cities to boost secure supply. However, these efforts are of little consequence for the irrigation sector. Here, the National Water Initiative (NWI) is relying on water markets to encourage more efficient use to reduce the socioeconomic impact within irrigation communities. The NWI, however, stresses that current water market mechanisms and instruments are impeding markets from providing maximum benefits. It emphasises that more sophisticated markets and instruments are needed. In other industries derivative products have provided the biggest efficiency gains (ACIL, 2003), however, these have failed to emerge within the water sector.

This process will require changes to the traditional ownership/use right structure of water products. Innovative water products could also be designed to provide cost effective ecosystem services while addressing structural adjustment issues. The development and implementation of more innovative and derivative based water products has in the past been impeded by a number of factors such as:

- a) the link between land and water;
- b) the absence of clearly specified entitlements in water;

- c) the lack of secure and transparent registers in which third party interests in the water entitlement can be registered and secured; and
- d) the level of uncertainty about the magnitude of the future stream of water allocations yielded by the water entitlement.

Many of these impediments are presently being removed under the National Water Initiative. It could therefore be expected that the development of new water products might gain pace.

A second factor which is likely to drive the demand for more innovative and sophisticated market products is the extended period of drought which has had a major impact on the viability and vulnerability of the irrigation sector. As water scarcity in Australia intensifies and as high value users experience allocation prices first reaching \$500/ML in 2002/03 and then approaching \$1,000/ML during 2006/08, they will look more seriously at alternative ways of securing their water supply. The purchase of additional water entitlements may appear as a logical solution, however, might not be the most viable or profitable. High value users might be better off buying some kind of risk sharing contract with lower value users such as options or conditional leases or access rights to inter-seasonal storage to carry water over from one season to another.

Recent experience indicates that low value users are willing to sell at much lower prices during normal supply years. Irrigators with significant investments (such as in irrigation infrastructure, plantings, dairy herds or equipment) dependent on a secure water supply therefore may be better off buying water, to store it for drought years, or signing contracts for the supply of water during droughts. Experiences during drought years suggest that buyers become frantic, and sellers (naturally) pursue the highest possible price. As a consequence, buyers spend too much time and effort securing adequate water at a time when they need to concentrate on managing the drought. On the other hand, low value users might be willing to sign a contingent contract against a low annual payment and a 'reasonable' price when the contract is executed. This would provide a secure cash flow during all years while they could continue their low value cropping or sell their seasonal allocations during most years. For buyers it would provide certainty of supply during droughts and spread out and fix the cost of drought management.

Since many of these water products will be developed and traded in a speculative as well as a productive capacity, their development will depend on the profitability of investing in water entitlements as a financial asset. This paper explores the viability of investing in a water entitlement with the intention of selling the annual water allocation over a 5 year holding period and then reselling the entitlement with the anticipation of a capital gain. This is analogous to investment behaviour in many other capital markets such as property and shares.

The following section will discuss the derivative instruments which could potentially be introduced and the institutional and socio-economic impediments to this occurring. This discussion will be followed by a discussion of how market activities and market participation has increase over time, This will be followed by an analysis of prices paid in the market for seasonal water allocations and for water entitlements during the 1993 to 2007 period using initial yield calculations, discounted cash-flow analysis, cycle factor analysis and time series analyses. This research is a continuation of previous work by the authors Bjornlund and Rossini (2005, 2007a,b) to explore the viability of using water as an investment vehicle.

### **Potential water product and impediments to their introduction**

Futures and options are important instruments in the trade of many agricultural commodities and natural resources assisting buyers and sellers to manage their risk by protecting them against unforeseen fluctuations in prices. Traders having opposing or relative risk differences, such as producers and processors tend to drive these markets. In the Australian water market the risk differential between high value water users (mainly in permanent horticulture and viticulture planting) and producers of annual crops should be sufficiently large to enable this to operate. The Australian irrigation industry has seen two major changes that have increased the irrigators need for flexible risk management tools. Increasingly irrigators are growing commodities under contract for major processors (Burch et al, 1992) committing themselves to deliver certain volumes of produce at fixed prices. This leaves irrigators at risk, if water prices increase, or low allocation levels force them to buy additional water at high prices. Water authorities have changed their

allocation policies to only allocate water, which is actually in reservoirs plus minimum inflow expectations during the year and then increasing such allocations as supply increases. This has in reality shifted the burden of risk management from authorities to individual irrigators (McGuckian et al, 1999). Futures, options as well as 'contingent contracts' might help farmers managing these risks.

### ***Put and call options***

This product will allow potential buyers and sellers to make contractual arrangements to buy and sell water allocations or entitlements at an agreed price over a given period of time. A put option allows a potential seller to ensure that they can sell their water at a given price within the period stipulated in the contract. On the other hand a call option allows a potential buyer to ensure that he can buy water at an agreed price during the life of the contract. Both options are normally associated with a one-off payment when the contract is signed and then an additional price per ML of water, when or if the option is executed.

Call options will allow high value water users (those with capital investments in permanent plantings, dairy herds or equipment) to enter into agreements with potential sellers during normal years for the delivery of future water allocations if the need arises. It provides some level of certainty of supply during droughts which will allow the buyers to concentrate their time and effort on managing the drought rather than securing water enough on a week by week basis creating significant uncertainty, anxiety and stress. From the buyers perspective it might also allow them to secure contracts at a lower rate than if buying during periods of droughts when buyers get into panic and sellers try to maximize revenue. The upfront price of the option could be seen as an insurance premium and as a way of spreading the cost of securing supply during droughts. Call options provides the seller of water with a secure future price, as well as a cash payment whether the option is executed or not. They don't have to find buyers or incur selling costs during each season.

The put option allows sellers to make informed and certain decisions at the beginning of the season as to whether to grow a crop or sell their water. They can compare the contractual price with the potential net gain from growing their crop under current price/cost levels.

### ***Futures contracts***

Futures allow the farmers to lock in their cost structure for future seasons. If they are working under a contract with fixed delivery prices and volumes, they can then secure their budget in advance. For sellers, it will help the low-value producers to decide whether to sell the water during future seasons. They can weigh up the guaranteed price offered against their gross-margin for productive use of the water. It will thus help both the buyers and sellers managing their risk. Under a futures contract it is important, that a system is in place, ensuring that the contracting parties are capable of fulfilling their obligation upon maturity of the contract. This process is normally undertaken by clearing houses sponsoring the transactions (Goldberg, 1988). With many commodities, such as cotton, being sold forward on futures exchanges, it is important for these producers to be able to lock in water costs and volumes to reflect the forward contract.

### ***Contingent contract***

Under this scenario, contracts are entered into between buyers and sellers, which are automatically executed under certain circumstances. Typically the buyer pays a one-off price to the seller for the contract and thereafter a predetermined price every time the contract is executed. Such contracts are especially suitable for high value water users dependent on a high level of certainty about water delivery. This would include urban water suppliers, horticulture, viticulture and intensive stock keeping such as dairies and factory farming. Contingent contracts will allow buyers to own less than 100% of the required water rights securing additional water only if required due to climatic conditions or low annual water allocation announcements. A typical producer may own 80% of the required water as an entitlement, sufficient the meat needs during most seasons, and the purchase the remaining 20% as a contingent contract when needed. Sellers of such contracts will typically be lower valued users producing annual crops. They would have access to the water 80% of the years will receive a payment for water 20% of

the years to off-set their productivity losses as well as a one-off payment up front as an extra bonus. In the USA, contingent contracts have been used between cities and surrounding irrigators. One example of such a contract was between Utah City and a local farmer. The city paid a one-off fee of US\$25,000 to the farmer and a price of 300 tons of hay plus US\$1,000 in cash every time the contract was executed. During the first 25 years the contract was only exercised three times (Shupe et al, 1989).

### ***Impediments to the introduction of such market instruments***

In the introduction a number of institutional impediments were discussed and how these have been, or are in the process of being removed under the National Water Initiative. We also discussed that as water scarcity intensifies resulting in low seasonal allocations and high market prices, the water user's opposition to such instruments is likely to decline.

The introduction of more sophisticated market instruments will however also require that water markets are reasonably efficient. That is, there must be a high number of buyers and sellers in the market; a good flow of information on demand, supply and market prices; efficient market mechanisms and market intermediaries to provide, fast safe and secure market transactions. For investors and investment funds to be active in this market there must be a financially sound relationship between the price of entitlements and allocations.

The introduction of water exchanges both in the private (e.g. WaterFind and the National Water Exchange) and semi public sectors (e.g. WaterMove) as well as a number of private water brokers facilitating individual transfers, seems to suggest that market intermediaries and market mechanisms are emerging (Bjornlund, 2003, Bjornlund and McKay, 2001). Many of these water exchanges provide ongoing information on water market prices and volumes which suggests that the impediment of information flow may be reducing.

In the following sections we will investigate whether the level of market activity and price developments in both entitlement and allocation markets are likely to reach a state where markets can be considered to be reasonable efficient.

### ***Case Study***

In this paper prices paid in the markets for water entitlements and water allocations over a 14 year period are analysed. Market prices for water entitlements and allocations within the Goulburn-Murray Irrigation District (GMID) in Victoria, Australia have been collected for the period from a number of sources: 1) irrigator surveys; 2) water brokers; 3) water exchanges, and 4) Goulburn-Murray Water, the authority managing the GMID. Allocation prices have been collected from water brokers and since 1998 for WaterMove and its predecessor. Mean monthly prices have then been computed both for entitlements and allocations. Based on these the following analyses have been conducted:

- Initial yields have been calculated both on a monthly and annualised basis. The monthly calculation estimates the yield from an investment in water, at the entitlement price for that month and then assuming that they sell the water allocation yielded by the entitlements at the mean monthly market price for that month, in perpetuity. The annualised calculation estimates the yield from an investment in a water entitlement based at the median entitlement price for that year and assumes that the annual allocation is sold at the median price for that year. In each instance the expected allocation income is the market price adjusted for the allocation level less variable and transaction costs.
- Time series analyses to estimate the annual growth rate of allocation prices and entitlements as well as seasonal indices
- Cash-flow analyses computing the internal rate of return on an investment in water entitlements over a five year holding period. Internal rates of returns are computed under various decision making scenarios regarding when the seasonal allocation is sold. Analyses are also conducted to identify the extent to which the return is gained from capital gain and finally comparisons are made between returns from investments in water

entitlements and those which would have been obtained from investing in the ASX 200 accumulation index over the same holding period; and

- Cycle factor analysis to see how prices of allocations and entitlements fluctuate in a cyclical pattern. .

To understand the computations it is necessary to describe the allocation mechanisms within the GMID. At the beginning of each irrigation season GMW estimates how much water is available in the reservoirs within each supply system and computes a minimum expected inflow to the reservoirs during the season. Based on this estimate GMW announces the opening allocation as percentage of each irrigator's volumetric entitlement. Every second week during the season GMW reassesses the availability in the reservoirs and announces changes to the allocation level. Table 1 shows the opening and closing allocation for each season in the two main supply systems the Murray and the Goulburn.

**Table 1: Opening and closing allocations 1991 to 2008**

Year	Goulburn System		Murray System	
	Closing allocation	Opening allocation	Closing allocation	Opening allocations
1991/92	200	180	200	200
1992/93	200+	140	200+	180
1993/94	200+	200	200+	200
1994/95	200+	200	200+	200
1995/96	150	150	200	150
1996/97	200	200	200	200
1997/98	120	120	130	130
1998/99	100	40	200	95
1999/00	100	35	190	100
2000/01	100	48	200	200
2001/02	100	55	200	200
2002/03	57	34	129	129
2003/04	100	0	100	18
2004/05	100	0	100	42
2005/06	100	0	142	82
2006/07	29	0	95	76
2007/08	45 <sup>1</sup>	0	33 <sup>1</sup>	0

<sup>1</sup>As of 2 January 2008

It is apparent from Table 1 that a shift in the allocation mechanism took place in 1998/99. Prior to 1998/99 final seasonal allocations were announced at the opening of the season in most years. Allocations were based on water availability as well as anticipated inflows during the season based on historical records. This changed in July 1998, since then opening allocations have been announced based on availability in the reservoirs plus only minimum historical inflows. It is easy to see from Table 1 that this change in policy has shifted most of the risk management associated with inflows during the season from GMW to the irrigators. It is also obvious that this change has increased the need for market instruments to assist irrigators in managing this risk.

## Findings

The findings are discussed in separate sections and general conclusions drawn at the end.

### **Market activity and market participation**

This section analyses the extent to which water trading has taken place measured as a percentage of total entitlement base within the GMID (Table 2) and as a percentage of total water use during each season (Table 3). While it is clear from Table 2 that the allocation market has been far more active than the entitlement market, both markets shows a steady increase. Trading on the entitlement market began slowly taking ten years before the annual trade consistently accounted for 1% of the the entitlement base. However after this period the market quickly grew to around 2-3% of the entitlement base. During the first 16 years of entitlement trading from 1992 to 2007, 369,160 ML, representing 19.4% of all water entitlements, have changed hands. Even though entitlement markets have been slow on the up-take, it seems by 2006 to have had quite a substantial impact on the distribution of water entitlements.

**Table 2: Allocation and entitlement trading within the GMID**

Season <sup>1</sup>	Entitlement base <sup>2</sup>	Allocation market		Entitlement market	
		Volume trade <sup>3</sup>	% traded <sup>4</sup>	Volume traded <sup>3</sup>	% traded <sup>4</sup>
1989/90	1907145	21927	1.15	0	0.00
1990/91	1907145	31955	1.68	0	0.00
1991/92	1907145	32148	1.69	2715	0.14
1992/93	1907145	22829	1.20	8100	0.42
1993/94	1907145	29961	1.57	6369	0.33
1994/95	1907145	206872	10.85	9941	0.52
1995/96	1907145	132955	6.97	8230	0.43
1996/97	1907145	102924	5.40	10573	0.55
1997/98	1906763	245773	12.89	16349	0.86
1998/99	1905668	208069	10.92	23283	1.22
1999/00	1895578	215794	11.38	18173	0.96
2000/01	1893769	193335	10.21	16851	0.89
2001/02	1896718	259493	13.68	23834	1.26
2002/03	1883761	286418	15.20	19697	1.05
2003/04	1882806	338088	17.96	51335	2.73
2004/05	1852233	337707	18.23	44302	2.39
2005/06	1793637	332131	18.52	48914	2.73
2006/07	1764870	309189	17.52	60494	3.42

Produced on the basis of data provided by Goulburn-Murray Water

<sup>1</sup> August to May, season can vary from year to year;

<sup>2</sup> total volume of water entitlement within the GMID;

<sup>3</sup> total volume of water traded each season; <sup>4</sup> volume traded as a percentage of total entitlement

Trading in allocations has been much more active than in entitlements with some 18-19% of the entitlement base traded each year by 2003/04 (Table 2). This figure does not really reflect the impact that allocation trading has had, since in some years less than the full entitlement is available for use. Table 3 shows how big a proportion of total water use within each season was generated by trading. It is clear that water trading is accounting for a much higher proportion of water use when seasonal allocations are low, culminating with almost one quarter of all water used being generated by trade during 2002/03 when the allocation in the Goulburn System was only 57%. However, even with 100% allocations, the contribution of water trading to water use increased from 13% during 1998/99 when the allocation level first dropped to 100%, to 22% during the 2005/06 season.

**Table 3: Relationship between seasonal allocations and extent of trade**

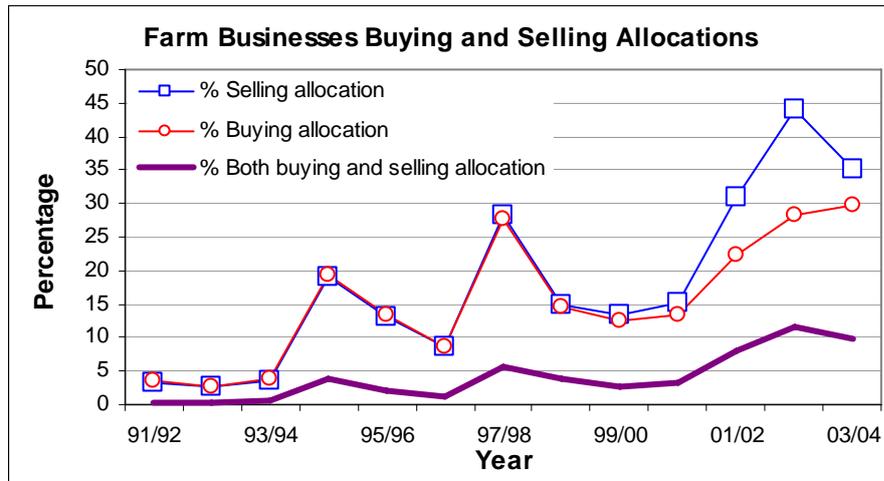
Season	Goulburn System		Murray System	
	Allocation (%) <sup>1</sup>	% of trade <sup>2</sup>	Allocation (%) <sup>1</sup>	% of trade <sup>2</sup>
1995/96	150	7	200	3
1996/97	200	4	200	3
1997/98	120	9	130	13
1998/99	100	13	200	5
1999/00	100	14	200	8
2000/01	100	16	200	2
2001/02	100	18	200	5
2002/03	57	24	129	16
2003/04	100	16	100	18
2004/05	100	18	100	22
2005/06	100	22	144	14
2006/07	29	37	95	20

Source: Based on Goulburn–Murray Water's Records

<sup>1</sup> Maximum seasonal allocation; <sup>2</sup> total water trade for season as percentage of total water use

While Tables 2 and 3 show clear sign of water markets increasing influence on who get access to water both in the long term and within any given season, it does not really tell us how widespread irrigators have adopted the use of water markets. Is it only a few big irrigators that trade or is trading widely used by a broader sector of irrigators? Initially there is no doubt that there were very few irrigators active in both the allocation and entitlement market (Figure 1 and 2).

However, since the change of allocation practice in 1998 market participation has increased steadily in both markets but mostly in the allocation market. During 2002/03, 45% of all farm businesses were selling allocations, 30% were buying allocation and 10% both bought and sold water. In total 85% of irrigators were active in the allocation market that year



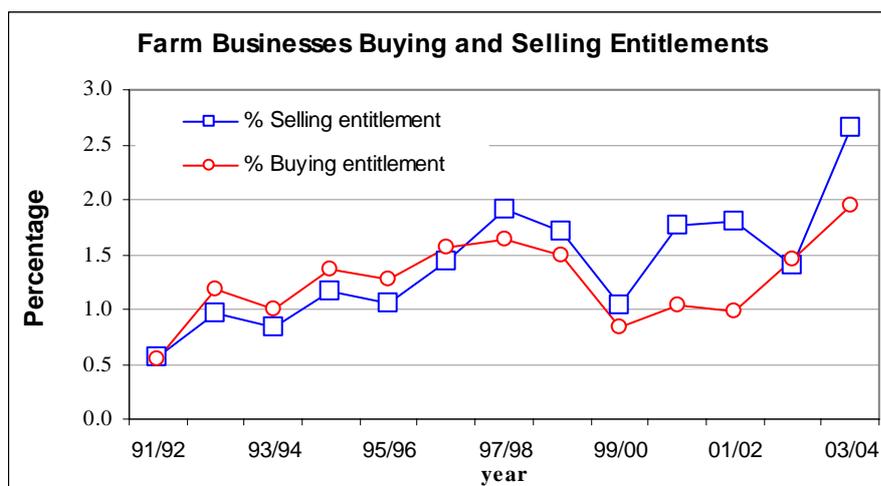
**Figure 1: % of farm businesses buying and selling allocations each year**  
(Source: Bjornlund, 2006)

The higher level of participation in selling than in buying both entitlements and allocations since about 1998 is due to the sale of water to downstream of the GMID into the Sunraysia area of Victoria and into South Australia where most of the horticulture and viticulture industries are located.

At the end of the 2003/04 seasons 81.4% of all farm businesses had participated in some kind of water market activity

- 9.6% had sold entitlements at least once
- 9.6% had bought entitlements at least once
- 49.8% had bought allocation at least once
- 62.4% had sold allocations at least once.
- About half the farm businesses had participated in 6 or more transfers.

(Bjornlund, 2005).



**Figure 2: % of farm businesses buying and selling entitlement each year**  
(Source: Bjornlund, 2006)

### Trends and seasonality

Prices for both entitlements and allocations have been steadily increasing since 1993. Entitlement prices have grown at an average annual rate of 12.3% while allocations prices have increased (on average) 20.2% p.a.. (Figures 3 and 4). The centred moving average (CMA) for entitlement prices shows three price levels with prices heading towards a new level during 2006-07 (Figure 3). The increase to a new price level is associated with a period of exceptional scarcity. The first increase took place after 1997/98 when the seasonal allocation was low for the first time (Table 1). Historically seasonal allocations had been around 200% of entitlements, in 1997/98 it was only 120% and have since not exceeded 100%. The second increase took place in 2002/03 when the seasonal allocation only reached 57%. The third increase started during the season of 2006/07 when allocations only reached 29% and prices has not yet settled at a new level.

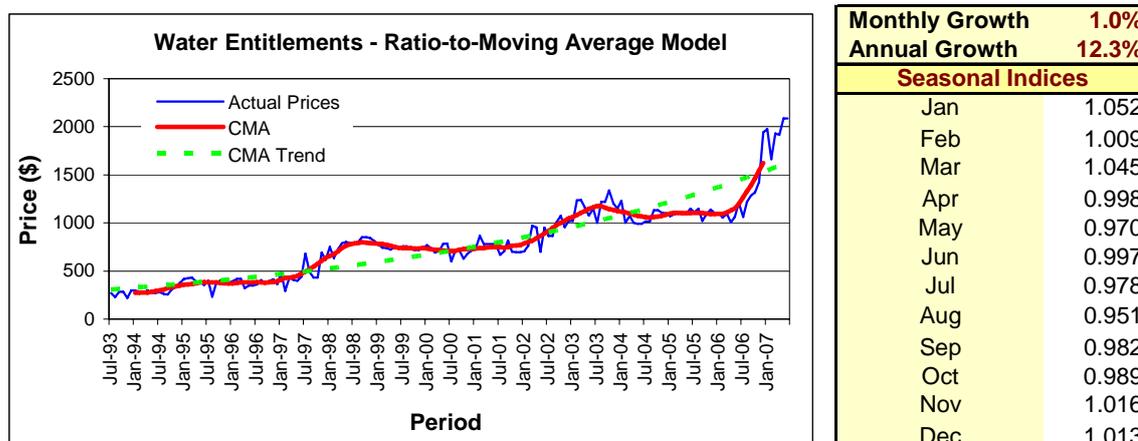


Figure 3: Entitlement prices 1993 to 2007 – trend and seasonality

Allocation prices (Figure 4) fluctuate more than entitlement prices but again the centred moving average indicates the same increases in price levels as discussed for water entitlements and for the same reasons. While it is logical that the price of allocations increase with scarcity it is less intuitively clear that entitlement should do so. When a buyer pays a very high price for one ML of allocation during any given year, the buyer receives that ML, which will allow the purchaser to endure a drought season. On the other hand when seasonal allocation levels keep decreasing, the willingness to pay for water entitlements should also decrease. Where an entitlement holder prior to 1996 would expect to receive 2 ML of allocation for each ML of entitlement they own, it is quite uncertain how many ML of allocation an owner of an entitlement will receive in the future (Table 1). It could therefore be expected that the price of a commodity with that level of uncertainty and actual decline in yield should decrease.

Analysis of entitlement prices shows that there is no significant seasonal variability in price (Figure 3) with all seasonal indices being around 1. On the other hand analysis of allocation prices shows clear sign of seasonality (Figure 4) with prices in the May-July period being only around 50% of the yearly average while prices in October average nearly 30% above the yearly average. This provides guidance to potential investors as to when to sell their allocations each season.

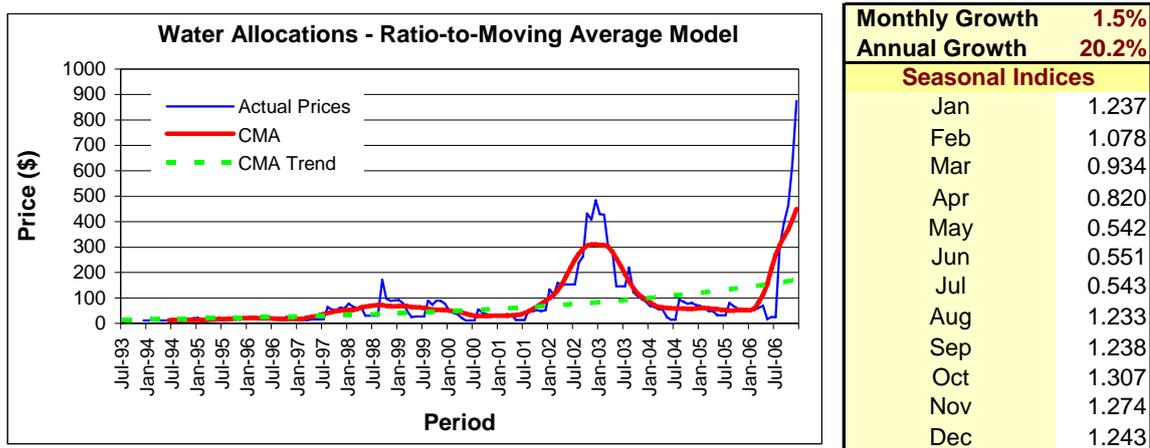


Figure 4: Allocation Prices 1993 to 2007 – trend and seasonality

**Cyclical movements in allocation and entitlement prices**

In markets for other commodities such as stock markets or property markets it is expected that the market value or price of that asset is determined by the expected monetary return and the required yield which largely reflects market risk. This is clearly evident both in share markets and in property markets. Investors' willingness to pay for shares on investment properties is linked to the anticipated income stream and future capital gain. To investigate this we computed the cycle factors for entitlement prices and allocation prices. The cycle factor is the relationship between the de-seasonalised price and the long term trend line and thus show price fluctuations caused by other factors than trend and seasonality.

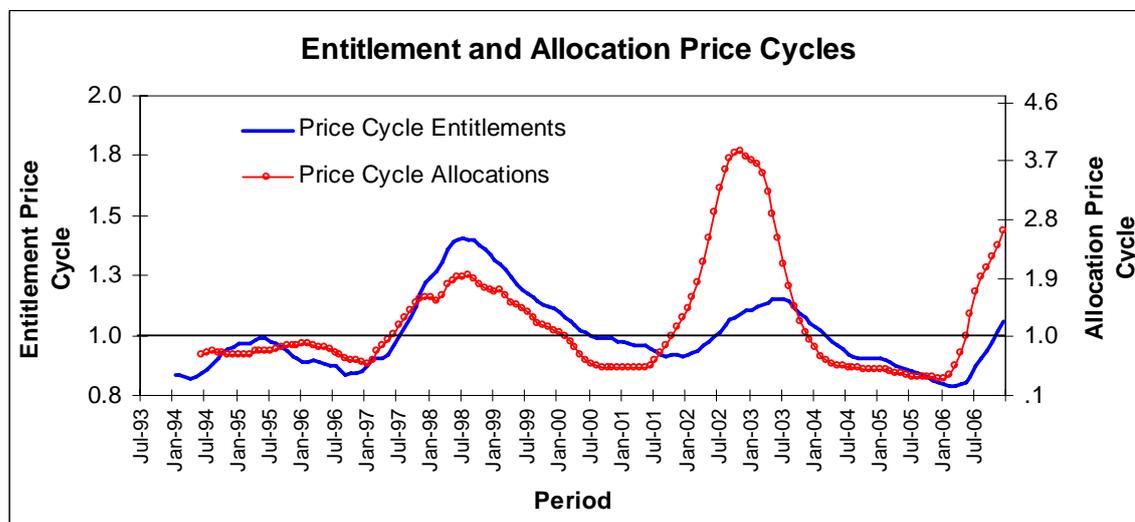


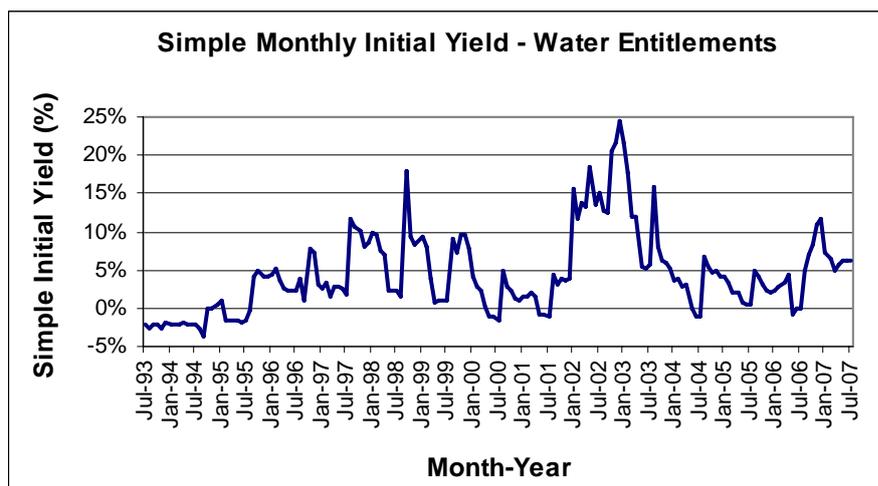
Figure 5: Entitlement and Allocation Price Cycles

The two price cycles are largely synchronized (Figure 5). In the early years of the market it appears that entitlement prices lead allocation prices. However, since 1997 the cyclical movements have been initiated with changes in the allocation price as conventional economic wisdom would suggest. What is also apparent is that allocation prices fluctuate much more widely than entitlement prices, especially during periods of exceptional drought (2002-03 and 2006-07). Note that the scale on the vertical axis for the allocation price cycle is more than twice as high as it is for the entitlement price cycle. This analysis should provide comfort for investors considering

investing in water entitlements. It also indicates that there should be potential significant gains from derivative products in helping water users manage these fluctuations.

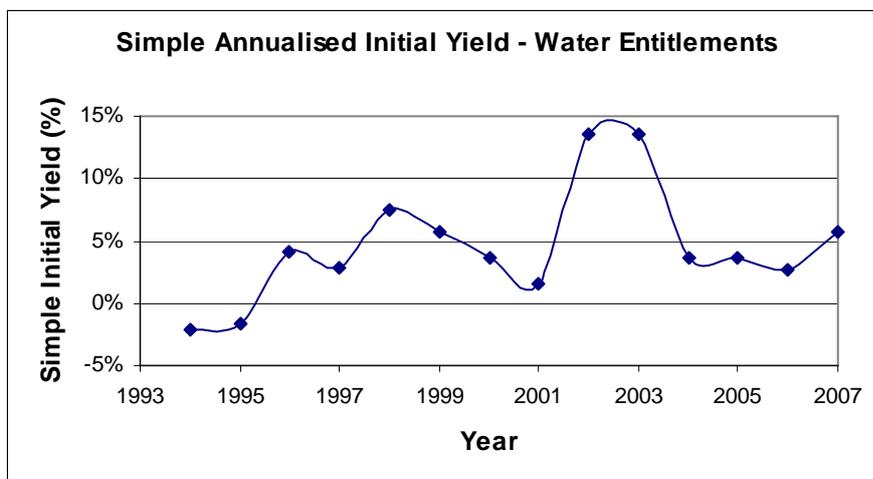
**Initial yield calculation**

A simple measure used by many investors to evaluate the profitability of an investment is to compute the initial yield, which is simply the expected earnings on the asset at the time of purchase as percentage of the price of the asset. In the case of water entitlements, it is the allocation price over the price paid for the entitlement. The monthly (Figure 6) and annualised (Figure 7) yields were calculated for the 1993 to 2007 period.



**Figure 6: Simple monthly initial yields**

Monthly initial yield figures fluctuate widely over the season reflecting the findings from the analysis of the price cycles which showed that monthly price fluctuations in the allocation market is several times higher than in the entitlement market. During the first three years of trading initial yields were actually consistently negative during the season suggesting that seasonal sellers only partly recovered unavoidable delivery costs associated with holding the entitlement. Since 1996 initial yields have consistently been positive except during April and May in some years where active irrigators are selling excess water for the season to recover unavoidable cost and demand is low.



**Figure 7: Initial yields based on median annual entitlement and allocation prices**

Initial yields based on annual median prices also show negative yields for the first two years. For most years since then yields have fluctuated just below and above 5% except for the years of

2002/03 and 2003/04 where yields were closer to 14%. Initial yields do not incorporate capital gain, which Figure 3 indicates is about 12.3% p.a., or increases in allocation prices during the period of ownership. To fully understand the investment potential of water entitlements we need to look at return over a holding period including capital gain.

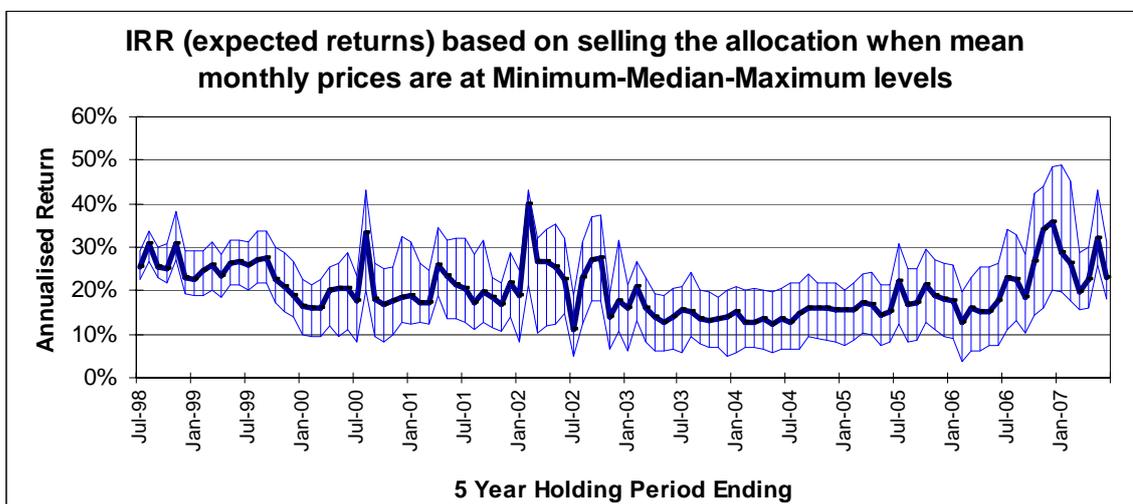
### ***Discounted cash-flow analysis***

To estimate the return from investing in water entitlements, a discounted cash flow (DCF) approach has been used to compute the internal rate of return (IRR) over a five year investment period. The following assumptions and scenarios were tested:

1. The investment is purchased at the mean entitlement price for each month. This becomes time zero in each cash flow. A separate DCF calculation was made for each month of the time series as long as data is available for the 5 year investment period. This was repeated for each of the six decision making scenario listed below resulting in 108, IRR estimates.
2. The entitlement holder then sells the allocation each year. To explore the importance of how to make the sell decision each season six scenarios were used. The first four scenarios assume that as much allocation as possible is sold during the month when the mean allocation price:
  1. is at a minimum for the year (constantly unlucky),
  2. is mid-range (median, most likely),
  3. is at a maximum (constantly lucky or very smart) (for scenario 1-3 see Figure 8),
  4. was at a maximum in the previous year (naive forecast);and two other scenarios
  5. one under which the entitlement holder sells an even proportion of the allocation each month over 10 months (a low risk strategy); and
  6. one under which the allocation is sold over the 6 months when prices are normally highest according to the seasonal indexes in Figure 2 (high seasons) (for scenario 4-6 see Figure 9).
3. In each instance the investor can only sell the amount that has been “allocated to that point”. So for scenario 3, if the maximum price is in December, but at that point only a 50% allocation has been announced, then they would sell the 50% allocation at that price, any additional allocation made available due to further increases in the allocation level will then be sold at the next highest price following the increase. In some instances this results in progressive sales over several months. It is assumed that the investor will attempt to maximise return by selling as much allocation as possible and this will occur each year during the 5 years investment period. For each sale a 3% commission is deducted (payable either to a broker or WaterMove).
4. In December of each year the entitlement holder pays the volumetric cost associated with holding the entitlement. This is a slightly simplified approach to a by now complex pricing structure but approximates the situation.
5. The investment is sold after 5 years at the mean entitlement price within a three month window according to the same scenarios as for the sale of the allocation (minimum, median, maximum and naïve entitlement price, with median being used for the even allocation scenarios) minus a 3% commission.
6. IRR is calculated as the monthly rate and converted to an effective annual rate.

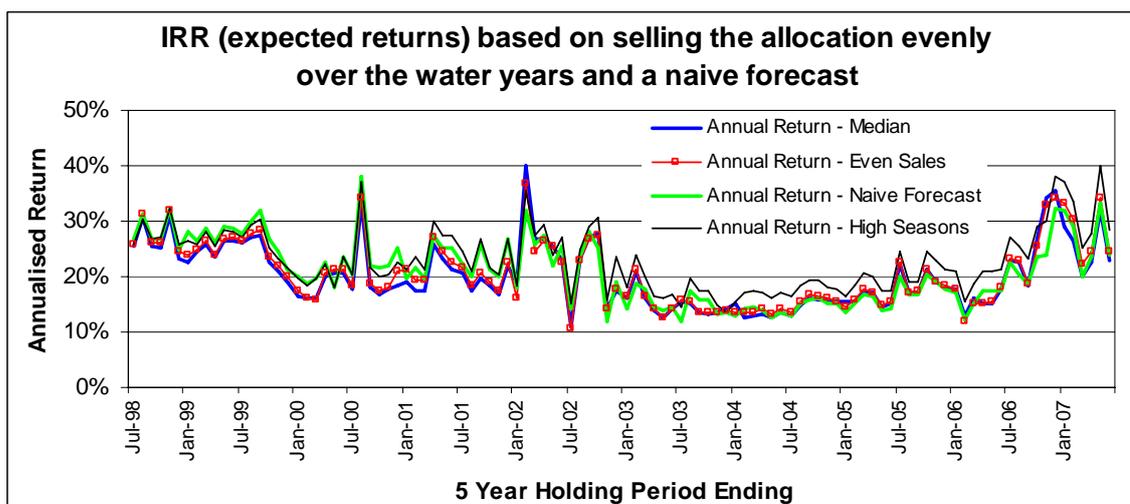
The IRR for a five year holding period vary dramatically over the analysis horizon. For the theoretical 5 year investment that ends in the early period, the returns would have been around 25%, dropping to around 20% for investments ending between 2000 and 2003. Investments ending during the period 2003 to mid 2005 (these would have been purchased in 1998 to mid 2000) show very steady returns around the 15% level and the market appeared to have matured and stabilised. The recent drought has meant that sellers of allocations have received an unexpected windfall in prices but have had a reduction in returns due to decreased allocation

volumes. The effect is that the theoretical investment, held over five years and ending in 2007, shows high variability in returns depending upon the exact periods of the investment and are particularly high if sold during periods of very high entitlement prices. The major effect of the drought has been to increase the risk of returns from an investment in water but to provide an overall increase in returns.



**Figure 8: IRR if selling allocations at seasonal minimum-median-maximum prices**

In reality no investors is likely to achieve returns based on selling at between minimum and median prices. Simple selling strategies can be followed to ensure returns consistently at or above median returns (Figure 9). During the early years the naïve forecast, that is, selling at the time when the price was highest the previous year seems to outperform both the even sales approach and provide similar results to those based on selling during the six months were seasonal indexes indicates prices to be highest. For investments made since 1998 (ending after 2003) the strategy of selling evenly over the six high season months have consistently outperformed any other way of selling by up to five percent and the naïve forecast approach have underperformed the even sales approach. Following the high season approach would have achieved return of over 20% for investments made at most times during investment horizon.

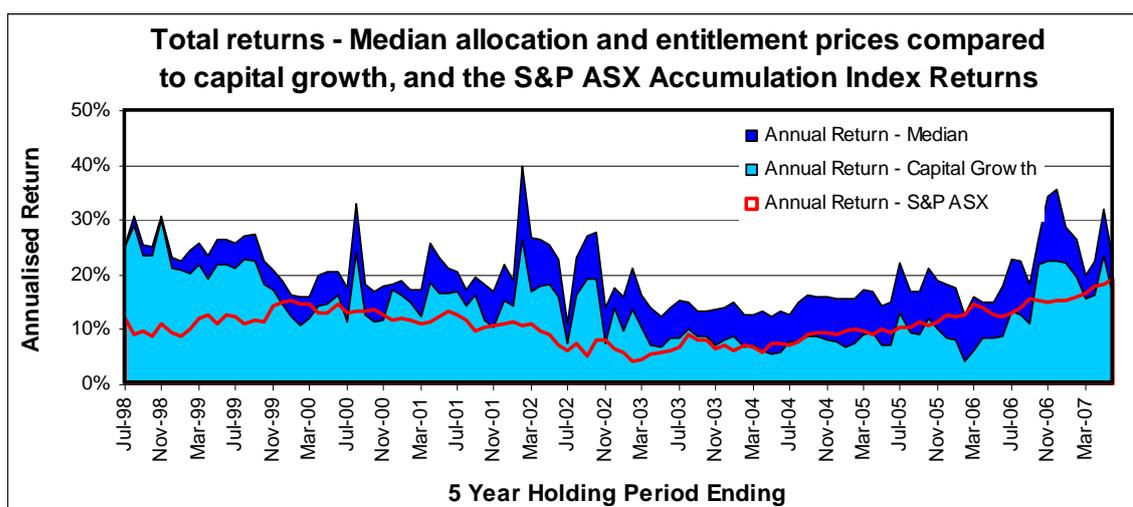


**Figure 9: Internal rate of return – five year holding period for water entitlements**

### **Capital growth or annual return? Comparison with return from investments in shares**

Capital gain appears to be the major contributor to overall return in a similar manner to the share market. Figure 10 breaks down the return into its capital gain and annual return components and confirms that most of the overall return is due to capital gain. However, over time the capital gain component has drastically declined while the return from the sale of water allocations has increased.

Most of the variability in the overall return is due to fluctuations in capital gains while the return from the allocations is less variable, but growing. From an investors perspective this is reassuring. As previously suggested it would seem strange that entitlement prices keep increasing while the seasonal allocations yielded by the entitlements are decreasing. Where initial returns were based primarily on speculative capital gains more recent investments would return a more stable annual income. These findings indicate that from a water seller's perspective, the declining seasonal allocation levels are more than made up for by increasing allocation prices. This reflects a maturing market and makes water entitlements a more appealing investment vehicle. Figure 8 also provides a comparison with the S&P/ASX 200 accumulation index. This indicates that returns from investments in water entitlements, while more variable, have exceeded those in the share market by about 5% p.a. for investments (assuming a 5 year holding period in each instance) in more recent years. While early investments showed considerable higher differences due to early low entitlements prices more recent investments have been very variable. This probably reflects the increased risk associated with the long term yield of water entitlements under current policy conditions.



**Figure 10: Total return, capital growth and the S&P ASX accumulation index**

### **Conclusions**

This paper has analysed market activity and actual prices paid and accepted for water allocations and water entitlements in a water market in the Goulburn-Murray Irrigation District, Australia's largest irrigation area. The purpose was to evaluate whether the fundamentals are emerging to support the introduction of more sophisticated market instruments such as derivative products. Experiences from markets in other resources suggest that the most significant efficiency gains are achieved from the markets in derivative products rather than from trading in the product itself. The development of such markets requires a reasonable level of market maturity and the existence of institutions to support such markets and provide security of ownership and certainty of market outcome. Especially if derivative products such as futures and options are introduced

buyers of such products needs to have a high level of certainty that the product will be delivered when and if the contracts are being executed.

Historically, institutional impediments to the efficient operation of water markets have been high due to restrictions on trade, links between land and water rights, lack of secure entitlement registers and insecurity about the future stream of water allocation yielded by water entitlements due to unresolved issues related to environmental flows. Many of these issues either have been or are in the process of being resolved, under the auspices of the National Water initiative. Water markets, and especially the involvement of non-water users or investors in this market, have been impeded by significant community concern. This concern is still ripe but it could be expected that irrigators with significant investments in water dependent infrastructure will start to see the benefit of such water products as scarcity intensifies and allocation prices repeatedly reaches levels between \$500 and \$1,000 per ML and as it becomes more and more difficult to secure adequate supply regardless of the price. Instruments which allow such irrigators to resolve supply issues during periods of extreme drought, well in advance, should be very appealing

This paper has indicated that water markets are maturing, that volumes traded and the participation rate is increasing to levels which should constitute mature and liquid markets with a high number of buyers and sellers. The emergence of a number of water exchanges and private water brokers provides ongoing information flow about supply and demand and price formation. Finally, financial analysis suggest that entitlement and allocation prices follows the same cyclical pattern, that prices in the two markets are steadily increasing and that returns from investing in water entitlements over a five year holding period consistently outperform the Australian share market.

It is therefore concluded that the fundamentals are emerging for the introduction of more sophisticated water product and market mechanisms.

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