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## **"WHO DARES WINS"**

*Opportunities to improve  
water trading in the south-east  
of South Australia*

**FINAL REPORT to the South East  
Catchment Water Management Board**



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POLICY AND ECONOMIC RESEARCH UNIT

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November 2000

The recommendations presented in this report have been made by the Policy and Economic Research Unit of CSIRO Land and Water and do not necessarily represent the views of the SE Catchment Water Management Board.

In accepting the final version of this report, the SE Catchment Water Management Board does not necessarily endorse any views or recommendations made in this report, either wholly or in part.

## **EXECUTIVE SUMMARY**

Water policy in the South East has just completed a period of review and revision. The result has been a pro-rata rollout of most of the unallocated water in the unconfined aquifer of five Prescribed Wells Areas. With this roll-out completed further development of these water resources is heavily dependent on the development of water trading arrangements. Consistent with our terms of reference, this report seeks to

- Identify the issues currently restraining water trading;
- Develop/identify a range of processes for the establishment of an effective water market;
- Identify the critical success factors for water trading; and
  - Identify the experiences from elsewhere, which have proved to be unsuccessful or inappropriate for prudent resource management.

Issues currently restraining water trading were identified through a series of focus group meetings with water users and holders of water rights, comparison of current practice with actual and planned practices elsewhere, and a series of workshops with Board and Government representatives. Recommendations in the report propose a range of processes for the establishment of an effective market and factors critical for success. We have taken literally the Board's implied request that we draw attention to and do not propose processes or arrangements that have proved unsuccessful elsewhere.

### **The value of water in the South East**

Irrigation in the South East directly accounts for over \$93 million in regional value added. As most of the water available for irrigation has now been allocated, increase in the value of production is dependent upon trading opportunities. Water trading gains can be expected to come from

- Transferring holdings to areas where they can be used;
- Increases in the efficiency of water use;
- Trade to higher value uses; and
- Elimination of the 'shadow' effect.

It is also possible to use trading arrangements to help the South East to keep water resource use within sustainable limits.

Economic analysis suggests that it is not unreasonable to expect a 20% increase in water use efficiency on an irrigation farm using 1,000 ML per annum to produce an additional \$164,000 per annum. Elimination of a 1,000 ML shadow in a valuable area could produce an extra \$3,500,000 per annum in net benefits (See Appendix 1).

The title to this report arises from a comment made to us during consultations in the South East. The sense of all the meetings we held was that the Board should search for excellence in the management of the South East's Water Resources. Irrigators and land holders want an apolitical system that will serve them well - in perpetuity. – They want a system that will not create more problems. This report is written with this proposition in mind.

## **Should the South East move to the frontier of best practice?**

Our strong recommendation is that the Board avoids the mistakes that have been made by others and, building upon global experience, move to the frontier of best practice in the allocation of water rights. If the Board goes for world best practice, the South East will win - economically, socially and environmentally. The alternative is to proceed incrementally, dealing with problems as they emerge. Global and Australian experience suggests that this incremental approach never works in areas that are or, as a result of changes, become over allocated. The general experience is that trading turns over allocation into over-use. Economic and community values decline. **We recommend that, as well as acting to improve trading arrangements, changes are made to ensure that trading improves and sustains water use in the South East. (R1)**

South Australia already has impressive institutional and administrative arrangements for its water resources. The step from where the Board is to the very forefront in the management of renewable natural resources requires

- Enabling water users to separate "access" rights (the site specific rules about how water may be used at any location) from "volumetric" entitlements so that trades in volume are not hindered by complex administrative procedures;
- Introduction of a simple volumetric accounting system and limiting trading opportunities to those people prepared to use this system;
- Deepening thin markets by ensuring good flow of information for each of the South East's 70 odd management areas;
- Through a competitive process, appointment of a preferred broker with a mandate and contract to develop each of these markets;
- Re-specification of existing rights as volumetric shares of the PAV for each management area.

There is lots of detail behind this five-point strategy but, in essence, this is what we recommend. We don't recommend fiddling around the edges.

### **This report**

The first question that this report asks is: "How do existing licence arrangements line up with world best practice?"

Having highlighted opportunities for improvement, the report then focuses in on trading arrangements. "How should the market be established?"

Recognising the power of imperfect markets to frustrate and hinder progress, the report also searches for property right and institutional arrangements so that trading will help the people of the South East achieve the goals they have set for their water resources.

## **Rights to South East groundwater**

The South East's water resources consist of a series of confined and unconfined aquifers divided administratively into 5 Prescribed Wells Areas. Prescribed Wells Areas are divided further into zones and management areas. The borders of most, but not all, management areas coincide with the boundaries assigned to each hundred.

Water rights, rules for water quality protection and trading arrangements are used for totally different purposes. The rules for protecting water quality, in particular, work at cross purposes to the security of an individual's water rights and ease of trading arrangements. Licence holders would prefer an absolute guarantee that none of the rules about access to water and the ways it can be used will change. In reality, however, knowledge about aquifers and how they respond to use is far from perfect. At times, this means that the rules and conditions under which people are allowed to use water need, at least periodically, to be changed. Clearly there are competing objectives but the sustainable use of water requires that:

- 1) Water is allocated in a manner that does not result in depletion, by keeping use within Permissible Annual Volumes (PAV).
- 2) Increases in salinity be controlled in areas where irrigation and soil conditions are such that water quality, rather than water quantity, limits water potential.

This latter purpose - the control of salinity - is not always well appreciated by irrigators. The main cause of salinity is groundwater recycling.

There will soon be 6 very different types of water allocation in the South East. Some are specified in volumetric terms and others by area.

In each management area, the market is very thin. There are approximately 70 management areas. Across the entire South East, the record number of applications to expand the area irrigated on a property is 254 and the record number of trades in any one year is 57. To September of this year (2000), 36 trades have occurred. The number of licence holders in each management area is typically around 20 to 40 and can be as low as 5.

## **Opportunities to improve licence and allocation arrangements**

Experience from the rest of the world suggests that it is easier to set up systems that don't work than ones which do! The lessons that emerge from these experiences and this literature are summarised in Appendix 2. Well-designed systems avoid problems, poorly designed systems compound them.

All tradeable property right systems, including those used to manage water, are based upon limits set by administrators. If these limits are wrong, trading may result in changes that lead to social, economic and environmental catastrophes. As a result, the foundations of a system must be well defined. Examples of problematic trading systems can be found in many of the world's over-exploited fisheries and in a number of Australian groundwater based irrigation areas. There are many other examples of failure and poorly

functioning systems. Typically, the systems that are worst are those that respond slowly but irreversibly to unsustainable pressures. Groundwater systems fall into this category.

The South East will benefit most by the development of water trading that is accompanied by the progressive introduction of institutional, administrative and legal arrangements that are consistent with world best practice. Changes consistent with this vision include

- 1) Definition of entitlements so that it is clear that holders are given a *proportional share* of the PAV as climate, land-use and water availability change through time.
- 2) The development of a low cost debit and credit water accounting system.
- 3) Immediate introduction of meters in all areas that are over-allocated, rapid introduction of meters in all areas that are more than 80% allocated and phased introduction in areas that are more than 50% allocated.
- 4) Separation of volumetric allocations of PAV from site-specific access or use rights. This could be achieved under the current Act by progressively issuing all holders of a Water (Taking) Allocation with
  - a) a Volumetric (Holding) Allocation indicating the share of the PAV held by them;
  - b) a Water (Taking) Allocation defining the maximum amount of water that can be "used" per annum on the land title described by the title and also the way that that water may be used.

To use water as distinct from holding it, both a Water (Taking) Licence and Water (Holding) Licence would be necessary.

- 5) Making it clear that licensed "use" refers to the volume that transpires or evaporates and, whether flood irrigation or other similar system, is different from the volume that is pumped.

Examples of the first page of these two types of allocation are presented on the following pages. The CT on the first licence is code for the Certificate of Title to which it relates. The formula for converting from irrigation equivalent to crop area ratio is not mentioned. The second example is of a volumetric holding allocation. No certificate of title is mentioned.

GOVERNMENT OF SOUTH AUSTRALIA  
DEPARTMENT FOR WATER RESOURCES

PO Box 1046 MOUNT GAMBIER 5290  
Ph. (08) 8735 1134 Fax (08) 8735 1135

**WATER LICENCE**  
*pursuant to section 29 of the Water Resources Act 1997*

Licence No.

Licensee(s):

**Prescribed Water Resource from which water may be taken or from which a water allocation has been made:**

LACEPEDE KONGORONG PRESCRIBED WELLS AREA(LKPWA)

**Water Allocation per annum:**

Purpose	Allocation
TAKING IRRIGATION	21.9 haIE

**Source(s) of Water:**

Description	Allocation
LKPWA Unconfined	21.9 haIE

**Intervals at which conditions of this licence may be varied by the Minister (sections 29(4)(e) and 30(1)(b) of the Water Resources Act 1997):**  
yearly (on or about 30 June each year)

**This licence is effective from 2 July 1997 and remains in force until terminated by or under the Water Resources Act 1997 (the "Act").**

**This licence is subject to the Act, and any conditions which may be specified from time to time in the Regulations, or by the Minister under the Act, and to the following further conditions:**

1. The water allocation(s) endorsed on this licence must only be used on the land described below, unless otherwise approved:  
**CT**                      Hundred of  
   Allotment              in Deposited Plan
2. The water allocation(s) endorsed on this licence must only be used for the purpose(s) described above, unless otherwise approved.
3. The water allocation(s) endorsed on this licence must only be taken from the source(s) described above and where specified the amount of water taken from each source(s) must not exceed the component of the allocation assigned to it, unless otherwise approved.
4. The licensee must not cause, suffer or permit any water to be used for or in relation to any activity which is an offence under the provisions of the Act or any other legislation with effect in South Australia.



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**WATER LICENCE**  
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Licence No.

Licensee(s):

**Prescribed Water Resource from which water may be taken or from which a water allocation has been made:**

LACEPEDE KONGORONG PRESCRIBED WELLS AREA(LKPWA)

**Water Allocation per annum:**

Purpose	Allocation
HOLDING	6500.0 kL

**Source(s) of Water:** Description

LKPWA Unconfined COMPTON MANAGEMENT AREA

**Intervals at which conditions of this licence may be varied by the Minister (sections 29(4)(e) and 30(1)(b) of the Water Resources Act 1997):**

yearly (on or about 30 June each year)

**This licence is subject to the Water Resources Act 1997 (the "Act"), and any conditions which may be specified from time to time in the Regulations, or by the Minister under the Act, and to the following further conditions:**

1. The holding allocation endorsed on this licence is not to be used unless and until the Minister decides that the proposed use of the allocation specified pursuant to the water licence application is approved, with or without conditions, and is amended to a taking allocation.
2. If and when the holding allocation endorsed on this licence is amended to a taking allocation the water allocation must only be taken from a well within the management (MGT) area described as the source of water on this licence.
3. The licensee must not cause, suffer or permit any water to be used for or in relation to an activity that constitutes an offence.
4. If the name and/or the address of the licensee(s) changes, then the licensee(s) must notify the Department in writing within 21 days of the change occurring.

**Notes:**



Both types of allocation state that the Minister may vary the conditions attached to that licence annually.

## **Metering**

It is recognised that many people are opposed to the introduction of meters. One of the main reasons for this is the fact that the difference between the water that is pumped and the water that is "used" has not been well communicated. Global experience, however, is that un-metered systems are characterised by over-exploitation and economic decline. As the State Water Plan says "if you can't measure it, you can't manage it" (p.58). We recommend

- immediate introduction of meters in all areas that are over-allocated;
- rapid introduction of meters in all areas that are more than 80% allocated; and
- phased introduction of meters in areas that are more than 50% allocated.

The State Water Plan sets the date of 2005 for complete conversion of all allocations. As part of this conversion process, irrigators will need to be given the flexibility to carry forward water from year to year. To facilitate this and as an interim arrangement, we recommend that each licensee be allowed to carry forward up to one year's allocation and that, on conversion, all area allocations be given one year's allocation in advance. People who wish to have access to more than this amount will need to acquire it via the trading market.

## **Conversion from irrigation equivalents to volumetric allocations**

A major issue for the South East is to find the most equitable means to convert those parts of the existing allocation system that are still area based to volumetric or, if this direction is not followed, then how to convert the volumetric holdings into area-based allocations. The central building blocks for the system are current definitions of the volume of water that is "used" by the reference crop for each zone. As estimates of rates of evapo-transpiration have been used to estimate consistency with the PAV for each area, we do not recommend recalculation of each licensee's implied share of the PAV. Any departure from this fundamental building block is likely to result in the simultaneous reduction of all other allocations in the area.

A major issue for the Board to resolve is the confusion that exists in the South East about

- the difference between the volume pumped and volume used; and
- how these volumes relate to the crop area ratios used to define the area that may be irrigated.

Under some flood irrigation systems, the volume pumped may be as much as 4 times the volume that transpires, evaporates or is exported from the district.

Collectively, this is what is "used". That which returns to the unconfined aquifer is available for re-use.

Global experience indicates that communities will fight forever over the details. The most successful systems are those that are built on sound conceptual foundations. During the transition good systems all start by mimicking existing conditions as closely as possible. Trading and periodic reviews are then used to phase in the new set of arrangements. Given this, we recommend that any person wishing to trade an area allocation or expand an area allocation have the volumetric "use" defined by multiplying the irrigation area estimate by the current estimate of "use" per hectare for the reference crop. Management plans should then stipulate the assumed Pump- to-Use-Coefficient that is assumed for each crop and type of irrigation.

Take, for example, the case of a person who holds a 21 ha of irrigation equivalents and is using this to irrigate Sub-clover seed in Zone 3 of the Lacepede-Kongorong Prescribed Wells Area. The assumed rate of evaporation and, hence, use from this crop is 4.93 ML per hectare so the volumetric allocation would be

$$21 \text{ hectares times } 4.93 \text{ ML} = 103.53 \text{ ML}$$

This is the amount that would be tradeable. That which may be pumped, however, could be quite different from this. The crop area ratio for Sub-clover seed in Zone 3 is 2.7. This, however, is not the number that is needed. What is needed is a set of Pump-To-Use-Coefficients (PTUCs)<sup>1</sup> that facilitate estimation of the volume that may be pumped for a reference crop and for the crop that is grown. The PTUC for the reference crop may, for example, be 4.0 and for Sub-clover seed be 5.2 or 3.8. In the first instance, we suggest that the PTUC set for each crop should be set as close as possible to current practice. Each management plan should then provide for the periodic review of each PTUC. Where significant errors exist, the plan could provide for a gradual transition that brings the PTUC in line with reality.

### **The recharge issue**

World best practice suggests that it is critical to use well-established scientific principles to estimate the quantity of water available in an area for consumptive use. In the South East, this estimate is published as a Permissible Annual Volume. World best practice suggests that the sum of all allocations should never be allowed to exceed the PAV set for any area. This means that, whenever a change in land-use significantly reduces recharge by, for example, planting a forest or high water using perennial plant, an adjustment to the PAV must be made.

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<sup>1</sup> Other names are possible. It is the concept of that is important.

The options available are to include either all forms of land-use in the estimation of PAV, draw an arbitrary line or adjust the PAV and extent of irrigation as land-use changes. We recommend the latter, more administratively simple, approach. Rather than issuing significant recharge effect allocations, land-use change approvals that are likely to significantly reduce recharge should be made conditional upon surrender of an allocation equivalent to the expected effect on this change on the aquifer and modification of the PAV for the relevant management area.

When a person plans to significantly increase recharge and they register their intent to do so, they should be able to apply for a new water holding in proportion to the increase in PAV that their action creates.

### **Trading arrangements**

Irrespective of whether or not any or all of the above opportunities are taken, there is an opportunity to significantly improve the market for water in the South East.

Irrigation contributes around \$93million per annum in the form of value added in the region. Wise trading arrangements offer the opportunity to significantly increase this contribution without creating new problems. Increases in value added as a result of a trade can exceed \$4,000 per hectare (See Appendix One). By way of example, a 20% improvement in the efficiency of water use by a potato grower using 1,000 ML per annum and the use of this saving to produce lucerne seed would increase the annual value of production by \$164,000.

As the market is thinly spread across 70 management areas and the volume of trades per year are likely to remain small, we recommend that a process be run to select a preferred broker for the South East. This broker should be commissioned to provide an internet trading site and associated trading service for the South East for a period of 5 years. The Board should not set up its own trading company. We perceive it to be more cost effective to acquire the necessary software and trading skills from an outside provider. It is also wise for the Board to avoid any accusations of conflict of interest.

During the short-listing process, the Board should explore the merits of using this broker to communicate trading opportunities to irrigators and those with water (Holding) allocations. Many of these people are not familiar with water trading opportunities and there may be many misunderstandings. After the first five years and, as the market should be well established, it may not be necessary to continue with a preferred broker arrangement.

As the market develops, the Board, in conjunction with other Catchment Boards in the State, could encourage the brokers to work towards setting up professional accreditation processes to ensure accountability of brokers and agents in water trading. It is advisable for the Board to remain at “arm’s length” from these processes.

## **Making the market work efficiently, equitably and dependably**

The water market in most parts of the South East is likely to remain "thin". That is, the number of transactions that occur in any management area is likely to be relatively small. In such situations, administrators need to search for arrangements that make the market deeper.

One of the most effective ways of doing this is to focus on the incentive for people to trade and to lease or sell unused water allocations. As a general rule, there will be more trades if

- the broking fee is low (achieved by commissioning a preferred broker);
- information about prices is freely available (achieved by establishing and publicising market trends, allowing people to search a central register of transactions, etc);
- anonymous lists of water available for sale is easily available (achieved by selecting a preferred broker and requiring provision of an internet site, etc);
- application fees are low and approvals rapid (achieved by adopting processes that simplify administration);
- it is possible to get prior approval to use water at a location ( achieved by separating holding allocations from access issues so that people can get approval to irrigate before they search for the water to use);
- the trading areas are large (achieved by allowing trial trading across management area borders and following separation of holding and taking allocations, searching for opportunities to combine management areas);
- low cost temporary trades are possible with immediate approval (achieved by separating holding and taking allocations, introducing meters and setting up a water accounting system);
- borrowing from future allocations is discouraged (achieved by setting a 100% penalty for borrowing water from next year's allocation - in effect the rule is if you take 10 ML from next year's allocation rather than buying it you lose 20 ML off the top of next year's allocation);

In addition, the Board and the Government need to consider how best to allocate water in those parts of the South East where the roll out has not been completed. We suggest that this water should remain unallocated until trading is well established and then used to deepen the market for water.

## **Deepening the market and lowering transaction costs**

One of the most innovative opportunities to make thin markets work effectively is to introduce a zero-revenue auction process. We recommend that the Water Resources Act be amended to allow any hundred or management area to introduce an annual zero-revenue process if more than two thirds of irrigators support the idea. Under this mechanism, 10% of each

holding would be offered for sale via a mechanism where the expected clearing prices would be publicised for a week and reserve prices changed in light of this information. Water holders should be encouraged to add additional water to zero-revenue auction.

With regard to fee and levy arrangements, we observe that, if PAVs are set and periodically reviewed, if allocations to the environment are appropriate, and if Significant Recharge Effect Allocation arrangements are in place; then a catchment levy applied to all water holdings in proportion to the volume held, will encourage trade and economic development. A case can also be made for a separate levy in proportion to land value or land area as some of the Board's costs relate more to these measures than the volume of water.

During our consultations, a number of people suggested that a higher levy should be applied to those people who do not offer water for trade. If a water accounting system is in place, the economic incentive to trade should be sufficient. If water is not trading, this is probably due to either a lack of demand or an impediment in the trading system. Introduction of low cost ways to trade water rather than introduction of tradeable levies is the way to go.

### **The settlement system**

One of the problems that plague the introduction of any tradeable property right system is the need to move a complex paper trail of records into a formal property register. South Australia, the home of the Torrens Title registration system, is a world leader in the development of such systems. Under the Torrens Title system, titles are registered centrally and any dealing associated with these titles is valid only when the dealing is recorded on that central register. The Department is moving towards such a system but it is not yet fully in place. At present, there is considerable mis-match between the procedures used to buy and sell land and those used to buy and sell permanent water. It is only a matter of time until a serious error is made or a person rots the system. In consultation with other Boards, we recommend that dealing and settlement arrangements for all trades associated with permanent water trading be made consistent with established conveyancing practices as quickly as possible.

Temporary trades, as they are called, will be most effectively managed via the introduction of water accounts that resemble the statements used by all Australian banks.

### **Implementation**

The recommendations, options and suggestions made in this report propose a framework that aims to keep the South East in front and leave it with a water resource legacy of water resource allocation, management and trading decisions that it can be proud of. It assumes that the South East wishes to prosper, wishes to manage its water resources sustainably and does not want to trade into problems. The last section in this report lists a set of decisions that

- can be taken by the Board;

- require consultation with the other Boards;
- require administrative changes at Departmental level; and
- require or could be more effectively implemented if supported by amendment of the Water Resources Act.

The report closes with a suggestion that the South East be used as the platform to improve water trading arrangements across the State.



## **SUMMARY OF RECOMMENDATIONS**

### **This report recommends that**

As well as acting to improve trading arrangements, changes are made to ensure that trading improves and sustains water use in the South East. (R1)

This report's recommendations and guidelines for the improved licensing and management of water resources in the South East apply equally to the confined aquifer, as they do to the unconfined aquifer. In the long run, the Board should expect that confined water, as well as unconfined water, will be traded. (R2)

### **To build a solid foundation for successful trading, this report recommends that**

The Board pursues opportunities to convert existing licences into tradeable shares. (R3)

To facilitate trade and, in particular, conversion from one crop to another, or from one form of irrigation technology to another, a set of Pump-To-Use-Coefficients (PTUCs) are necessary. These coefficients should indicate the difference between what is pumped and what is used. Under some flood irrigation systems, as much as 4 times the amount that either transpired or evaporates is pumped. (R4)

Policies be put in place to ensure that trading arrangements retain consistency with the PAV set for each area evolve and change through time. The definitions of allocations should recognise that PAVs. (R5)

If the Board, in consultation with the State Government, opts to define allocations as proportional shares of the PAV associated with each aquifer, we recommend finding a simple straightforward means of calculating each person's share. As a basis for discussion, it is suggested that each person's share could be defined as the quantity of water assumed to either transpire or evaporate from the reference crop. If this option is taken then the sum of allocations should retain consistency with the PAV. Most other models will require a subsequent pro-rata adjustment to once again make the sum of all allocations consistent with the PAV. (R6)

### **To increase the extent of opportunities to improve water use**

Policies and management plans allow and encourage people to allow separation of volumetric entitlements from access for "use" entitlements, so that these rights can be sold or leased to separate people. (R7)

To prevent people from capriciously acting to create a shadow over another person's holding, all new access licences contain a condition that will result in the forfeiture that shadowing opportunity if it has not been used for four years. This should not extend to the volumetric allocation attached to a licence, only the right to use that volume at a specific location. (R8)

**To prevent trading resulting in the over-use of water, we recommend that**

As it is State policy that all bores should be metered before 2005, no trades be allowed to or from farms that are not metered. That is, any person who wishes to expand the area they irrigate, or any person wishing to acquire water from another person, be allowed to use that water only if they first convert their allocation to a volumetric one. (R9)

Upon conversion to a volumetric, each holder of a Water (Taking) Licence be allocated one year's allocation and that as an interim strategy the maximum amount that may be carried forward from year to year be one year's allocation. (R10)

The penalty for over-pumping, that is pumping without an allocation, be double the amount that is pumped in excess of the allocation held. Consistent with this model, people with a volumetric holding licence should be allowed to carry forward up to one year's allocation. (R11)

**To allow and keep the administrative cost of annual volumetric trades low, this report recommends**

A simple bank-like accounting system be established for the South East's water resources so that low-cost volumetric trading arrangements can occur quickly and simply. (R12)

Land-use change approvals that are likely to significantly reduce recharge should be made conditional upon surrender of an allocation equivalent to the expected effect on this change on the aquifer and modification of the PAV for the relevant management area. Conversely, when a person plans to significantly increase recharge and they register their intent to do so, they should be able to apply for a new water holding in proportion to the increase in PAV that their action creates. (R13)

**To facilitate the development of an informed efficient market, this report recommends that**

A process be run to select a preferred broker to provide an internet site and associated trading service for the South East for a period of 5 years. (R14)

During the short listing process when a preferred broker is selected, the Board explore the merits of contracting the preferred broker to communicate trading opportunities to irrigators and those with water holding licences. In partnership with the preferred broker, the Board could prepare an information booklet on trading opportunities, processes and arrangements. (R15)

As the market develops, the Board, in conjunction with other Boards in South Australia, encourage brokers to develop a process of accreditation in a manner similar to the real estate industry. Ideally, all brokers would need to demonstrate knowledge, carry liability insurance and adhere to a professional code of practice. (R16)

No unallocated water be released until a strong, viable market is established. On a management area by management area basis and as an interim strategy, unallocated water could be used to deepen the market for water by offering it for sale on an annual basis. (R17).

The Water Resources Act be amended to allow any hundred or management area, to introduce an annual zero-revenue process, if more than two thirds of irrigators support the idea. Under this mechanism, 10% of each holding would be offered for sale via a mechanism where the expected clearing prices would be publicised for a week, and reserve prices changed in light of this information. Water holders should be encouraged to add additional water to zero-revenue auction (R18).

A review be conducted to select some areas where cross-border trading is allowed on a trial basis. Cross-border trading may be more feasible if access or use rights are separated from volumetric allocations. (R19)

Fee and levy arrangements be reviewed once decisions about other recommendations in this report have been made. Trading fees and levies be aligned with administrative costs and kept as low as possible. The transfer of a volume or holding should cost much less than the transfer of an access right as only the latter requires a hydrological assessment. (R20)

Dealing and settlement arrangements for all dealings associated with permanent water trading, be made consistent with land title trades as quickly as possible. (R21)

**To allow trading arrangements to be varied in accordance with local arrangements, this report recommends that**

Management plans be used as the main mechanism to define the rules and conditions under which trades are allowed. (R22)

From a trading perspective, management plans should:

- a. Identify where cross-management area border trading may be trialed and how the impacts of these trials should be monitored;
- b. Document interim PTUC and propose a process for their revision;
- c. Define annual PAV and, where appropriate<sup>2</sup>, set in place a transitional arrangement to bring the sum of allocations in line with the PAV
- d. Set maximum and minimum depth to groundwater levels, salinity concentrations, etc that if exceeded would trigger a review
- e. Define access rules including the factors to be considered when applying the "4 kilometre square test";
- f. Define the show cause rules that would apply to people whose licences are creating a shadow on the water use opportunities available to others;
- g. Define the maximum amount of water that may be carried forward from year to year;
- h. Set a time frame for the roll-out of meters; (R23)

**To facilitate the efficient development of water trading arrangements and maintain South Australia's position as a world leader in water resources management, this report recommends**

The South East be used as the place to develop, test and refine water trading arrangements in South Australia. (R24)

## **Acknowledgements**

The methodology we used to prepare this report began with a search of the formal literature and the internet for examples of water trading experiences of relevance to the South East. Henning Bjornlund from the Water Policy and Law Group at the University of South Australia undertook this search. To this, we added our own information and experience, to provide the backdrop of lessons upon which this report is based. We would like to thank Henning for his role in this process and also for his critical review and comments on some of the ideas set out in this report.

Our terms of reference required us to specifically consider the social and economic impacts of water trading in South East. Water trading is already occurring in the South East and Melissa Bright' s analysis of the implications of alternative scenarios gave us an invaluable set of insights into the range of issues to be considered.

To ensure that we understood the full range of issues faced by the Board, we began with a series of workshops and focus group meetings with landholders in the South East. Meetings with irrigators and non-irrigators at Mount Gambier, Naracoorte and Keith were very constructive and rich in observation. We owe a considerable debt to these people. They challenged us considerably, understood all the issues, and stressed the need for decision and for a set of trading arrangements that will increase the prosperity and ensure that these arrangements improve rather than detract from the environment.

As part of the above process, we also met with the Board to scope alternatives and held a series of challenging workshops with staff employed by the Board and the Department of Water Resources. Randy Stringer, from the Centre for International Economics also participated in all our discussions and made many valuable contributions that we would like to acknowledge. It has been a joy and pleasure to work with all of these people. Responsibility for statements and judgements made in this report, however, must remain with us.

Finally, we would like to acknowledge and thank Jenny Peterson from the South East Catchment Water Management Board Staff. She tracked down a great deal of information for us and met our many requests with enthusiasm.

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## **PART ONE: WHY BOTHER WITH TRADE?**

### **The State of Affairs in the South East**

Water policy in the South East has just completed a period of review and revision. The result has been a pro-rata rollout of most of the unallocated water in the unconfined aquifer of five Prescribed Wells Areas.

A new era in water resource management has arrived. Although small amounts of water remain unallocated in a few management areas, most water in the unconfined aquifer is fully allocated and, if current estimates are correct, a number of areas are already over-allocated.<sup>3</sup>

From now on, most growth, development and change in water use will necessarily be accompanied by trading in water rights, allocations and holdings. To assist this transition, the South East Catchment Water Management Board commissioned this report to identify the most effective way to improve trading arrangements. The report identifies opportunities at the State and Board level.

In the South East, water drives options for economic development in agriculture and also other key industries like forestry, tourism, paper manufacturing and food processing. Water trading represents an opportunity to expand higher value uses of water and to do so in ways that neither result in declines in water quality or future opportunity. In agriculture, this might mean converting a dryland pasture to an irrigated pasture, or horticulture and viticulture. Where the location of irrigation changes, trade in water holdings and/or allocations is necessary.

As demand for water increases, holders of water allocations will review their options and ask questions about the way they earn money and use water. In this new water era, they may choose to continue doing things the same way, move into higher value crops or sell/lease any surplus water.

A key feature that drives the framework for this report is recognition that the South East's water resources are groundwater, rather than surface water based. Groundwater systems change slowly and are difficult to monitor. This means that mistakes take time to reveal themselves. Permanent changes in recharge rates are not easily separated from weather induced fluctuations. Water quality problems move laterally at rates that range typically from 100 to 300 metres per year. A neighbour may not become aware of the fact that an aquifer has become contaminated for many years. Moreover, once they emerge, these problems are not easily rectified. In short, unless close attention is paid to the fundamentals, the South East could trade itself into a set of unresolvable environmental, economic and social disasters.

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<sup>3</sup> The Lacepede Kongorong Prescribed Area is the only area where significant amounts of water are expected to remain unallocated.

## **Socio-Economic Gains of Trade or “What’s at Stake?”**

So let’s get to the question at hand – what’s at stake? Why not just let things continue the way they are. Future environmental, economic and social development of the region is what is at stake. Fundamental to this is how individuals use their limited resources to satisfy their unlimited wants without causing problems for others.

Water is important for not only the individual but also the regional economy. The better water is managed, the healthier the local economy will be and the better its environment will be.

Within the South East's regional economy, water markets are going to be one of the main mechanisms used to allocate scarce resources among competing uses and users. They are also going to be one of the main mechanisms used to protect the region's environment. Each time a trade occurs, there is an opportunity to compound or reduce existing problems.

Water use in the South East is capped for two reasons. The first reason is simply to prevent aquifer depletion. As the aquifer drops, the costs of ground water pumping rises. As well, water levels need to remain high enough that local wetlands, sink holes, river systems etc are maintained. The second - less appreciated reason - is that controls on irrigation are used to prevent declines in water quality. Salinity and nutrient contamination are the two main problems. When an area of land is irrigated, some of the water evaporates or transpires, but the salt and many of the nutrients return back to the aquifer. Each time the exercise is repeated, water quality declines. Long-term, economic development depends on good quality water. While there is some experimentation with salt resistant crops and research into potential uses of saline water, many of these options are unlikely to deliver the economic returns of current agricultural practices.

In the short term, the only way for many enterprises to expand production or get into more intensive water use is to buy water. Under the new regime, nearly all rights to use water have been allocated to landholders. This means that a trade will precede many changes in water use. The trade can be expected to occur when an aspiring buyer can use the water more profitably than the seller can. This is where the gains from trade emerge.

The gains from water trade can be categorised into two groups - those benefits that accrue directly to the user of the water, and those that are captured by the wider community.

The expanding water trade will involve such things as:

- movement of water from application to crops that produce more profit per hectare and industries that produce more dollars per megalitre of water used;
- increased economic development activity and/or employment;
- improved water use efficiency.

Expanding water trade has to be undertaken in a manner that does not significantly diminish the second category of benefits, which includes option and existence values that accrue to individuals and society. Option values relate to the fact that people want the resource, i.e. underground water, to be there for future generations. Existence (intrinsic) value is the value associated with knowing a resource is there for its own sake (i.e. satisfaction in the fact that the South East has healthy water). These are benefits associated with sustainability and in some cases with the private benefits listed above. The individual does not always act in ways that ensure the sustainability of the resource.

There is a third category of benefits that includes the indirect benefits that accrue to the region such as the spin-off benefits of job creation and the expansion of services in the region. These indirect benefits can be short term if the resource is not managed sustainably.

Trade forces a review of the property rights structure. By separating the title to land and water, trade is facilitated. Informal markets for water will develop if there is scarcity and a growing demand for water, despite legal impediments, as experience in Pakistan and India suggests. Trade has a tendency to put pressure on groundwater and surface water systems and as a result great care is required to ensure that the fundamentals are set up correctly. As technology changes and trades occur over time, further review and refinements may be required.

The potential gains from these trading opportunities are significant. As detailed in Appendix One, gross margins for high value uses, like viticulture, are in the vicinity of \$4,000 per ML while those for irrigated pasture range between \$140 and \$750 per ML. This means that trading can increase regional income by more than \$2,000 per ML.

## PART TWO: THE CURRENT SYSTEM

### Types of Allocations

With the pro-rata rollout there are, at least, three types of water allocation in the South East. They are

1. **Water licences with a holding allocation** defined as a right to a volume of water available in a hundred or management area. These allocations are not attached to a specific certificate of title and do not entitle the holder to use the water without first obtaining a taking allocation. The Select Committee, in recommending the roll out of un-allocated water, suggested that these allocations should be allocated as a proportional "share of the available water resource" but, departing from emerging best global practice, recommended that they be issued as "a kilolitre volume."
2. **Water licences with an area taking allocation** defined as a right to irrigate a specified area described by a certificate of title. The area is defined in irrigation equivalents and is converted to an actual crop area using crop area ratios that vary from Prescribed Wells Area to Prescribed Wells Area.
3. **Water licences with a mobile area taking allocation** defined as a right to irrigate an area of land in a water management area or hundred. The area is defined in irrigation equivalents and is converted to an actual crop area using crop area ratios that vary from Prescribed Wells Area to Prescribed Wells Area.

As a result of the pro-rata rollout, and as a matter of policy, it is envisaged that any conversion of a holding allocation will be in volumetric terms. Thus, in the very near future, the water rights in the South East will also be defined by

4. **Water licences with a volumetric taking allocation** defined as a right to use a volume of water per year at a location defined by a certificate of title.<sup>4</sup>
5. **Water licences with a mobile volumetric taking allocation** defined as a right to apply a specified volume of water to an area of land in a water management area or hundred.

Consideration is being given to requiring changes in land use that significantly affect the rate of groundwater recharge to be licensed. Allocations of this form could be used to give people credit for increasing the rate of groundwater recharge by removing a forest or introducing an aquifer storage and recovery program. Conversely, they could be used to facilitate the introduction of mechanisms that force any change in land-use change, that reduces the rate

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<sup>4</sup> A small number of volumetric water rights existed prior to the pro-rata roll out. These are primarily for industrial purposes.



of aquifer recharge, to be off-set by a reduction in the volume of water used for irrigation. For the purposes of this report, we refer to this form of allocation as a Significant Recharge Effect Allocation.

6. **Significant recharge effect allocation** defined as a right to affect significantly the rate of recharge in an area by, for example, establishing a new plantation.<sup>5</sup>

These subtle differences among each type of allocation makes comparison of them difficult. To aid comparison, Table 1 draws attention to the key features of each type of allocation. In the process of doing this, and for this report, we also assign abbreviated names to each type of allocation. In the near future, trade among all of these six forms of allocation can be expected. Unless arrangements are put in place to free up the water now in Volumetric Holding Allocations, opportunities for economic growth through irrigation will be limited.

To understand water licensing arrangements in the South East, it is necessary also to understand two other considerations. First, while most water use is supplied from unconfined aquifers, a smaller amount is supplied from confined aquifers. As all confined aquifers are only partially developed, and the water in them reserved primarily for urban and industrial purposes, there is less opportunity for trading among these allocations. **This report's recommendations and guidelines for the improved licensing and management of water resources in the South East apply equally to the confined aquifer, as they do to the unconfined aquifer. In the long run, the Board should expect that confined water, as well as unconfined water, will be traded. (R2)**

Second, water use in the 20 kilometre strip on either side of the South Australian and Victorian border is subject to conditions set out in the Border (Groundwater Agreement) Act 1985. For management purposes this area is divided into 11 zones on either side of the Border, 8 of which are under the jurisdiction of the South East Catchment Water Management Board.

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<sup>5</sup> Elsewhere in this report we propose a more cost effective and administratively simple way of dealing with this issue.

**Table 1 Summary of existing and expected water allocation arrangements in the South East of South Australia**  
(Assuming that *none* of the recommendations in this report are accepted.)

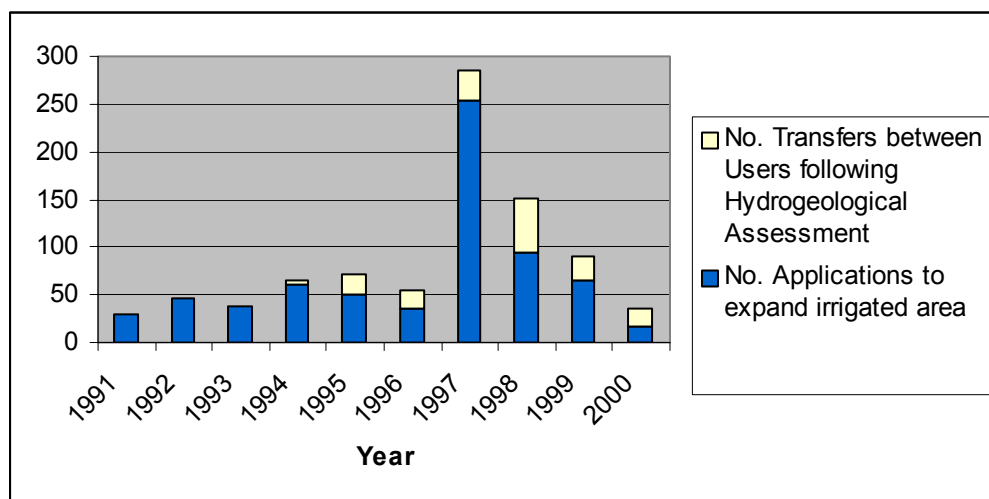
<b>Allocation Type</b>	<b>Volume that may be "used" *</b>	<b>Use or access entitlement</b>	<b>Location and transfer restrictions</b>
Volumetric Holding Allocation	Up to the volume stated.	None.	Can be used within the Water Management Area if converted to a Taking (Mobile or Site) Allocation.
Area (Site)Taking Allocation	All that is needed to grow a specified crop area.	Grow nominated crop up to the irrigation equivalent stated multiplied by the crop area ratio.	Location described by the certificate of title. Transferable within the Water Management Area.
Volumetric (Site)Taking Allocation	Up to the volume stated.	Pump up to x times the volume allocated. *	Location described by the certificate of title. Transferable within Management Area.
Area (Mobile) Taking Allocation	All that is needed to grow a specified crop area.	Grow nominated crop up to the irrigation equivalent stated multiplied by the crop area ratio.	Management Area. {These allocations may be taken from another location, perhaps even in another management area, for a short time.}
Volumetric (Mobile) Taking Allocation	Up to the volume stated.	Pump water up to x times the volume allocated. *	Management Area. {See comment above for Area (Mobile) Taking Allocation.}
Volumetric Significant Recharge Effect Allocation	Maximum limit on extent of change in recharge. Conceptually, credits are possible.	Change vegetation over an area defined by the recharge equivalent by change in recharge.	Area described by the certificate of title. Credits and debits are transferable within Management Area.

\* As explained elsewhere, some flood irrigators are under the misunderstanding that conversion to volumetric systems will not take account of the fact that much of the water pumped returns to the aquifer. In this report, "use" refers to the quantity that is permanently removed from the aquifer by evaporation, transpiration or export..

## Recent Trading Experience

Figure 1 and Table 2 below summarise the extent of recent trading and expansions in the extent of irrigation across the South East. Under current rules, any increase in the area irrigated or any trade requires a hydrogeological assessment. In any single area, the number of trades is very small.

**Figure 1 Summary of the number of trades and application to expand irrigation in the South East**  
(The data used to produce this figure is in Table 2.)



**Table 2 Number of applications to trade water in the South East**

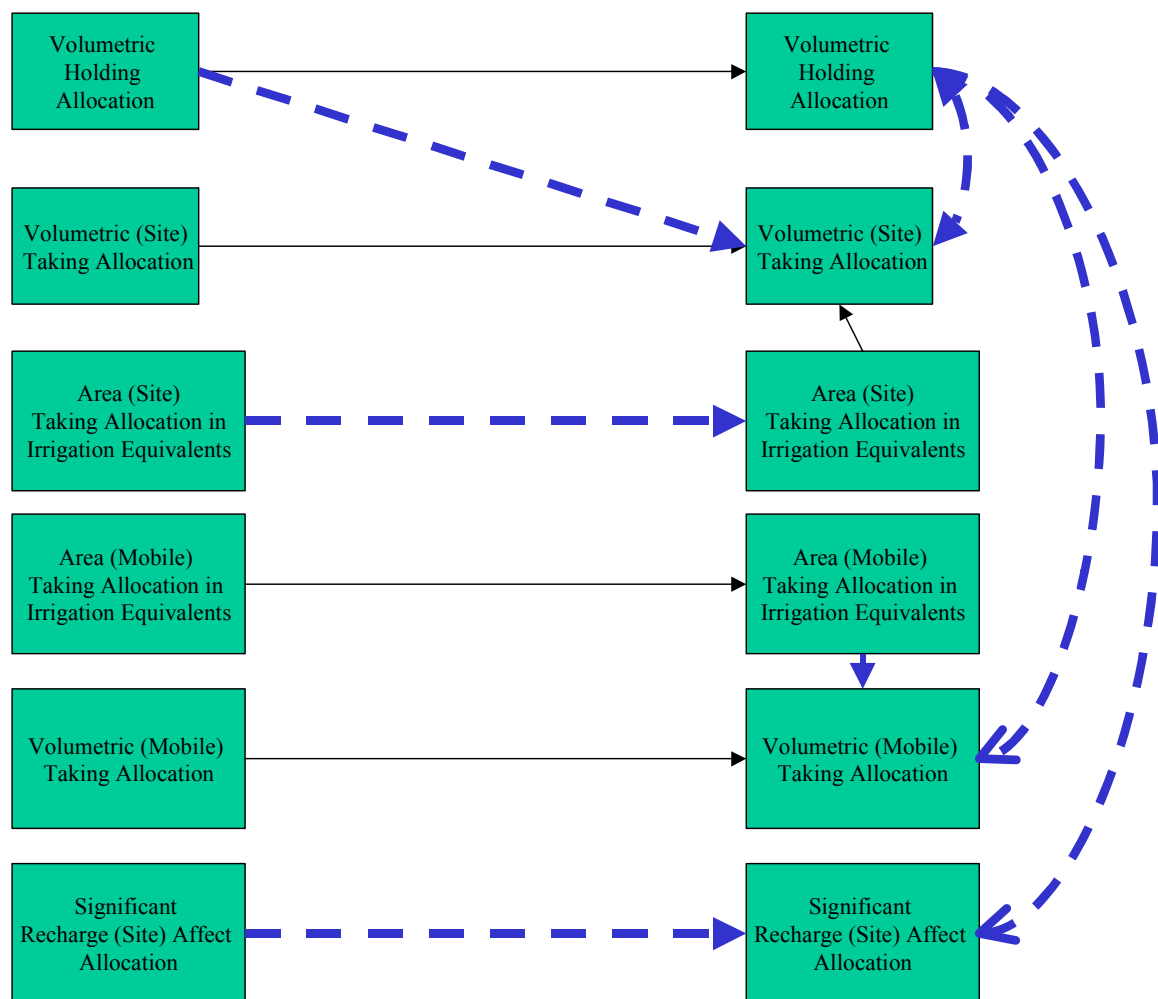
Year	No. Applications to expand irrigated area	No. Transfers between Users following Hydrogeological Assessment	Total
1991	29	0	29
1992	47	0	47
1993	38	0	38
1994	61	3	64
1995	51	20	71
1996	36	18	54
1997	254	31	285
1998	95	57	152
1999	66	24	90
2000	17	19	36
<b>Total</b>	<b>694</b>	<b>172</b>	<b>866</b>

Source: Fred Stadter, Dept for Water Resources, Naracoorte

## What trades are possible under the current regime?

Under existing arrangements, and as summarised in Figure 1, trade among all the forms of allocation in Table 1 can be expected. Current policy requires a hydrogeological assessment for any trade involving a Water (Taking) Allocation, including conversion from a Water (Holding) Allocation to a taking allocation. There is a notable exception, a hydrogeological assessment is not required when the water rights are sold with the land.

**Figure 2** Types of trades expected over the next 10 years under existing legislative and administrative arrangements. The thick blue lines indicate trades that require hydrogeological assessment before approval. Other permutations are possible but policy indications are that most of these other permutations will not be permitted.<sup>6</sup>



The first step in the hydrogeological assessment is a desk assessment based on information held within the Department. Field assessments may be required in some circumstances.

<sup>6</sup> The State Water Plan makes it clear that within five years all groundwater irrigation should be metered.

During a hydrogeological assessment, a "4 kilometre square test" is applied to any unconfined aquifer trade. The test is a pragmatic tool for protecting aquifer quality, impacts on nearby landholders and the environment. One consequence of this policy is that any taking allocation casts a "shadow" over a 16 square kilometre area. Generally, the presence of one allocation, limits the range of opportunities available to others within the "shadow". In the past, the cost of conducting the 4 kilometre square test has been met by the Department for Water Resources. When the test results in a refusal of permission, the applicant may, at their own expense, commission a more comprehensive assessment of the likely hydrogeological consequences of the proposed trade.

A second major consideration is the area within which trades are possible. Under current arrangements, trading is only possible within a hundred, or within a management area or sub-area. In the most restrictive case, this means that the total number of allocations within any trading regime is five. In virtually all cases, the number is less than 100 allocations.

Another consideration is the fact that both permanent and temporary trades can be expected. Under current arrangements, temporary trades can be expected to occur via the lease of an allocation to another person.<sup>7</sup> If, as proposed in the State Water Plan, meters are installed, a temporary trade could take the form of a transfer of an actual volume of water to a third person. Leasing of water to third parties could create a situation where there are shadows over large areas where no irrigation is occurring.

Across the South East, a few towns and a few industries have access to water in the confined aquifers that sit below the unconfined aquifer. Opportunities to trade these allocations are few, as most of this water is reserved for urban, industrial and recreational purposes. This means that, in the short term, the information provided in this report is most relevant to the users of the unconfined aquifer.<sup>8</sup>

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<sup>7</sup> Administratively, this is achieved by amending the allocation on the licence that the water is traded from and increasing the allocation on the other one. These amendments stipulate the period of time for which this change remains in place.

<sup>8</sup> There are two main types of recreational water users: golf courses and sporting fields. Golf courses are a profitable enterprise and thus it should be possible for the owners of the golf courses to buy water on the market. Sporting fields may not be profitable outside major urban areas and there may be public amenity reasons for providing water for these fields. Some choices are available:

- take water from the confined aquifer,
- require the local governments operating these fields to purchase the water through tax revenues, or
- make an exception for non-profit enterprises in the allocation of resources and wait for the line-up of exceptional cases.

If a special provision is made for recreational use outside the market, then it will be necessary to put rules in place to prevent this water from being traded.

## **PART THREE: THE NUTS AND BOLTS OF DESIGNING SYSTEMS**

Our advice, in this part of the report, is based on the premise that the South East is interested in:

- diversified economic development;
- supports sustainable use of the resource; and
- would prefer people to be able to make decisions in an environment with access to information and not be tied up in unnecessary red tape.

Everything we learned in the workshop and focus group meetings supports these basic premises.

### **Organising Principles**

The following is a set of principles that are useful in organising ideas about the competing goals inherent in designing the mechanics of a property rights system. It is extremely important in designing a system to keep track of why each policy is being put in place, and identify the reasons why it is being introduced. The recommendations in this report are based on the assumption that the Board is interested in developing policies and programs that pursue:

- Environmental protection/improvement – the trading system should not result in any backsliding in terms of environmental standards.
- Productive and allocative efficiency – trading encourages water resources to be assigned to their most valuable use and to be applied efficiently.
- Low information requirements – information requirements should be kept to a minimum – often this means asking: "What do administrators really need to know?"
- Low administrative costs – the cost of setting up, enforcing and reviewing the system should be kept low. Simplicity is often the key.
- Equity – no group should be severely disadvantaged by the trading system and it should not allow individuals to hold others to ransom.
- Adaptability – the system should be able to adapt easily to changing technology, prices and climatic conditions.
- Dependability – the system should keep use within sustainable limits as they are redefined through time, even when information about the likely responses is uncertain.
- Continuing incentives – resource users should have an incentive to exceed targets including environmental standards and efficiency of resource use.

- Permanence – the trading and allocation system should not be vulnerable to erratic or sudden changes.<sup>9</sup>

### **World Best Practice**

Appendix 2 contains a summary of global experiences with the introduction of trading to a variety of resource allocation systems. Many of the features of world best practice are already being implemented in South Australia. "World Best Practice" is characterised by:

- Security to promote investment in the form of a perpetual right or a guaranteed right. Without security, resource users will not have incentive to invest in long term technologies or the incentives "to do the right thing" and exceed environmental standards
- A structure that recognises that the amount of water available for consumptive use is likely to change through time as social values, climates, technology, etc change. Essentially, this means that the right should be specified as a share of the water available for consumptive use, not a volumetric guarantee. Systems that guarantee a volume are not dependable as the political and administrative costs of amending each licence is considerable.
- Clear separation of the right to receive an allocation from the access conditions under which this allocation is used. This substantially lowers transaction and administrative costs.
- An adaptive structure that ensures that water trading will not result in declines in water quality and other forms of degradation (essentially no unintended backsliding in environmental quality).
- Doing everything possible to increase the size, depth and scope of the market. Information about prices and opportunities to trade should be available widely, but in an anonymous manner.
- Giving maximum opportunity for people in local areas to trial alternative arrangements and empower them to make collective decisions. In this way, no one group is likely to be severely disadvantaged.

As demonstrated so vividly in the Namoi Valley in NSW, the limits to aquifer use are often set by people who do not have access to perfect knowledge about an aquifer's potential. If the limits are not conservative enough then the result can be a social, political, environmental and economic disaster. Conversely, trading arrangements offer the best opportunity for communities to manage their way out of such problems and to keep out of them.

What follows is a discussion of how water trading arrangements could relatively easily be improved in the South East. If these changes in policy and

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<sup>9</sup> Adapted from M.D. Young (1992). Sustainable Investment and Resource Use: Equity, Environmental Integrity and Economic Efficiency.

administrative arrangements are made then, in our judgement, the South East's environment, its natural resources, its economy and its people would be much better off. Moreover, as time progresses, water trading arrangements will come to be valued as the glue that keeps the South East as a leading region.

**Opportunity One: Design the licensing system so that the sum of allocations is always less than the PAV**

Some tough choices lie ahead – to protect the environment in fully and over-allocated areas it may be necessary to reduce current allocations to ensure long term sustainability. The problem is “whose allocations” should be reduced. For the purposes of discussion, let’s use a figure of 20% as being the proportion that must be cut back.

A reasonable question to ask is: can a trading system help keep water use within sustainable limits? In the South East, the sustainable limit is defined in each region as a Permissible Annual Volume (PAV). The science that underpins estimates of these volumes has been made on the basis of limited data. As discussed with focus groups of irrigators, it’s likely that current permissible annual volumes are imprecise and even if they are right, the only thing known for certain is that as climate changes occur, they cannot remain right.

As global best practice is showing over and over again, the solution to this problem is to allocate shares to each irrigator, and then put in process an arrangement that forces the periodic assessment of the annual allocations available to each share holder. No other system is dependable.

The most dramatic example of this conclusion that we are aware of is in New Zealand. Three years after they rolled out fishing quotas on a ton-by-species basis, the Government of New Zealand compulsorily acquired them all and replaced them with fishery shares. The mistake cost them over \$30million dollars in compensation. Unfortunately, few governments have such courage. Resources around the world are littered with examples of serious over-exploitation because hard decisions are deferred indefinitely.



In summary, global experience would suggest that South East water licences would be more valuable if each volumetric holding or taking allocation was issued as a share of the Permissible Annual Volume. Some will argue that there is very little difference between the current arrangements and issuance of formal shares. The reason for this is that all licences state that the Minister may vary licence conditions is issued annually. This is true but in practice volume or area allocations are rarely changed, as the process is administratively complex and time consuming. The main advantages of defining rights as a proportional share are that this approach

- Forces annual estimation and announcement of PAV in a transparent manner;
- Makes it clear how the risk of any variations in the PAV as a result of changes in climate or knowledge about aquifer potential is allocated;
- Removes the need to recall and re-issue all licences every time the PAV is changed.

Consequently, **we recommend that the Board pursue opportunities to convert existing licences into tradeable shares. (R3)** This could be achieved at the same time as area allocations are converted to volumetric allocations and when holding allocations are transferred or attached to a taking licence.

This report must address whether trading arrangements could increase the number of management areas that are over-used and, where this occurs, ask the question: Can trading arrangements be used to help solve this problem?

The answer to the first question yes. Trading can be expected to result in over-use of aquifers in the South East.

The answer to the second question is yes too. Trading arrangements can be used to reduce over-allocation problems. One of the most recent examples of this approach can be found in New South Wales, where over-allocation problems in the abalone industry are being solved by retiring 50% of each allocation each time it is traded. Bluntly, the approach taxes those people who leave the industry and it discourages adjustment.

From the Board's perspective, apart from putting in place strategies to bring all current allocations in line with the Permissible Annual Volume (PAV), a serious issue is the question of how well these PAVs have been set. In areas where irrigation is more profitable than dryland agriculture, trade can be expected to take use to the limit set by the sum of all allocations. Trade flushes out water which is not being used (sleeper licences). Where assumed relationships among area, pumped volume, recycling and crop type parameters are incorrect, over-use can be the result.

## **Opportunity Two: Periodically announce evapo-transpiration assumptions about the relationship between volume pumped and volume used**

Our consultations with the people in the South East have revealed that water licence arrangements are poorly understood. A major source of this misunderstanding is a failure to understand how Area (Site) Taking Allocations convert to Volumetric Licences. The source of this confusion lies in the failure to understand that PAVs are worked out based on the volume used not the volume pumped. A typical scenario in Zone 3 of the Lacepede-Kongorong Prescribed Wells Area would be

- “I have 50 ha in irrigation equivalents”
- “for a standard reference crop this entitles me to use 4.93 ML per ha”
- “so I have a licence to use  $4.93 \times 50 = 246.5$  ML per year”
- “but as I am flood irrigating annual clover with a crop area ratio of 2.8 means I am allowed to have  $50 \times 2.8 = 140$  ha of clover”
- “But to grow this clover, I know that I pump around 1000 ML per annum!”

All this is correct. The missing piece in the equation is a set of formulae that allow for estimation of the proportion of water that returns to the aquifer. If 1000 ML is pumped, and it is assumed that clover under flood irrigation 75.35% of this water returns to the aquifer, then there is no problem. **To facilitate trade and, in particular, conversion from one crop to another, or from one form of irrigation technology to another, a set of Pump-To-Use-Coefficients (PTUCs) are necessary. These coefficients should indicate the difference between what is pumped and what is used. Under some flood irrigation systems, as much as 4 times the amount that either transpired or evaporates is pumped. (R4)**

## **Opportunity Three: Convert from irrigation equivalents to volumetric licences**

A major issue for the South East is to find the most equitable means to convert those parts of the existing licence system that are still area-based to volumetric or, if this direction is not acceptable, then how to convert the volumetric holdings into area-based allocations. The central building blocks for the system are current definitions of the volume of water that is "used" by the reference crop for each zone. As the rate of evapo-transpiration from a reference crop has been used as the basis for estimation of the consistency of allocations with the PAV for each management area, we do not recommend departure from this framework. There is considerable confusion in the South East about

- the difference between the volume pumped and volume used; and
- how these volumes relate to the crop area ratios used to define the area that may be irrigated.

Under some flood irrigation systems, the volume pumped may be as much as 4 times the volume that transpires, evaporates or is exported from the district in the product produced. Collectively, this is what is "used". That which returns to the unconfined aquifer is available for re-use.

Global experience indicates that communities will fight for ever over the most appropriate way to re-allocate water, and that the most successful systems are those that are built on sound conceptual foundations but start by mimicking existing conditions as closely as possible. Given this, we recommend that any person wishing to trade an area licence, or expand an area licence, have the volumetric "use" defined by multiplying the irrigation area estimate by the current estimate of "use" per hectare for the reference crop. Management plans should then stipulate the assumed Pump To Use Coefficient (PTUC) for each crop and type of irrigation.

Take, for example, the case of a person who holds 21 ha of irrigation equivalents and is using this to irrigate Sub-clover seed in Zone 3 of the Lacepede-Kongorong Prescribed Wells Area. The assumed rate of evaporation and, hence, use from this crop is 4.93 ML per hectare so the volumetric allocation would be

$$21 \text{ hectares times } 4.93 \text{ ML} = 103.53 \text{ ML}$$

This is the amount that would be tradeable. That which may be pumped, however, could be quite different from this. The crop area ratio for Sub-clover seed in Zone 3 is 2.7. This, however, is not the number that is needed. What is needed is a set of PTUC that facilitate estimation of the volume that may be pumped for a reference crop and for the crop that is grown. The PTUC for the reference crop may, for example, be 4.0 and for Sub-clover seed be 5.2 or 3.8. In the first instance, we suggest that the PTUC set for each crop should be set as close as possible to current practice. Each management plan should then provide for the periodic review of each PTUC. Where significant errors exist, the plan could provide for a gradual transition that brings the PTUC in line with reality.

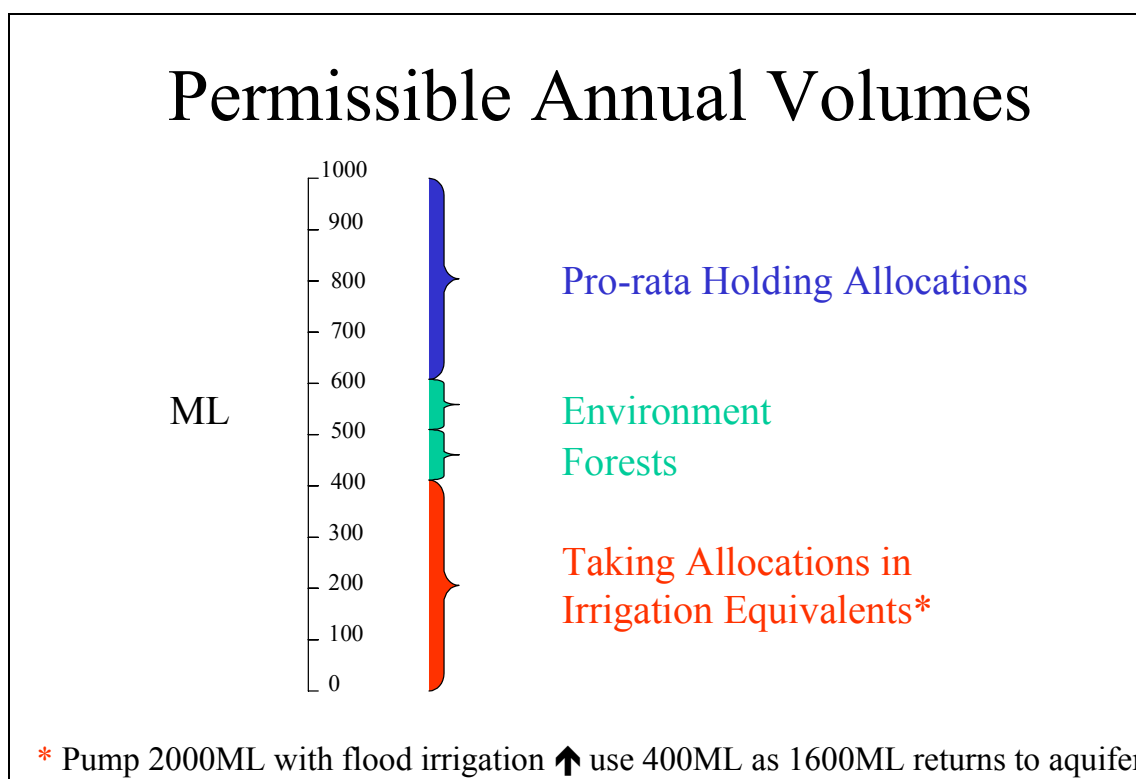
Thus, we recommend putting in place a means of accounting for water that is used and facilitating trade in a low cost manner. In the first instance, the key is to mimic current practice and move systematically to water allocations (and use patterns) that are sustainable. Again our emphasis is on getting the fundamentals right.

A related problem, is a widely held perception that current crop area ratios are incorrect. Processes are in place to review them and a significant number of people are expecting their allocation to increase. In some cases, the allocations are expected to be doubled. If the roll out has been complete, however, any increase in allocation immediately creates a situation where the aquifer is over-allocated.

Consider a typical management area, such as that modelled in Figure 3. The PAV is assumed to be 1000 ML. At present, let's say 400 ML are being used (transpired and evaporated) under Area (Site) Allocation Licences. During the roll out, 100 ML was set aside for the environment and 100 ML for increases in forest area over the next two years. The remaining 400 ML were

issued to water users as Volumetric Holding Allocations. These holding allocations are then traded and converted into taking licence to facilitate an increase in the area planted to vines. Two scenarios are possible.

**Figure 3: The current relationship among licensed allocations and PAV in a mock-up management area**



Under scenario one, the conversion of the 400 ML holding to a Volumetric (Site) Taking Allocation occurs and then aquifer return coefficients are written into the licence in a manner that allows their periodic revision and no PAV problem should emerge.

Under scenario two, the conversion is to an Area (Site) Taking Allocation using the assumed crop area ratio for vines of 3.5. If subsequent research shows the correct crop area ratio to be 2.5 then the aquifer becomes 16% over-allocated.<sup>10</sup>

**We recommend that policies be put in place to ensure that trading arrangements retain consistency with the PAV set for each area evolve and change through time. The definitions of allocations should recognise that PAVs. (R5)** As indicated in Table 3, ten water management areas are already over-allocated. Moreover, we stress that global experience would suggest that the science of estimating PAVs is far from perfect. Today, a significant number of groundwater dependent regions are in serious

<sup>10</sup>  $\{(((3.5/2.5)*800)-800)/1000\}*100=32\%$ . The error occurs over the full 800ML, not just the 400ML, that is converted to a taking allocation. The allocation for the forest and environment are not tradeable in our mock-up.

economic, social and environmental difficulty because initial estimates of PAV proved, in retrospect, to be an over-estimate.

**Table 3 Extent of allocation in selected parts of the South East ranked by extent of over-allocation (as of June 1999 and before the pro-rata roll-out)\***

Management Area	Allocation as % of PAV, June 1999
Grey	120.2
Beeamma	112.3
Wirrega	110.4
Willalooka	105.8
Zone 4A	105.1
MacDonnell	104.2
Zone 6A	104.1
Stirling	102.8
Hynam	101.7
Naracoorte	101.2
Padthaway	100.0
Zone 3A	99.5
Zone 5A	98.5
Cannawigra	98.3
Pendleton	89.8
Zone 2A	80.3
Zone 7A	95%

\* For more information, see Figure 4.

For dependability of supply and for no backsliding in quality, changes of the magnitude being contemplated need to be negotiated carefully with all people. One model that we suggest, as a draft proposal, is as follows:

- 1) Communicate the difference between volume pumped and volume used carefully.
- 2) Communicate the need to keep total volume used less than PAV.
- 3) Discuss options with licence holders with a view to deciding whether or not the stated relationship between each irrigation equivalent and PAV is to hold. If it is, then:
  - add a volumetric and/or PAV share statement to each licence and introduce meters;
  - set the PTUC for each crop type so that no adjustment is needed in the first 5 years;

- put a 10-year PTUC adjustment plan in place so that gradual changes occur in these coefficients.
- Only allow trading of volumetric allocations

A related issue is consideration of the benefits, or the merits, of encouraging efficient water use. Under a metered proportional share system, irrigators who switch to more efficient irrigation techniques and use less water, would be free to sell surplus water to others or expand the area they irrigate. If an irrigation equivalent allocation system is used, there is no incentive to trade or to improve water-use efficiency, as the "saved" water would move to an unallocated pool.

In summary, a share of the PAV is the most secure way of defining a right that is known and is certainly the most environmentally-dependable right that can be allocated to users.<sup>11</sup> Each year, each user might be sent a letter that announces the PAV and the user's allocation as a result. The clear advantage is that even if PAV reviews only occur every five years, an expectation of having a share in a resource is established. For example, an allocation of 5% of the PAV would be 50 ML, if the PAV were estimated to be 1000 ML, and 40 ML if the PAV had to be reduced to 800 ML for some reason.

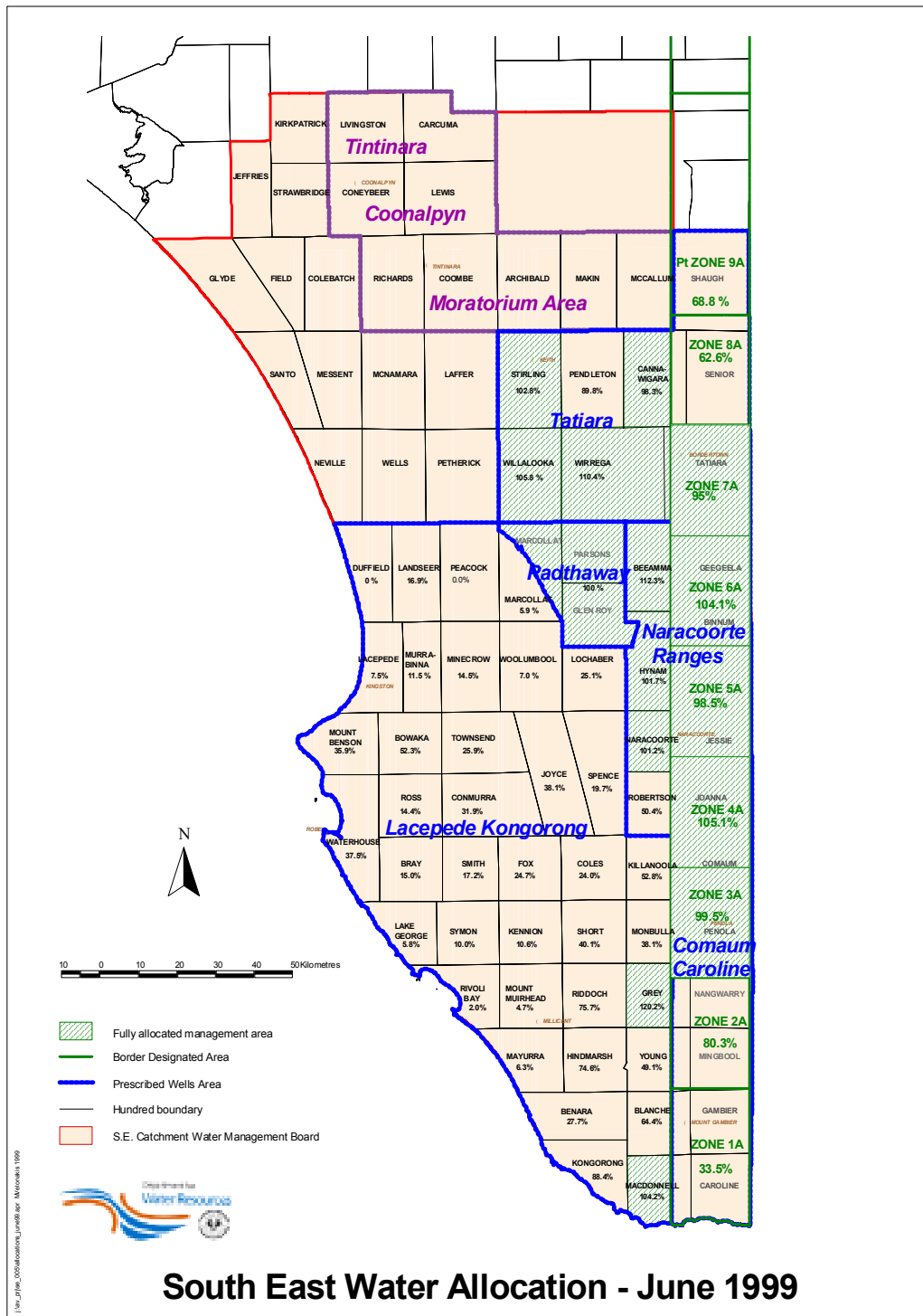
**If the Board, in consultation with the State Government, opts to define allocations as proportional shares of the PAV associated with each aquifer, we recommend finding a simple straightforward means of calculating each person's share. As a basis for discussion, it is suggested that each person's share could be defined as the quantity of water assumed to either transpire or evaporate from the reference crop. If this option is taken then the sum of allocations should retain consistency with the PAV. Most other models will require a subsequent pro-rata adjustment to once again make the sum of all allocations consistent with the PAV. (R6)**

There are serious consequences for the Board if it gets bogged down in consultation and discussions of equity and fairness. Experience in other parts of Australia and with other natural resources suggests that communities can get embroiled in arguments about how to fix the problem. Meanwhile the resource comes under increasing pressure. In over-allocated areas in New South Wales, no trading is being allowed until these issues are resolved. According to Figure 4, there are at least ten hundreds which are over allocated.

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<sup>11</sup> It is possible do define shares in complicated ways that reserve windfall gains to the Crown etc. The administrative and political costs of such arrangements tend to be prohibitive.

Figure 4 Location of hundreds and management areas in the South East



#### **Opportunity Four: Separate Access Licence from Volumetric Holding**

Over the last few years, the South East has been separating licences to use water from land titles. Under the new arrangements, any person may hold a Water Holding Allocation and these licences contain no reference to a certificate of title. At present, virtually all people who hold Water Holding Licences in the South East, also, hold an interest in land within the management area described by the licence. With time, however, we can expect people to accumulate water holdings and/or sell the land they own, but not their water holding. Gradually, land will become more and more separated from water holding. Trading arrangements can be used to bring this water into use. Sometimes these trades will be permanent. At the other extreme, people will buy the water they need on an annual basis especially if the annual market evolves.

Under current administrative arrangements in the South East, the volumetric component of a taking licence is still tied to a certificate of title. World best practice, draft guidelines about to be released by the High Level Steering Group on Water, and the current Water Resources Bill before the NSW legislature, all recommend clear separation of the holding from the access licence. Separating the right to access, and the right to a specific volume, allows for simpler trading, removes a number of impediments to economic opportunity, and allows administrators to focus on resource management issues.

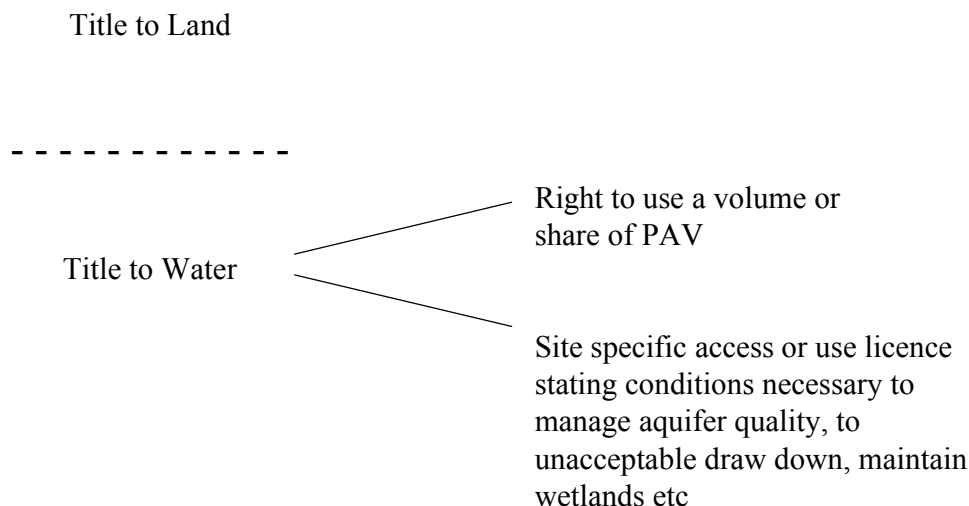
Different terms are used across Australia, but as recommended earlier, the right to receive periodic allocations of water that may be used for irrigation or other similar purposes, are best described as a “share”. Failing this, they should be described as an entitlement to use a volume of water in a manner that makes it clear that this volume will be periodically varied in an equitable, non-capricious manner. Across the South East, and the rest of South Australia, the first step in achieving this separation would be to separate out the volumetric component of each licence.

Figure 5 summarises the nature of the transition that is occurring elsewhere and is now considered as world best practice by most specialists in the design of tradeable right systems.



**Figure 5 Separating water and land titles into their various components**

## Refining Property Rights



**We recommend that policies and management plans encourage people to allow separation of volumetric entitlements from access for “use” entitlements, so that these rights can be sold or leased to separate people. (R7)**

It is our tentative assessment that separation of the volumetric licence from the use or access right could be achieved administratively.<sup>12</sup> Separation could be achieved by issuing Water Taking Licences that sets an upper limit on the quantity of water that may be used or pumped per year and making that use conditional upon access to a holding equivalent to that volume.

An example (set out in Figure 6) will make this clear. Let’s assume:

- Individual A has a bore with an Area (Site) Taking Allocation, to take the equivalent of 40 ML of water, by irrigating 10 hectares of pasture.
- When A's licence was issued, the decision to allow this was based on a 4 kilometre square test and it was granted on the understanding that this would prevent development of irrigation in the shadow around A (grey area in Figure 6). This was done because it was recognised that irrigation at both A and C would cause unacceptable salinity problems.
- In 2002, B signs a contract with A to lease the water

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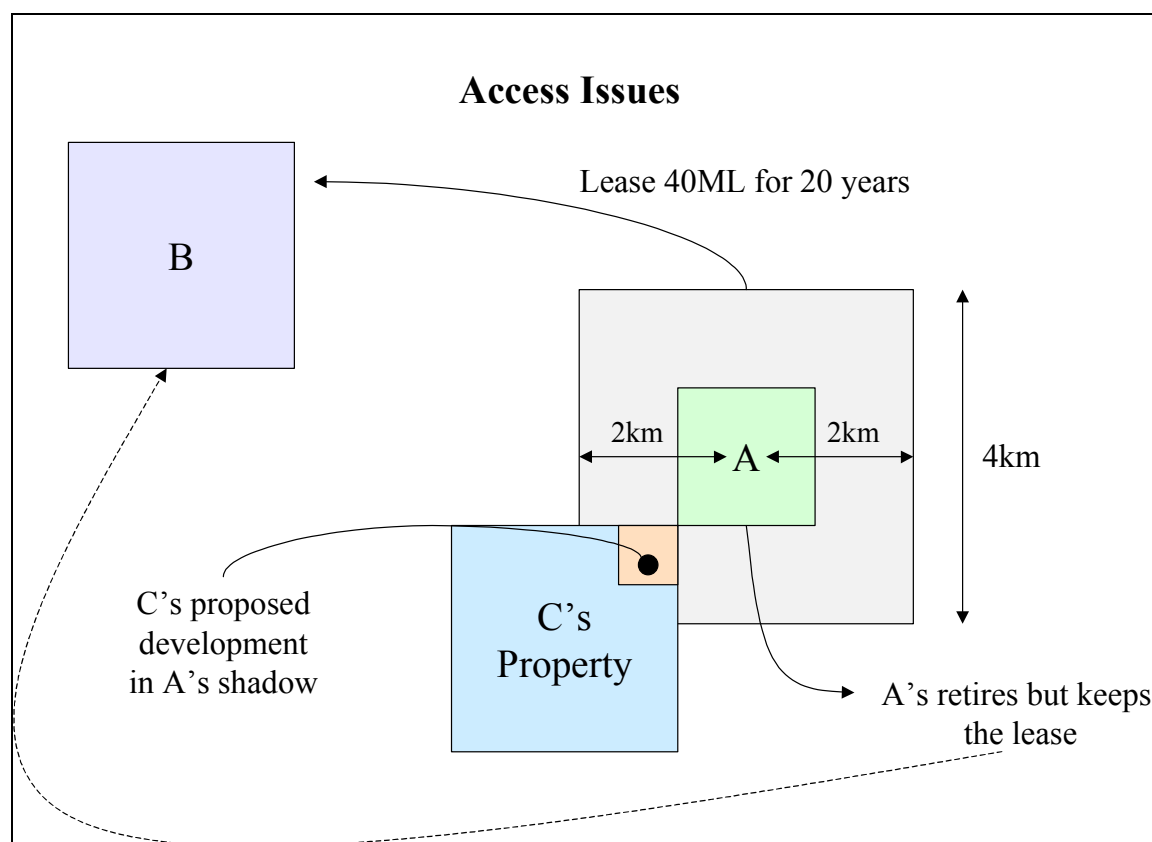
<sup>12</sup> To do this, a licence would simply state the maximum amount that can be used or may be pumped in any irrigation year. We can, however, find no direct power enabling the Minister to partition a taking allocation into a taking allocation plus a holding allocation. It could be possible for the Minister to require surrender of an existing allocation and then to re-issue a taking allocation and a holding allocation to the same person.

Under existing arrangements, a shadow is left over the land held by C. He or she cannot develop their land for irrigation because there is a risk that the lease to B could be cancelled.

- Soon after the lease is finalised, A sells their now dryland farm and retires to Mount Gambier, Naracoorte or Keith with the licence and the income stream realisable from lease payments.

The land once held by A and C's property have water use shadows over their land, even though no irrigation is occurring. We could go on and develop further scenarios. What is needed, is an administrative solution to the problem.

**Figure 6: An illustration of the way water trading will create development shadows over significant and valuable areas of land in the South East**



## What are the options to deal with the shadow issue?

### Option A

If the South East moves to a dual right system, that requires each irrigator to hold both a "taking" licence and either lease or own a "holding" licence, then the issues are simplified.

- 1) The holding issue is left to market forces.
- 2) The access, use or taking conditions are set out in a separate licence. Under this scenario, the 4 kilometre square test would still apply but the maximum amount that could be "used" per land title area in any one year would be set out in the access conditions. Hydrogeological assessment would be limited to consideration of issues that relate to acceptable ways of using water.
- 3) If C wants to irrigate then either they must convince the Department to cancel the taking allocation that attaches to A or negotiate a transfer of this access right from property A to property C.<sup>13</sup> Across the world, two approaches to this problem are taken. Either
  - Negotiation is left to A and C
  - "A" must show cause as to why the use right should not be cancelled. "A" must show cause he or she doesn't irrigate after a period of time say 3 to 5 years

We leave the choice between these two alternatives immediately above to the Board and Government. We do, however, draw attention to the fact that in some areas, especially ones where salinity is a major problem, the limiting property right may be the access right to an area where soils are valuable. In these situations, the access right may be very valuable while the corresponding holding right may be of much less value.

If, as we recommend, the Board supports separation of access rights from volumetric rights to the Government, and the recommendation is adopted, then very careful consideration needs to be given to the administrative implications of this recommendation. In areas where salinity rather than volume limits water use, then the result could be a flood of applications for access licences. To prevent this occurring, **we recommend that To prevent people from capriciously acting to create a shadow over another person's holding, all new access licences contain a condition that will result in the forfeiture that shadowing opportunity if it has not been used for four years. This should not extend to the volumetric allocation attached to a licence, only the right to use that volume at a specific location. (R8)**

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<sup>13</sup> For A to agree to this, it would be necessary either for the Minister to agree to convert the volumetric portion of this allocation into a holding allocation and then allow it to be temporarily transferred to C.

## Option B

If the South East does not move to a framework that separates access and holding issues, then either:

- 1) Approval of long-term leases of water could be made conditional upon an agreement to surrender the right to return this water to its "home" location for the leased period.
- 2) Alternatively, approval of a long-term lease of water would be made conditional upon the prior conversion of the taking licence into a holding allocation and then the attachment of that holding licence to the new area.
- 3) A sunset clause could be introduced requiring surrender of the right to return the water to A after a period of, say, 3 years of non-use at location A.

We consider this option to be inferior to Option A, but acknowledge that it is possible.

### **Opportunity Five: Introduce water meters as a precondition to trade**

As summarised in Figure 7 it is now State policy to move all groundwater irrigation to meters within 5 years. Across the World, and even in South Australia, all water managers are moving away from area-based allocation systems and moving toward fully-metered systems. The most recent example of this is in the Barossa Valley. Across the entire Barossa Valley, the Barossa Catchment Management Board has installed (or is in the process of installing) meters on all bores. A single contract was issued via a tender process. The cost of these meters increases with pipe diameter. The cost of an installed meter on 32mm pipe was in the vicinity of \$330 per meter. Costs increased to approximately \$1200 with installation for a 150mm pipe diameter.<sup>14</sup> The specifications for the meters were written to ensure that all the meters are of high quality, are tamper proof and require low maintenance. The cost of installing meters on 600mm pipes with some of the flood irrigators is going to be considerably higher.

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<sup>14</sup> Costs are indicative. This information is commercial-in-confidence.

## Figure 7 State policy on introduction of meters

Extract from State Water Plan, page 58, Volume 1

### "Volumetric Allocations and Measuring

An important prerequisite for efficient water use and good water resources management practice is to be able to accurately measure how much water is being used. It is often said that *if you can't measure it, you can't manage it*, and this applies to water use as much as it does to any other activity. Not all water allocations in South Australia are volumetric at present and not all water use is measured. This will be addressed over the next five years, by which time all allocations will have been converted to a volumetric basis and all water use will be measured.

### Action

*The Government will, by 2005, have converted all water allocations to a volumetric basis and all water use will be measured so that the Department for Water Resources can determine the annual amount of water taken."*

Global experience has revealed repeatedly that meters increase trust in the system, allow effective monitoring of use, create incentives for people to increase the efficiency of water use, reduce transaction costs, allow much easier and more equitable adjustment to changes in Permissible Annual Volumes, etc.

Considerable resistance to metering was expressed as part of the consultation phase of the Water Allocation Plan and during our focus group meetings with irrigators. The problem and the resolution of the problem may lie in how the issues are communicated. In discussing the need to meter water, it became apparent that flood irrigators are concerned about the difference between water used and water pumped. Most irrigators, which we consulted with, had never heard a discussion of the difference between pumping entitlements and estimates of the water used. Others stated that they believed these issues had been discussed publicly in community consultation meetings.

As an option, the Board may like to give priority to the introduction of meters in its most stressed management areas, and set a rule that requires compulsory introduction of meters on all bores in an area when use exceeds, say, 80% of PAV or in areas where salinity problems are severe and water use of very high value. There are a number of ways meters can be introduced:

- 1) Install meters on every bore within a specified time period via a centralised tender process that would reduce the costs considerably, compared with one-off purchases by each licensee as they begin to trade.
- 2) Require meters to be installed on every bore that is involved in a trade, and all new bores.

**Given that it is State policy that all bores should be metered before 2005, we recommend that no trades be allowed to or from bores that are not metered. That is, any person who wishes to expand the area they irrigate, or any person wishing to acquire water from another person, be allowed to use that water *only* if they first convert their allocation to a volumetric one. (R9)**

Once metering is in place, many of the other steps to streamline the process will fall into place. For example, introducing water accounts and arrangements that enable people to carry forward water from year to year will be simple and straight forward. We will deal first with carry forward provisions, then accounting arrangements and provide a tidy example.

### **Carry forward arrangements**

The current water licensing arrangements in the South East are based on the allocation of areas that may be irrigated. This means that each irrigator is able to apply water as needed. Typically, and as would be expected, more water is applied in a dry year and less in a wet year. Moreover, crop area ratios are based on average rates of use, not maximum rates of use. Introduction of metering and transition to volumetric allocations, however, means that a framework that mimics existing practices needs to be found. In practice, water use and trading arrangements need to be flexible. Importantly, this has major implications for the nature of the temporary market.

- a. If no carry forward is allowed, then the market value of water in dry years will be very high and opposition to the introduction of meters extreme.
- b. If 100% carry forward is allowed, then people may stockpile water and then demand rights to use it in non-sustainable ways.
- c. If, say, 30% of unused water may be carried forward, then there is an incentive for people to over-irrigate rather than conserve water.
- d. If carry forward is allowed, up to a limit of say, one or two times an individual's annual allocation, then there is an efficient incentive for water users to self-manage for drought and climatic fluctuations. Under this arrangement, people can be expected to trade water until everyone that wants to is carrying forward one year's allocation.

In practice, carry forward arrangements may need to vary from management area to management area. Thus, it seems most appropriate to specify the rules that apply in the plans being developed for each management area. As an interim strategy, and without access to data on water use practices at the individual farm level, **we recommend that upon conversion to a volumetric, each holder of a (taking) licence be allocated one year's allocation and that the maximum amount that may be carried forward from year to year be one year's allocation. (R10) Similarly, we recommend that the penalty for over-pumping, that is pumping without an allocation, be double the amount that is pumped in excess of the allocation held. Consistent with this model, people with a volumetric holding licence should be allowed to carry forward up to one year's allocation. (R11)**

Given that the Board has yet to decide how to convert area allocations into volumetric allocations, it is important to ensure that people are not given the opportunity to increase their share of the PAV by using the trading process to

convert a volumetric allocation into an area allocation and then back into larger volumetric allocation.

### Accounting for water use

Once meters are installed, the cost of permanent trades can be simplified considerably, by separating the water holding right from the annual allocation. World best practice, here, copies the systems used to track money in different people's accounts. As in most financial systems, a share holding entitles the person who holds that share on allocation day to receive an allocation or dividend. That allocation or dividend is then banked. All users must have an account and if the account is in deficit they are penalised.

Allocations are credited to an account. Periodic allocations can be transferred electronically or by cheque (See Figure 8). The account would have an opening balance that would reflect carry over from the previous year plus the allocation for that year totaling, for example, 50 ML. If the licence holder needed an additional 25 ML of water and could lease the water, the balance would increase by 25 to 75 ML. If this was a vineyard, and the water use was considered to be 100% of the 65 ML that was pumped, the account balance would be reduced to 10 ML. Depending on conditions in the aquifer, most of the water could be assumed to carry-over to the following year, say 9 out 10 ML for example. Water used, water that evaporates or moves down the aquifer before it can be used, is debited from the account. Rules about carry forward from season to season, etc need to be explicit. Visually, the account would look like that set out in Figure 9 below. Each water licence holder could view his/her account via the internet. The account could be confidential to the user or open to the management area via passwords.

**Figure 8: A water cheque**

The image shows a water cheque form on a textured, parchment-like background. In the top left corner, the word "Water" is written in a large, 3D, orange-to-yellow gradient font. To the right of "Water" is a "Date" field with a horizontal line for input. Below "Water" is a "Pay" field with a horizontal line. To the right of the "Pay" field is a small rectangular box with a green border containing a horizontal line followed by the letters "ML". Below the "Pay" field is a line of text: "The sum of \_\_\_\_\_ ML of Water from the \_\_\_\_\_ Management Area". Below this line is the text "SE Water Trading". At the bottom right is a "Signature" field with a horizontal line. At the bottom left is the contact information "807512 085 249:0223 7851".

**Figure 9: A mock-up of a water account**

<b>Water Account</b>		Statement No. 8		
Account Name: Mary Smith and Associates 1 of 1		Page		
Shares held: 1,200		Maximum carry forward from one season to the next 1,200 ML		
Date		Debit	Credit	Balance
1/07/00	Balance Brought Forward			400
1/09/00	Annual allocation, 1200 shares @1 ML per share		1,200	1,600
1/11/00	Purchase from Water Trading Pty Ltd		600	2,200
1/1/01	Water pumped 1/7/00 to 31/12/00 (3600 ML deemed use = 25%)	900		1,300
30/6/01	Water pumped 1/1/01 to 30/6/01 3600 ML deemed use = 25%	0		1,300
30/6/01	Unused water that may not be carried forward	100		1,200

**We recommend that a simple bank-like water accounting system be established for the South East's Water Resources so that low-cost volumetric trading arrangements can occur quickly and simply. (R12)**

#### **Opportunity Six: Introduce Recharge Credits and Debits**

Throughout the South East, the entire allocation system is based on estimates of rates of recharge to the unconfined aquifer. Three things can have a dramatic effect on these estimates:

- Land-use changes that significantly affect rates of recharge
- Water transfers between aquifers, especially in areas where the confined aquifer supports uncapped artesian bores
- Water harvesting for aquifer recharge.



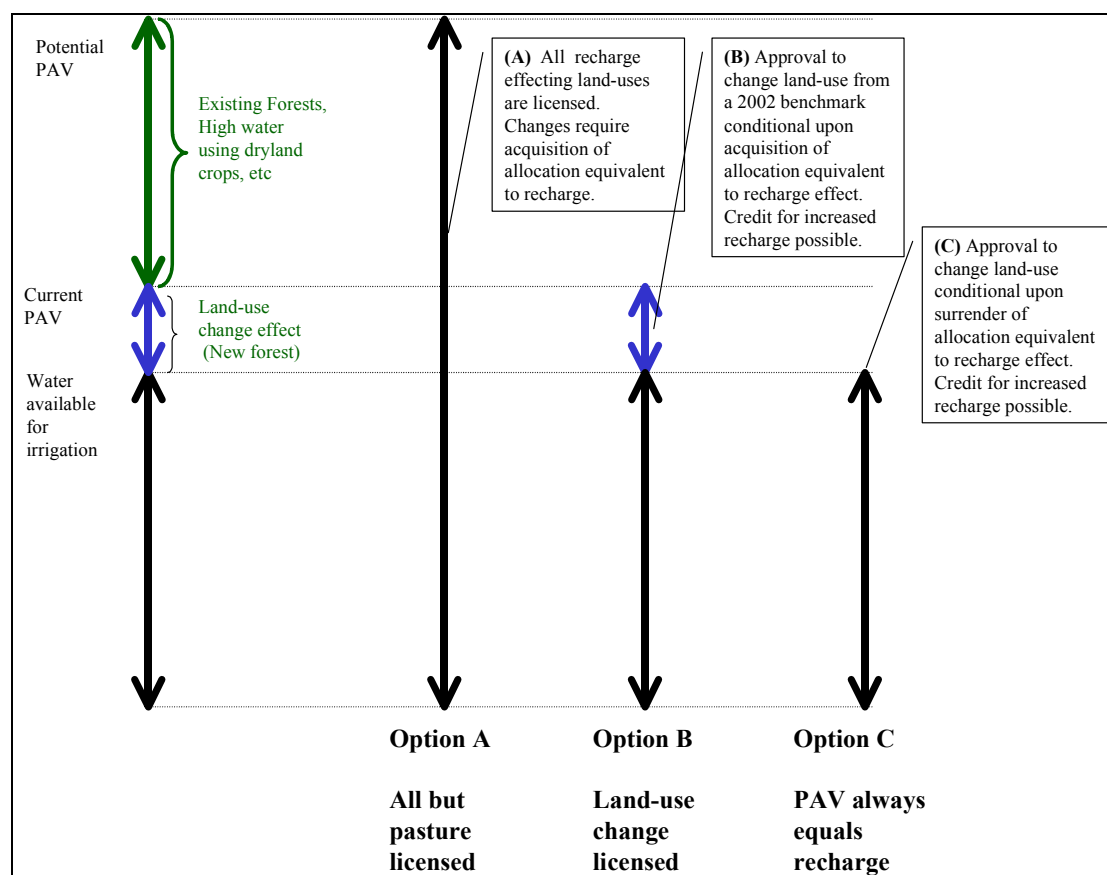
The latter two of these effects can be tracked easily using meters and, if appropriate, incorporated into a water accounting system that facilitates the equivalent of a temporary trade. The most important requirement is that consistency between the water allocation system and estimates of PAV be maintained through time in an equitable and efficient manner.

During the roll-out, and in all areas where the unconfined aquifer was not already fully allocated, a two year margin for forestry and other significant recharge depleting changes, was set aside before the pro-rata roll out. Beyond that point and in those areas already fully or over-allocated, if the integrity of the PAV-total allocation relationship is to be maintained, then any approval to significantly change land use in a recharge sense, needs to be made conditional upon an off-setting transaction. If a person wishes to convert a dryland pasture to a bluegum plantation, for example, this change will need to be done in a manner that reflects the fact that less water will now be available for irrigation. Equitably, we suggest that people who, for example, convert a plantation back to dryland pasture, should receive a credit that can be converted back into a water holding allocation.

Conceptually, there are three ways that changes in land-use, that significantly effect rates of groundwater recharge, could be incorporated into the existing allocation system. Each has the same effect but quite different administrative costs and implications. Summarised in Figure 10, the options are:

- Option A – require approval to effect recharge, but approval would be conditional upon reallocation of water licences. All existing forests etc, are issued a licence. Effectively, each tree is defined as a mini-spray irrigator;
- Option B - require any landholder who wishes to change land use in a manner that significantly changes recharge, to obtain a licence to do so, and to hold an allocation equivalent to the effect of that change on recharge. (A 2002 baseline is set and all land-use changes from that base are brought into the system);
- Option C - require any landholder who wishes to change land use in a manner that significantly reduces recharge, to surrender allocation equivalent to the effect of that change on recharge and allocate a new holding allocation to any person who increases recharge.

**Figure 10 Options for modifying the allocation system to account for the effects of land-use change on recharge so that PAV remains consistent with licensed arrangements**



Of the three options, Option C is the simplest in administrative terms. It also reduces the cost of monitoring because PAV remains consistent with the rate of vertical recharge.

Option A takes the Board into the realm of integrated catchment modelling. Option A requires a large amount of hydrogeological survey information, and administrative effort. The value of the economic opportunity allocated, however, is the same as Option C. Option B is similar to Option C but builds a system that will require continual reference back to an arbitrary reference date. With time Option B will drift further and further away from reality. Option C has low set-up and maintenance costs; and keeps PAV consistent with reality.

Under Option C, if a person wishes to plant 100 hectares of forest and this was estimated to reduce water use by 90 ML they would first have to buy and surrender 90 ML. If another person held a licence for 1000 ML in a water management area with a PAV of 10,000 ML, then as a result of this transaction, their share of the PAV would rise from  $1000/10,000$  to  $1000/(10,000-90)$ .

In summary, for simplicity, and in order to keep administrative and monitoring costs low, we suggest that negative recharge change effects be retired from the allocation system, and the option to roll recharge credits into the allocation be established. By doing this, any periodic estimate of PAV, will remain consistent with the rate of recharge that is actually occurring, not tied back to an arbitrary point in time. **We recommend that land-use change approvals that are likely to significantly reduce recharge should be made conditional upon surrender of an allocation equivalent to the expected effect on this change on the aquifer and modification of the PAV for the relevant management area. Conversely, when a person plans to significantly increase recharge and they register their intent to do so, they should be able to apply for a new water holding in proportion to the increase in PAV that their action creates. (R13)** Significant recharge effect allocations are not necessary.

## **PART FOUR: MARKETING ARRANGEMENTS**

An unusual feature of the current water market in the South East, is that in reality it consists of 70 little markets - one for each hundred or management area. At present, buyers and sellers must seek out one another through informal networks. A water market need not be a physical place, but a network would greatly facilitate orderly buying and selling of water. In this part of our report, we focus on options to make these markets work for the collective interest of people in the South East, and to make protection of the region's water resources easier. We search in particular, for arrangements that create a sense of respect, understanding and trust.

### **Nominating a Broker or Brokers**

Most markets for natural resources, like water, involve brokers and/or dealers. In return for a commission, these people search for willing buyers and sellers and bring them together in a manner that enables them to charge a commission. As a result of water reforms in other parts of Australia, a number of water broking businesses have been set up across Australia. Some offer full internet trading, others provide information over the internet but settle trades off-line. Many land agents also get involved in water trading on an opportunistic basis. Many people negotiate trades privately with each other.

As summarised in Table 2, the largest number of trades that have ever occurred in the South East in any one year is just under 300. When divided among the many management areas involved in trading, this means that there are not enough trades, for highly competitive and well-informed markets to emerge without careful administrative guidance. Various models are possible:

1. The Board and/or the Department could maintain a register of completed trades so that those interested in finding out price histories and transaction details can do so in the same way as they can for any land dealing in the State.
2. The Board could maintain a register or Bulletin Board of people interested in trading water.
3. The Board could maintain its own secure internet trading site and provide associated facilities, although arguably, this would represent a conflict of interest.
4. The Board could run a competitive tender process to select a preferred broker to maintain internet trading facilities for all management areas in the South East, and on behalf of the Board develop water trading in the South East. A minimum set of services would be specified, and fixed annual fee paid to the broker for assistance in developing the market, making information available, etc. During the selection process, competition would focus on the range of additional services offered and fee to be charged for each transaction.

5. The market could be allowed to develop as opportunities for profit emerged.

Of the options listed, we perceive the best mix to be one where any person who wishes to find out the details of recent trades, the current market price of water etc. can do so. Coupled with this, **we recommend that a process be run to select a preferred broker to provide an internet site and associated trading service for the South East for a period of 5 years. (R14)** We recommend this option, as we perceive it to be more cost effective to encourage a third party to develop the trading skills, necessary software and processes. It is also wise for the Board to avoid any accusations of conflict of interest. **During the short listing process when a preferred broker is selected, we recommend that the Board explore the merits of contracting the preferred broker to communicate trading opportunities to irrigators and those with water holding licences. In partnership with the preferred broker, the Board prepare an information booklet on trading opportunities, processes and arrangements. (R15)<sup>15</sup>** After the first five years, it may not be necessary to continue with a preferred broker arrangement, as the market should be well established.

**As the market develops, the Board, in conjunction with other Boards in South Australia, could encourage brokers to develop a process of accreditation in a manner similar to the real estate industry. Ideally, all brokers would need to demonstrate knowledge, carry liability insurance and adhere to a professional code of practice. (R16)**

In passing, we note that international experience and research suggest that one of **the most effective trading arrangements is what is sometimes known as a double auction process.** Under this arrangement, offers to sell and offers to buy are listed on a bulletin board or equivalent (i.e. internet) for a fixed period. Bids and offers remain open until an appointed time and all people can see the nature of all bids and all offers. People on both sides are allowed to revise their bids and make additional bids and offers until the market closes. Another model is a sealed bid auction or tender process, which is similar, but under this model no-one knows the extent of all other bids. At closure, the market clearing price is what is paid or received.

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<sup>15</sup> Consultation with irrigators may suggest wisdom in commissioning two brokers. One for the Upper South East and one for the Lower South East. Once both are established they may choose to compete with each other.

## **PART FIVE: MAKING THE MARKET WORK EFFICIENTLY, EQUITABLY AND DEPENDABLY**

As already noted, the water market in most part of the South East is likely to remain "thin". That is, the number of transactions that occur in any management area, is likely to be relatively small. In such situations, administrators search for arrangements that deepen and expand the market.

One of the most effective ways of doing this is to focus on the incentive for people to trade and to lease or sell unused water allocations. As a general rule, there will be more trades if:

- the broking fee is low (achieved by commissioning a preferred broker)
- information about prices is freely available (achieved by establishing and publicising market trends, allowing people to search a central register of transactions, etc)
- anonymous lists of water available for sale is easily available (achieved by selecting a preferred broker and requiring provision of an internet site, etc)
- application fees are low and approvals rapid (achieved by adopting processes that simplify administration)
- it is possible to get prior approval to use water at a location ( achieved by separating holding licences from access issues, so that people can get approval to irrigate before they search for the water to use)
- the trading areas are large (achieved by allowing trial trading across management area borders and following separation of holding and taking licences, searching for opportunities to combine management areas)
- low cost temporary trades are possible with immediate approval (achieved by separating holding and taking licences, introducing meters and setting up a water accounting system)
- borrowing from future allocations is discouraged (achieved by setting a 100% penalty for borrowing water from next year's allocation - in effect the rule is, if you take 10 ML from next year's allocation rather than buying it you lose 20 ML off the top of next year's allocation)

In addition, the Board and the Government need to consider how best to allocate water in those parts of the South East where the roll out has not been complete. Data on the extent of unallocated water in the South East is not yet available but is expected to be considerable in the Lacepede Kongorong Prescribed Area. The reason why this water has not been applied for is primarily because people perceive it to be of little value. Consequently, **we recommend that no unallocated water be released until a strong, viable market is established. On a management area by management area basis and as an interim strategy, unallocated water could be used to deepen the market for water by offering it for sale on an annual basis. (R17).**

## Deepening the Market

One of the most innovative mechanisms used to improve thin markets has been developed in the United States. In this country, coal powered electricity generation facilities participate in a sulphur dioxide emissions trading system.<sup>16</sup> As so few power stations are involved, every year a proportion of each licence holder's allocation is put up for sale. The power station is free to set as high a reserve price as they wish, but is forced to think about and make their allocation available. Bids and reserve prices are anonymous so that firms can not determine strategically who they sell to. The result is a mechanism that frees up any unused allocations and encourages firms to innovate. Adjustment is occurring at the most cost-effective locations. Each year the total allocation to each firm is reduced on a pro-rata basis. It also makes the unit value of each allocation abundantly clear to all. The system is known as a "zero-revenue auction" because the government offers this service at no charge and, hence, collects zero-revenue from the process.

Applied to water markets in the South East, such an arrangement has the potential to speed adjustment and increase investment. The system would only work in areas where meters are in place. Our recommendation is **the Water Resources Act be amended to allow any hundred or management area, to introduce an annual zero-revenue process, if more than two thirds of irrigators support the idea. Under this mechanism, 10% of each holding would be offered for sale via a mechanism where the expected clearing prices would be publicised for a week, and reserve prices changed in light of this information. Water holders should be encouraged to add additional water to zero-revenue auction (R18).** In making this recommendation, we can report that, in several of the focus group meetings, the irrigators were quite enthusiastic about these auctions, but felt that it would be wiser for the mechanism to be introduced voluntarily and trialled in one or more management areas. We note that such an arrangement would be of particular interest to any firm commissioned to supply a broking service to the South East.

In addition to this, the Government could agree to only release any unallocated water to the South East via this process.

In the most sophisticated version of this option, a 10% zero-revenue auction process would be used for both permanent and temporary trades.

## Boundaries

Separation of holding and access licences may make it possible to amalgamate a number of hundreds into larger management areas. If this is not possible, then **we recommend that a review be conducted to select some areas where cross-border trading is allowed on a trial basis.**

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<sup>16</sup> When burned, sulphur-rich coal releases sulphur dioxide which, when mixed with water in the air, forms sulphuric acid. Acid rain is the result.

## **Cross-border trading may be more feasible if access or use rights are separated from volumetric allocations. (R19)**

### **Levies and fees**

A related issue is the nature of catchment levies that apply to holding and taking allocations. As the roll-out has not been completed, and marketing arrangements have not been put in place yet, the Minister announced that no catchment levy will be collected from the owners of holding allocations in 2000. In the long run, however, continuance of this exemption will diminish the incentive for people to use water. As noted by the Select Committee, a levy on holdings will tend to "flush out" unused water. The contrary view put to us, is that groundwater moves through the South East slowly, therefore saving good water for the future and for the environment, is "not a bad strategy."

If PAVs are set and backed by a process encouraging their periodic review, if allocations to the environment are appropriate, and if Significant Recharge Effect Allocation arrangements are in place, then prospects for sustainable economic growth will be greater if a catchment levy is applied to all water holdings.<sup>17</sup> If the levy should reflect approximate management costs, then it is easy to argue for a larger levy on "use". Consideration could also be given to the application of a much higher levy to irrigation enterprises in fully allocated management areas that are not metered. This would reflect the expected future costs that non-metered systems impose on management and the increased risk that non-metered systems impose on other irrigators and on the community.

During our consultations, a number of people suggested that a higher levy should be applied to those people who do not offer water for trade. We observe that if a water accounting system is in place, the economic incentive to trade should be sufficient. If water is not trading, this is probably due to either a lack of demand or an impediment in the trading system. Introduction of low cost ways to trade water rather than introduction of tradeable levies is the way to go.

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<sup>17</sup> This should not be interpreted as a recommendation for a levy based solely on volume. We have not examined the issue closely, but suspect that the most efficient and equitable arrangement is one that involves a levy whose magnitude is, at least, a function of volume, area of land held and type of use.



A related issue is that of the fees and charges that apply to different types of trades. Under current arrangements

- The fee for a new licence is \$135.50
- The fee for a licence transfer is \$250
- There is no charge for a hydrogeological assessment. Complicated transfers could be assessed for an additional \$100.

**The Board may wish to recommend to the Minister, and the Department of Water Resources, that trading fee and levy arrangements be reviewed once decisions about other recommendations in this report have been made. We recommend that trading fees and levies be aligned with administrative costs and kept as low as possible. The transfer of a volume or holding should cost much less than the transfer of an access right as only the latter requires a hydrological assessment. (R20)** They need to be consistent with the principles for water reform as laid out by the Council of Australian Governments (COAG). COAG has recommended that water pricing should reflect full costs including the cost to the environment. Where cross subsidisation occurs, these cross-subsidies should be transparent. Full cost pricing should recognise externalities imposed on others.

### **Increasing confidence in the licensing system**

One of the problems that plague the introduction of any tradeable property right system, is the need to move a complex paper trail of records into a formal property register. South Australia, the home of the Torrens Title registration system, is a world leader in the development of such systems. Under the Torrens Title system, titles are registered centrally and any dealing associated with these titles is valid only when the dealing is recorded on that central register. The Department is moving towards such a system but it is not yet fully in place.

A public register of water licences and allocations is maintained by the Department of Water Resources and can be viewed by the public during office hours. The system is continuously updated and backed up by the Department.

Most banks now require, as part of contractual arrangements, that the licensee register the bank's interest in the allocation, and that a trade would have to be notified, or in some cases approved, by the bank. A key difference between the licence transfer and land title transfer processes, is a well-developed suite of settlement protocols, arrangements and standard contracts. These procedures need to be quite different for permanent as distinct from temporary or fixed volume transfers. As a step towards the resolution of such issues before a major problem emerges, this issue should be discussed with representatives from all catchment Boards. **We recommend that dealing and settlement arrangements for all dealings associated with permanent water trading, be made consistent with land title trades as quickly as possible. (R21)**

## **PART SIX: SUGGESTED IMPLEMENTATION STRATEGIES**

As indicated in the start of this report, the South East is at a cross-roads in water resource management. With the allocation process completed, further development of the region's water resources and resolution of over-allocation, will be most cost effectively achieved through the development of a reliable and efficient market for water.

Permanent and temporary water trading has the potential to deliver economic, environmental and social improvement - to deliver a "triple bottom line" improvement. Poorly implemented it also has the potential to deliver an administrative, environmental, economic, social and political nightmare. Which outcome occurs is a function of the way trading is implemented.

Essentially, our terms of reference are to:

- Identify the issues currently restraining water trading;
- Develop/identify a range of processes for the establishment of an effective water market;
- Identify the critical success factors for water trading;
- Identify the experiences from elsewhere, which have proved to be unsuccessful or inappropriate for prudent resource management.

The thrust of our advice is based upon an assumption that the Board wishes to deliver its charter that focuses on sustainability. Global and National experience is that, unless the foundations upon which any trading system is built are robust, the simple introduction of trading is likely to result first in backsliding on environmental objectives, then economic ones and finally social ones.

The South East is one of the more lucky parts of rural Australia. At the moment, its water resources do not appear to be seriously over-allocated and it is experiencing a period when, and where, people are interested in increasing investment in water and land related activities. It has significant salinity and water contamination problems but, if the recommendations in this report are implemented, and on the basis of information provided to us, all appear manageable.

This report finds that one of the main issues restraining water markets, is the way that water allocations are defined, allocated and registered. To develop a set of effective, albeit thin markets, it is necessary to put in place a set of arrangements that will ensure that each management area does not trade into problems and also to facilitate separation of access and volumetric considerations. To do this, we have recommended development of a share or similar strategy to ensure that allocations remain less than PAV at all times. We also recommend that people be informed of opportunities to separate access rights from volumetric entitlements.

### **What trades should be allowed?**

**We recommend that management plans be used as the main mechanism to define the rules and conditions under which trades are allowed. (R22)**

Elsewhere in this report, we draw attention to the need to introduce mechanisms that will enable the Board to efficiently and equitably keep the sum of allocations less than the PAV for any management area. A number of areas are already over-allocated and in many others it is likely that current PAV estimates are wrong. As indicated in the State Water Plan, and in global experience, the only known way to do this is to meter water use. Moreover, trading systems built on a mixture of volumetric and area based systems are plagued with problems. For these reasons, we recommend that trading be allowed only among volumetric licences. Any person who wishes to buy or have temporary access to an Area (Site) Taking Allocation, or a Area (Mobile) Taking Allocation should be required to first convert their licence and the licence that is to be traded, to a volumetric licence.

In a few areas, applications for water during the pro-rata roll-out in the unconfined aquifer have been less than that which was available. As a result, some management areas may have significant quantities of unallocated water. As an interim strategy, we recommend that none of this water be allocated on anything other than an annual basis. Release of this water should occur only via a market process. At the management area level, this decision should be reconsidered only after all issues associated with crop area ratios, over-allocation and estimation of PAVs have been resolved.

### **Trading arrangements**

The Board can and should begin the process of short listing and then selecting a preferred broker. During the short listing process, attention should be given to the range of market clearing mechanisms offered. The option of selecting different brokers for the northern and southern parts of the South East should not be ruled out.

We continue to emphasise the advantages of separating allocation and access rights, then allowing markets for each of them to evolve. We also draw attention to the advantages of establishing water accounts and reducing the costs of trading.

### **Management Plans**

The intention under the Water Resources Act is that Management Plans be used as the means to stipulate arrangements that are Management Area or Prescribed Wells Area specific. This is consistent with World Best Practice and we see no advantage in changing the arrangement. **From a trading perspective, we recommend that management plans should:**

- a. Identify where cross-management area border trading may be trialed and how the impacts of these trials should be monitored;**
- b. Document interim PTUC and propose a process for their revision;**

- c. **Define annual PAV and, where appropriate<sup>18</sup>, set in place a transitional arrangement to bring the sum of allocations in line with the PAV**
- d. **Set maximum and minimum depth to groundwater levels, salinity concentrations, etc that if exceeded would trigger a review**
- e. **Define access rules including the factors to be considered when applying the "4 kilometre square test";**
- f. **Define the show cause rules that would apply to people whose licences are creating a shadow on the water use opportunities available to others;**
- g. **Define the maximum amount of water that may be carried forward from year to year;**
- h. **Set a time frame for the roll-out of meters; (R23)**

### **Administrative and legislative opportunities to enhance trading**

While the Board has responsibility for development of draft management plans and regional water trading policies, the Department of Water Resources maintains the licensing system that facilitates trades. As the Department is in the process of reviewing and improving the licensing system, this report is timely. Our brief examination of the Act suggests that it is probably possible to implement most, if not all, the recommendations proposed in this report, although in some cases the processes needed to achieve them would be complex and in-efficient.<sup>19</sup> Opportunities to maximise economic development and to protect the groundwater resources of the South East, would be much greater if the Water Resources Act and associated Regulations are amended to allow:

- The development of a water accounting system with a low-cost cheque like trading system;
- Separation of water allocations from access rights;
- Replacement of an existing licence with one which defines an area right in volumetric or share terms

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<sup>18</sup> If shares are introduced this is not necessary.

<sup>19</sup> We do not think that it is possible under the Water Resources Act 1997, to temporarily trade a water (Holding) allocation, to convert a water licence with a taking allocation into a water licence with a holding allocation, or to introduce a zero revenue auction (where all licence holders give up some water). We also do not think it is possible for the Minister to replace an existing licence with another that, for example, converts an irrigation area into a volumetric share of the PAV. Amendments to the Act may be required.

- Issue of a volumetric allocation to a person who increases vertical recharge by, for example, converting a forest into a dryland pasture;
- Licensing of water brokers in the same manner as real estate agents and land conveyancers;
- Establishment of dealing and settlement procedures that mimic those used for land transactions
- Establishing and maintaining a central register of water licences and interests in them that mimics the State's Torrens Title system;

At an administrative level, we also observe that the array of charges being set by the Department discourage the adoption of efficient trading arrangements. By separating allocations from access conditions, and setting up a simple accounting system that tracks the status of each licensee's water, trading costs should fall to be of similar magnitude to those associated with a normal banking account.

### **Consultation**

Finally we note that this report raises many issues and identifies many opportunities that have not yet received wide discussion.

Successful expansion of water trading requires:

- Strong consultation with community, other Boards and Government on the recommendations in this report;
- Use of Management Plans as the means to define and constrain trading opportunities
- Engagement with the Department of Water Resources and other Boards to assist them to simplify and improve administrative procedures
- Engagement with the Government with a view to amending the Water Resources Act to increase the extent of opportunities to use and develop the water resources of the South East;

**Our final suggestion and recommendation is that the South East be used as the place to develop, test and refine water trading arrangements in South Australia. (R24)**

## **APPENDIX I - ECONOMIC IMPACT OF PRIMARY INDUSTRIES AND WATER TRADING IN THE SOUTH EAST**

Prepared by Melissa Bright, PIRSA Rural Solutions

The regional economy of the South East is substantially based on agriculture. In particular, large scale production of sheep, cereal crops, beef cattle, dairy, wine grapes and vegetables, particularly potatoes.

A large proportion of agricultural production is processed within the region before it is exported from the region. EconSearch Pty Ltd estimated that primary industries and the associated processing in 1995-96 directly accounted for 41 per cent in terms of value added and therefore gross regional product. This activity indirectly generated a further 27 per cent of the region's economy, in total generating over two-thirds of the region's value added. Table A1 summarises the direct and indirect impact for all primary industries in the region.

**TABLE A1: TOTAL ECONOMIC IMPACT OF PRIMARY INDUSTRIES IN THE SOUTH EAST**

	<b>Gross Value of Output (\$m)</b>	<b>Value Added (\$m)</b>
<b>Direct Impact</b>		
Sheep	117	78
Grains	50	27
Beef	64	42
Dairy	39	23
Other Livestock	4	2
Grapes	43	27
Other Agriculture	100	61
Forestry	90	53
Meat Products	158	34
Dairy Products	56	13
Wine	132	43
Other Food Products	66	19
Wood and Paper Products	539	209
<b>TOTAL DIRECT IMPACT</b>		<b>629</b>
<b>Indirect Impact</b>		
Trade		101
Transport		45
Business Services		27
Finance		25
Other Manufacturing		20
Utilities		15
Accommodation & Restaurants		15
Communications		13
Ownership of Dwellings		55
Other Sectors		94
<b>TOTAL INDIRECT IMPACT</b>		<b>409</b>
<b>TOTAL IMPACT</b>		<b>1,037</b>

Source: Regional Planning Framework for Primary Industries in the SELGA Region, PIRSA Sustainable Resources

Table A2 illustrates the percentage of production attributable to irrigation in South Australia and Australia as a whole in 1990. Within South Australia, the main crops requiring irrigation include vegetables, fruit, grapes, pastures and milk respectively.

**TABLE A2: PERCENTAGE OF SOUTH EAST PRODUCTION ATTRIBUTABLE TO IRRIGATION - 1990**

<b>Crop</b>	<b>SA</b>	<b>Australia</b>
Apples	97	97
Citrus	95	95
Pears	95	95
Apricots	95	92.9
Vegetables	96	91
Grapes	81.3	88.5
Peaches	87	87
Oilseeds	7	65.8
Milk	51	44
Pastures	54.5	19.8
Sheep	1	6.6
Wool	0.5	3.2
Cereals	0	2.1
Wheat	0	1.2
Barley	0	1.2
Cattle	0.3	0.4

Source: Australian Irrigation Council, Melbourne

Using the above percentages of production attributable to irrigation and the value added identified in Table A1, it is estimated that irrigation in the South East directly accounts for over \$93 million in regional value added. Note that this is an estimate of the farm gate value of irrigation only. In addition, industries such as paper mills and dairy processing plants utilise water (as illustrated in table A1 above) and contribute substantially to the regional economy.

### **Gains from Water Trade**

There are several possible situations where gains from water trade can be obtained. These include:

- Increases in irrigation development from previously unallocated water;
- Movements of water to higher value uses;
- Increases in availability of water for irrigation development due to improvements in water use efficiency; and
- Elimination of the 'shadow' effect.

Quite obviously, the decision to undertake water trading will only occur if the benefits expected to be received exceed the costs incurred. To illustrate the possible benefits of water trade, a very simplified approach has been taken using gross margins for selected industries to measure the direct market benefits. Due to the time restrictions of this project, non-market and indirect benefits have not been measured, although the above section provides an



indication of the value of flow on benefits/costs that may result from an expansion/contraction of primary industries in the region.

The following sections estimate the potential gains that may occur from water trade. It is possible however that some management areas are over-allocated and there will be a reduction in the water allocation. If such a situation arises it is expected that there will be a significant reduction in value of production in the affected areas (see Table A5 for a comparison of gross margins for irrigated versus non-irrigated agriculture).

### **Possible Gains from Previously Unallocated Water**

The following table presents gross margins per ML estimated by Rolls and Botting (1998) and provides an indication of the types of gains that could be expected from undertaking an irrigation activity with previously unallocated water.

**Table A3: Gross Margins per ML of Water Used in Selected Agricultural Activities**

<b>Primary Industry</b>	<b>Gross Margin per Mega Litre</b>
Meat from Pasture	140
Lucerne Seed	360
Subterranean Clover Seed	400
Milk from Pasture	750
Potatoes	820
White Wine Grapes	3,500
Red Wine Grapes	4,900

Source: John Rolls and David Botting (1998)

### **Possible Gains from Movements of Water to Higher Valued Uses**

There are clearly some very large gains in to the region to be made from water trading. For example, using the gross margins in Table A3 above, Table A4 suggests that by trading one ML of water currently used for meat from pasture to red wine grapes, an extra \$4,760 could be obtained.

**Table A4: Possible Gains from Trading Water to Higher Value Uses in dollars per ML**

	TRADE TO					
TRADE FROM	Lucerne Seed	Subterranean Clover Seed	Milk from Pasture	Potatoes	White Wine Grapes	Red Wine Grapes
Meat from Pasture	220	260	610	680	3,360	4,760
Lucerne Seed		40	390	460	3,140	4,540
Subterranean Clover Seed			350	420	3,100	4,500
Milk from Pasture				70	2,750	4,150
Potatoes					2,680	4,080
White Wine Grapes						1,400

Source: John Rolls and David Botting (1998)

However, there are several constraints on the applicability of the above scenarios. Trading gains will vary hundred by hundred and management area by management area depending on many factors such as suitable soil types, climate, topography and water quality.

An important scenario missing from the above table is the movement from dryland agriculture to one of the irrigation options. There is little information on the gross margins of irrigated versus non-irrigated crops. However, the following gross margins (see Table A5) are available from the Farm Business Planner (1999) which provides an interesting indication of the magnitude of difference between predominantly irrigated agriculture and non-irrigated agriculture (see Table A2 for percentage of production attributable to irrigation for each activity).

**Table A5: Gross Margin per Hectare for Selected Agriculture Industries**

	<b>Gross Margin per Hectare</b>
<b>NON-IRRIGATED AGRICULTURE</b>	
Wheat (ASW)	\$176
Barley (Schooner)	\$222
Merino Wethers	\$98
<b>PREDOMINANTLY IRRIGATED AGRICULTURE</b>	
Dairy	\$1,459
Shiraz Grapes (\$750/t)	\$7,441

Source: Farm Business Planner

While Table A4 highlights the possible gains from trade, as mentioned above, the decision to trade will also depend on the associated costs of trading. Aside from the administrative costs of trading, many of the changes above may involve significant levels of capital investment. Some of these costs can be prohibitively high. For example, it is estimated that the development costs of a shiraz vineyard in the South East is nearly \$30,000 per hectare (Farm Business Planner, 1999). Trading will allow movement of water to those people who are best able to source such capital.

### **Possible Gains from Improvements in Water Use Efficiency**

Improvements in water use efficiency will increase the amount of water available for other irrigation developments. The best way to illustrate the potential benefits from improvements of water use efficiency is by way of example.

Consider two irrigators, one is a potato grower (Irrigator A) and the other produces lucerne seed (Irrigator B). Assume the lucerne seed producer improves his/her water use efficiency by 20 per cent, raising the gross margin per megalitre to \$450 (from \$360). Assume that the lucerne seed grower is constrained by land availability to undertake further irrigation development. The irrigator therefore has 200 ML available for trade.

**Table A6: Possible Gains from Improvements in Water Use Efficiency**

	<b>Entitlement (ML)</b>	<b>Trade</b>	<b>Gross Margin (\$/ML)</b>	<b>Gross Value (\$)</b>
<b>Current Situation</b>				
Irrigator A	1,000	0	820	820,000
Irrigator B	1,000	0	360	360,000
				1,180,000
<b>Allowing Trade</b>				
Irrigator A	1,000	+200	820	984,000
Irrigator B	1,000	-200	450	360,000
				1,344,000
<b>Net Benefits from Trade</b>				<b>164,000</b>

Trading the 200 ML to a potato grower will result in a net benefit of \$164,000.

#### **Possible Gains from Eliminating ‘Shadows’**

It is possible that the existence of ‘shadows’ currently constrains significant irrigation development in the South East. To illustrate the potential benefits of eliminating the effect of shadows the following example has been developed.

Consider three irrigators, one potato grower (Irrigator A), one lucerne-seed producer (Irrigator B) and another grower interested in growing white wine grapes (Irrigator C). Assume that the white wine development is within the 16 kilometre area of the lucerne seed producer. Under the current situation, even if the lucerne seed producer leases his/her water allocation to the potato grower, the white wine grape development is unable to be undertaken.

With the separation of the water right and water use property rights, the lucerne seed grower is still able to trade his/her water to the potato grower and he/she is also able to lease his/her water right to the white wine grower. The development is therefore able to go ahead and 1,000 ML will be obtained by the grape grower from the water market.

**Table A7: Possible Gains from Eliminating ‘Shadows’**

	<b>Entitlement (ML)</b>	<b>Trade</b>	<b>Gross Margin (\$/ML)</b>	<b>Gross Value (\$)</b>
<b>Current Situation</b>				
Irrigator A	1,000	+1,000	820	1,640,000
Irrigator B	1,000	-1,000	360	0
Irrigator C	0	0	0	0
				1,640,000
<b>Separating into Two Property Rights</b>				
Irrigator A	1,000	+1,000	820	1,640,000
Irrigator B	1,000	-1,000	450	0
Irrigator C		+1,000	3,500	3,500,000
				5,140,000
<b>Net Benefits from Trade</b>				<b>3,500,000</b>

Assuming 1,000 ML is brought into the area, eliminating the effect of the ‘shadow’ will result in a net benefit of \$3,500,000.

### **References**

Rolls, John and Botting, David (1998) *Toward Integration of Surface and Groundwater Management in the South East of South Australia*

Primary Industries and Resources South Australia (1998) *A Regional Planning Framework for Primary Industries in the South East of South Australia*

Farm Business Planner (1999), special issue from Stock Journal

## **APPENDIX II - LESSONS ON WATER TRADING FROM AUSTRALIA AND ABROAD**

Based on a literature review by Henning Bjornlund, University of South Australia.

Formal functioning markets in water exist in Australia, Southern and Western United States, Chile, Spain and Mexico. Informal water markets have developed in India and Pakistan though these markets are technically against the law (Meinzen-Dick, 1998; Saleth, 1998, Shah, 1993).

Experience from around the world has accumulated and we can spread these examples along a continuum of what has worked and what really hasn't. However, there are no perfect examples that can be easily adopted as institutions and rules evolve within a particular political and cultural context. Chile is an interesting example. In 1981, Chile introduced a system of transferable water rights expressed as shares of river flow that are converted to volumetric equivalencies. When river flows are severely reduced, then users' rights are reduced proportionately. Chile has been quite successful in keeping transactions cost relatively low by good organisation and flow metering throughout valleys such as the Limari Valley (Hearne, 1998).

In Mexico, an institutional framework has evolved that has encouraged robust markets within water use associations but trades are almost unheard of outside the association. In order for a trade to occur outside an area, all members of the association must agree, the government must approve and the proceeds flow to the water use organisation (Rosengrant and Binswanger, 1994; Salinas-Leon, 1994). As a result there are very few trades outside a district. Access to water limits the economic development that could have otherwise occurred.

### **Reducing Transaction Costs**

Transaction costs are the costs that are incurred related to the trade. It includes the value of time, fees and charges and the general hassle endured by the buyer and seller as part of undertaking the trade. There are numerous examples from around the world of markets where very few transactions occur because of excessive transaction costs.

#### **i. Simplifying the Approval Process**

In Utah and New Mexico, the office of the State Engineer determines whether a transfer will have adverse effects on others (Howe, 1998). The approval process is considerably faster and simpler than in states where the judiciary settles disputes and which have rules depending on defining traditional consumptive use. If disputes wind up in the courts, then trading "dries up" (MacDonnell, 1990).

#### **ii. Defining Property Rights**

In the state of Arizona, water rights are not separate from land and as a result, cities such as Tuscon and Phoenix have bought irrigated land and transported the water the city (Colby and Bush, 1987). The cost represents a

huge waste of resources. South Australia has done a lot of things right in the Water Resources Act 1997, water ranching is not necessary.

New South Wales has issued a white paper on water reform and the State has draft legislation that is waiting to be passed. The legislation represents an innovative package of water rights with a variety of security levels associated with water rights. Features of this report include a plan to roll-out shares across the State and to separate this right to receive periodic allocations from the access right.

Current thinking in the United States is moving towards the privatisation of aquifers (Anderson, 1997). The property rights can be further refined to allow for the right holder to have a share in the long term mean annual recharge (flow right) and a share of the estimated stock of water (stock right).

Uncertainty regarding rights – whether real or perceived can severely limit permanent trade in water which is often a prerequisite for large investments and economic development.

Experiences from California clearly indicates that during periods of relative abundance of supply, communities find that the cost of introducing the property rights regime with the associated metering and accounting systems, are found to be excessively high. As scarcity increases conflicts over water rights issues escalate and the costs of solving the problem increases, the process takes long, and causes greater community animosity (Anderson, 1997).

### **Accounting System**

Best practice in water accounting– you start with a water right that is defined as a proportional share in the water in the aquifer. Ideally the water account should work like a chequing account with an opening balance that consists of the share of the available stock of water and the share of the recharge. Actual use or selling water is a direct debit. Buying water increases your balance. Excess use can be penalised by an extra debit to the account. Such an accounting system has operated in an aquifer in Switzerland since 1978 (Anderson, 1997). The Minister can revise the available total stock of water if unexpected problems crop up later. The individual's water right is unaffected.

### **Importance of Metering**

The enforcement and policing of rights is very important. In groundwater systems, excessive pumping leads to increased costs for everyone as well as environmental damage. The international literature is adamant in promoting metering as an essential prerequisite for water market systems (Anderson, 1997; Shah, 1993; Griffin, 1998)

### **Competitive Markets**

#### **i. Number of Buyers and Sellers**

From India, Pakistan, and the US we obtain clear lessons about the importance of large numbers of buyers and sellers. If there is only one seller

in an area and a large number of small buyers, then too little water at too high a price will be provided. Monopolistic behaviour has been eliminated by extending piping systems so that water could be moved from other tubewells (Shah, 1993).

## **ii. Diversity**

The larger the trading area, the more diverse the water users, and the more developed the network of market facilitators, the more efficient the market will operate and the more beneficial the outcome of trade (Gardner, 1985; Brown et al., 1982).

## **iii. Simulating competitive markets**

Double auctions or Bulletin Board Water Banks are thought to be the “state of the art” in getting to competitive prices. With a double auction process buyers and sellers post their bids and there can be various rules about when and how. This system operates within Murray Irrigation Limited. Sealed bid double auctions involve buyers and sellers submitting bids and offers and the price is determined by this process. This system operates within the Goulburn Murray Irrigation District.

## **iv. Water Banks in the US**

Water Banks have developed within a number of western states (MacDonnell et al, 1994). The longest serving bank is in Idaho and the best know is California’s Emergency Drought Water Bank (Carter et al, 1994; Dixon et al, 1993). The California Bank sets both the purchase and the sales price based on farm budgets with some profit incentives for sellers (Howe, 1997). The Idaho Bank sets prices to approximate the sellers’ financial obligations with no profit (Thompson, 1997). Both banks prioritize buyers and the California Bank also determines what water can be deposited in the bank. They therefore do not represent a normal market, where willing buyers and sellers exchange goods at agreed prices. They do however, facilitate sales of large volumes of water, in periods of extreme shortage, by providing a smooth and fast transfer process.

## **Access to Information**

Experience from within Australia (NSW and Goulburn-Murray Irrigation District) suggests that prices tend to be stable, when there is a public register of information on prices paid. Wide fluctuations due to thin markets represents another source of risk.

## **Impact on Neighbours**

Excessive pumping can cause a cone of depression allowing an infusion of saline water. As mentioned above monitoring and enforcement has to occur. Problems can be avoided by requiring buyers to put farm plans in place that show how irrigation and drainage infrastructure will be introduced to prevent these problems.



## References

- Anderson, T, Snyder, P. *Water Markets: Priming the invisible pump*. Cato Institute, Washington D.C. 1997.
- Brown, L.; McDonald, B.; Tysseling, J and Dumars, C. Water Reallocation, Market Proficiency, and Conflicting Social Values. In Weatherford, G.D.; Brown, L.; Ingram, H. and Mann, D. Eds. *Water and Agriculture in the West U.S. - Conservation, Reallocation, and Markets*. Studies in Water Policy and Management, Colorado, Westview Press, 191-256, 1982.
- Carter, H. O.; Vaux, H. J. and Scheuring, A. F. Eds. *Sharing Scarcity Gainers and Losers in Water Marketing*. California, Agricultural Issues Centre, 1994
- Colby S. B. & Bush, D.B. *Water Markets in Theory and Practice. Market Transfer. Water Values and Public Policy*. Studies in Water Policy and Management, Colorado, Westview Press, 1987.
- Dixon, L. S.; Moore, N. Y. and Schechter, S. W. *California's 1991 Drought Water Bank – Economic Impacts in the Selling Regions*. Santa Monica, Rand 1993.
- Gardner, B.D. Institutional Impediments to Efficient Water Allocation. *Policy Studies Review* 5(2), 353-63, 1985.
- Griffin, R.C. The Application of Water Market Doctrines in Texas. In Easter, K.W.; Rosengrant, M.W. and Dinar A. *Markets for Water. Potential and Performance*. Kluwer Academic, Boston, 1998, 51-64
- Hearne, Robert. "Institutional and Organisational Arrangements for Water Markets in Chile". In Easter, K.W.; Rosengrant, M.W. and Dinar A. *Markets for Water. Potential and Performance*. Kluwer Academic, Boston, 1998, 141-158.
- Howe, C. W. Increasing Efficiency in the Water Markets: Examples from the Western United States. In Anderson, T. L. and Hill, P. J. Eds. *Water Marketing – The Next Generation*. Lanham, Maryland. Rowman & Littlefield Publishers, 1997, 79-100.
- Howe, C. W. Water markets in Colorado: Past Performance and Needed Changes. In Easter, K.W.; Rosengrant, M.W. and Dinar A. Eds. *Markets for Water–Potential and Performance*. Boston, Kluwer, 1998, 65-76.
- MacDonnel, L. J. *The Water Transfer Process as a Management Option for Meeting Changing Water Demands*. Boulder, Colorado, Natural Resources Law Centre, University of Colorado, 1990.
- Meinzen-Dick, R. S. Groundwater Markets in Pakistan: Institutional Development and Productivity Impacts. In Easter, K.W.; Rosengrant, M.W. and Dinar A. Eds. *Markets for Water–Potential and Performance*. Boston, Kluwer, 1998, 207-222.

- Rosengrant, M. W. and Binswanger, H. P. Markets in Tradeable Water Rights: Potential for Efficiency Gains in Developing Country Water Resource Allocation. *World Development* 22(11), 1613-1625, 1994.
- Saleth, R.M. Water Markets in India: Economic and Institutional Aspects. In Easter, K.W.; Rosengrant, M.W. and Dinar A. Eds. *Markets for Water–Potential and Performance*. Boston, Kluwer, 1998, 187-205.
- Salinas-Leon R. Water and North American Free trade: Problems and Prospects for a Viable Water Market in Mexico. In Anderson, T. L. Ed. *Continental Water Marketing*. San Francisco, Pacific Research Institute for Public Policy, 113-144, 1994.
- Shah, T. *Groundwater Markets and Irrigation Development. Political Economy and Practical Policy*. Oxford University Press, Bombay, 1993.
- Thompson, B. H. Water Markets and the Problem of Shifting Paradigms. In Anderson T.L and Hill, P. Eds. *Water Marketing – The Next Generation*, Lanham, Maryland, Rowman & Littlefield Publishers, 1997, 1-30.