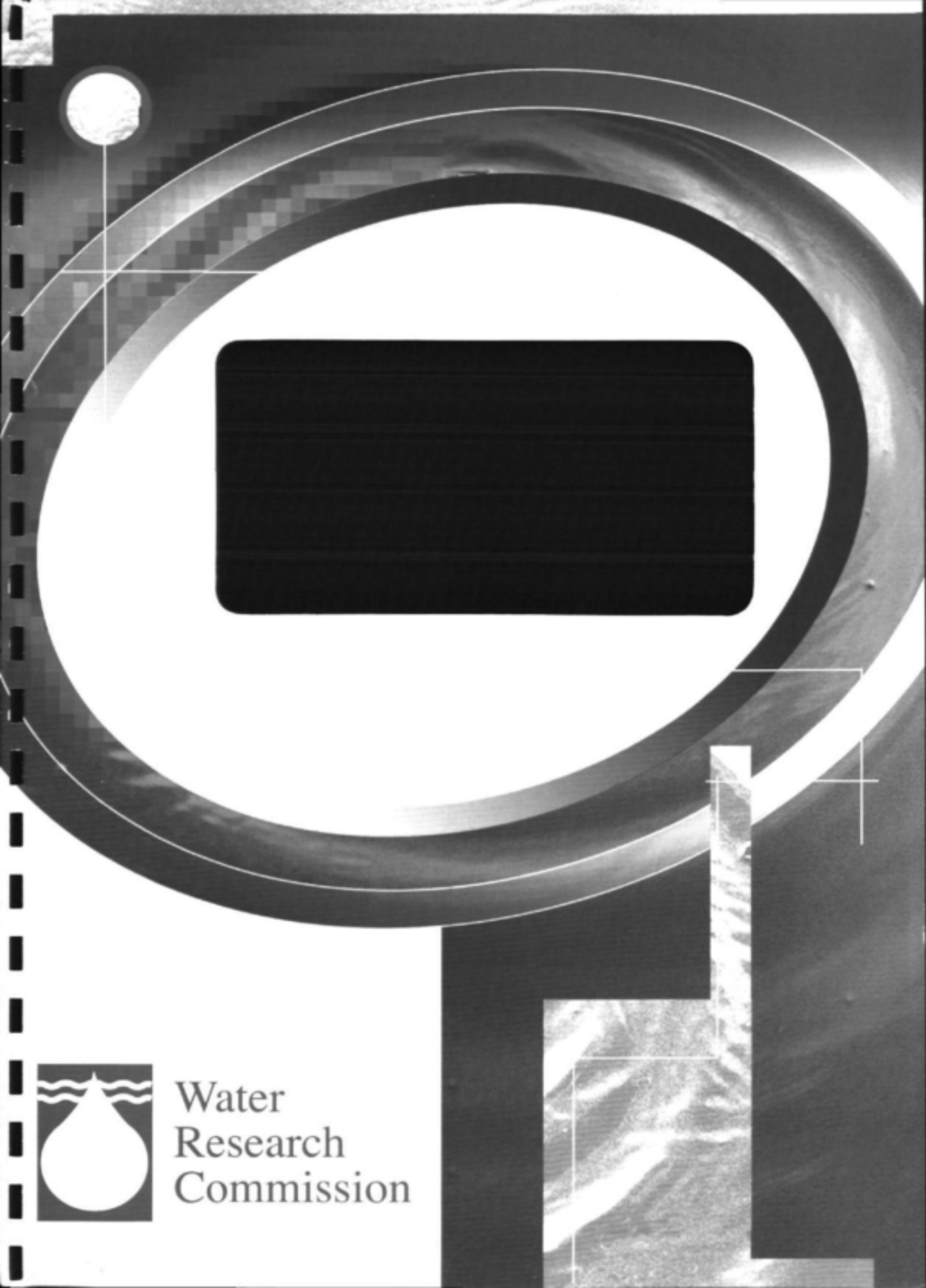

Water
Research
Commission

The promotion of irrigation efficiency in the implementation of the South African National WaterAct (1998)

CT Crosby

WRC report no. KV 139/02

The promotion of irrigation efficiency in the implementation of the South African National Water Act (1998)

BY

C T Crosby

Report to the Water Research Commission on the
Study Tour undertaken in South Africa by Dr Nick Austin
Water Use Efficiency Advisory Unit
New South Wales
Australia.
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The author wishes to express his appreciation to the Water Research Commission for making it possible for him to accompany Dr Nick Austin during the full period of his stay in South Africa.

During his short visit Dr Austin was able to meet a wide spectrum of people concerned with irrigation. We would both like to thank all for making themselves available, sometimes at considerable inconvenience to themselves.

It was a pleasure to travel with Dr Austin and to be able to compare notes on a wide range of important issues concerning these times of change in irrigation and water management in South Africa and New South Wales. On his return to Australia he sent back a string of e-mails and packages with "hot off the press" information.

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BACKGROUND TO STUDY TOUR

Dr Nick Austin who heads up the Water Use Efficiency Advisory Unit, NSW Agriculture, Australia approached the WRC for assistance in setting up appointments during a planned brief visit to South Africa.

> I will be arriving in Johannesburg on Tuesday 26 June, and will depart Cape Town on Saturday 7 July. My visit is thanks to an Australian National Committee on Irrigation and Drainage (ANCID) fellowship, **with the primary objective to explore estimation of crop water requirements using meteorological data,** and, using the resulting knowledge to improve efficiency and manage growth in irrigation water use. I am also visiting researchers on the west coast of North America prior to arriving in South Africa.
>
> New South Wales is implementing the new Water Management Act 2000 and the volumetric conversion process has established annual volumetric entitlements based on representative crop 'classes' and climatic zones. License holders on regulated rivers (those with major dams controlling releases for irrigation) have operated under a volumetric system for many years. However, the 11 000 or so license holders on unregulated rivers in NSW are now being 'converted'. The main task ahead is defining daily flow extraction limits. These limits will be based on stream flow and level of irrigation development. The proposed approach is to establish flow classes, with each license holder allocated a daily extraction limit for each flow class.
>
> A focus of our 'Water Reforms' in NSW is on improving agricultural water use efficiency to: manage demand, address over-allocation; and, claw-back water for the environment. There is an expectation / perception that improvements in efficiency will 'create' water and lessen the severity of reductions in allocation. Meaningful estimates of irrigation efficiency remain a significant knowledge gap.

It was felt that this visit came at an appropriate time and provided an opportunity to obtain new insights into international trends in promoting efficient irrigation management and administration. Dr Austin brought with him his Australian experience and came here direct from the United States where he visited with leading specialists including Prof Rick Allen the leading international specialist on crop evapotranspiration. The Water Research Commission (WRC) made it possible for Mr Crosby to accompany Dr Austin during his S African visit. Mr Crosby is the developer of the WRC funded computer program Sapwat, the procedure applied by the Department of Water Affairs and Forestry to estimate for registration purposes the volume of irrigation water use by farmers.

THE APPROACH FOLLOWED IN THE REPORT

In order to obtain full value from Dr Austin's visit the intention is to identify the NSW initiatives that could add value to processes currently being implemented in South Africa and to make realistic recommendations as to how this can be achieved. The approach will have to be pragmatic. For example S Africa is committed to the Catchment Management Agencies concept while NSW has their established pattern of Water Management Committees. While there is a common purpose there are differences in implementation policy that must be

accepted. This, however, does not preclude actions to promote improvements in the details of on-the-ground implementation.

Many of the present issues in irrigation are associated with the implementation of the National Water Act and include the establishment of CMAs and WUAs, registration, licensing, demand management, quantification of water use, water management plans, increased irrigation efficiency, Best Management Practices, management of water distribution, environmental impacts, water pricing, upgrading to higher value crops, scheduling and new technologies. The Water User Associations, many of them converted from existing irrigation boards and some completely new, are in the front line of these new developments and are the obvious starting points for initiatives.

It is not possible to include all the information gleaned from NSW procedures and experience in this report but the more important aspects are summarised in the appendix and will be cross referenced. The appendix is comprehensive enough to provide the reader with an understanding of the NSW Water Management Act 2000 together with the policy and implementation issues that have arisen.

The appendix consists of twelve sections:

DR NICK AUSTIN AND HIS ORGANISATION

Dr Austin is an agricultural engineer who grew up on an irrigation farm. His PhD studies were on modeling the impact of fertilised irrigated pastures on river water quality and he is now intimately concerned with the implementation of the NSW Water Management Act 2000. Dr Austin has since his visit to South Africa been occupied with the finalisation of River Management Plans, reviewed an ACIAR project in China and has been commissioned to write the second in a series of Irrigation Insights publications for the Australian National Program for Irrigation Research (NPIRD). His subject is ***Water Use Efficiency***.

For information that is more detailed see Section 2 of the appendix.

SECTION NUMBER	APPENDIX-NSW IRRIGATION SECTION HEADINGS	PAGE NUMBER
2	Functions of the Water Use Efficiency Advisory Unit, NSW	2

The Water Use Efficiency Advisory Unit, Dubbo, NSW, lead by Dr Austin and established in 1999, is in many respects unique. It is a joint initiative of the New South Wales equivalents of the Department of Agriculture and of Water Affairs and Forestry in South Africa. It is administered by the Department of Agriculture but has personnel from both departments and is jointly funded. It plays a key role in delivery of the agricultural inputs into the New South Wales water conservation strategy. The unit is accepted as being a well-informed neutral source of unbiased information and advice.

The value of a neutral professional group of this nature to both departmental management and to the stake holders involved in difficult negotiations can not be over estimated. South Africa has no equivalent group and, in the long term, this could have an adverse impact on South Africa's ability to achieve efficient water management and to compete on international markets.

TOUR PROGRAMME

The initial period from the 26-29 June was spent in Pretoria and comprised a number of general discussions and presentations aimed at introducing Dr Austin to the role and activities of South African institutions

- **ARC Institute for Agricultural Engineering**: Mr A Louw (director) and Mr A van Niekerk (head irrigation laboratory).
- **International Water Management Institute (IWMI)**: Dr D Merrey (director for Africa), Dr M Masiyandima (hydrologist) and Mr H Levite (irrigation engineer).
- **Water Research Commission (WRC)**: Dr G Green (deputy executive director), Dr G Backeberg (research manager) and Mr H Maaren (research manager).
- **Department of Water Affairs and Forestry (DWAF)**: Mr J Geringer (deputy chief planning), Mr D de Vaal (deputy chief engineer), Mr F van der Merwe (chief engineer irrigation) plus a well attended presentation by Dr Austin.
- **University of Pretoria**: Ms I van der Stoep (lecturer irrigation and rural development)
- **NB systems**: Dr N Benade (director). Discussions on the WRC funded research on irrigation scheme management.
- **Schoeman and Partners**: Mr H Schoeman (managing director), Mr F Joubert (systems management). Discussions and demonstration of the DWAF water use registration process and the application of Sapwat.

The period 30 June-2 July was spent in and around Pietermaritzburg and included the weekend. Two long motor drives were undertaken, the first covering the mountains and streams of the Southern Drakensberg where the registration process has much in common with parts of NSW and the second to the coastal sugar cane areas. Subjects ranged from on-site discussions of water registration in practice to a review of hydrology research, model development and databases with the emphasis on ACRU and the role of the CCWR. The exchange of ideas on irrigation efficiency was particularly useful.

- **DWAF Kwazulu-Natal**: Mr G Chrystal (deputy chief engineer) with major responsibilities for water use registration.

- **University of Natal, School of Bioresources Engineering and Environmental Hydrology:** Prof R Schulze, Dr G Kiker (lecturer and researcher), Mr A Pike (consultant and research hydrologist), Mr D Clark (research engineer) and Dr N Musonda (lecturer and research engineer)
- **CPH2O Consultants**: Mr J Hallowes (hydrologist)
- **Institute for Agricultural Engineering/ARC:** Mr G Ascough (engineer, seconded researcher irrigation efficiency), Ms C Kedge (engineer, seconded researcher treadle pumps and small farmer irrigation).
- **Computing Centre for Water Research:** Dr M Dent (manager)

The night of 3 July was spent in Bloemfontein where Mr P van Heerden (consultant and irrigation extension specialist) joined Dr Austin and Mr Crosby for the Bloemfontein and Kimberly sector of the visit.

- **Free State University, Soil Science Department**: Prof A Bennie (soil scientist, irrigation researcher, dry land and irrigation modeler and practical farmer).

The 4th July was spent in the Kimberley area starting with the inaugural meeting of the Orange/Vaal Water User Association demand management pilot project planning committee under the chairmanship of Mr E Mokwena (DWAF deputy director water conservation and demand management). The afternoon was spent in the field inspecting the irrigation, scheduling and management practices applied in the area by the irrigation boards (predecessors to the proposed WUA.):

- **Irrigation Board managers**: **Mr** W Bruwer (Orange-Vaal irrigation board), Mr H Postumas (Lower Riet irrigation board)
- **Griqualand West Cooperative:** Mr A Wiid (irrigation and scheduling advisor).
- **CSIR-Environmentek, consultants to pilot project:** Mr J Crafford (renewable resources for economic development), Ms M Wilkinson (project manager)

The last full working day, 5 July was centered on Stellenbosch and after a preliminary discussion at Elsenburg agricultural college irrigation efficiency research sites were inspected in the Heksrivier prime table grape area. The next morning, a Saturday, it was possible to drive through the main deciduous fruit producing areas before flying out from Cape Town.

- **Institute for Agricultural Engineering/ARC**: Mr F Koegelenberg (manager Stellenbosch office, irrigation engineering specialist)
- **Department of Economic Affairs, Agriculture and Tourism, Western Cape**: Mr A Roux (chief engineer), Mr P Keuk (irrigation specialist), Mr N de Jager (irrigation specialist).
- **Heksrivier Irrigation Board**: Mr C Olivier (manager).

THE SIGNIFICANCE OF THE VISIT

Mr Crosby has classified his accompanying Dr Austin on this visit as an "internal overseas study tour". The original subject of estimating crop water requirements was discussed in detail but this was common ground and expected. What was not anticipated was the value of comparing notes on irrigation efficiency and management for days on end while criss-crossing the country meeting people both in offices and on farms. It is seldom possible for practitioners to have an opportunity of this nature; usually contact is more formal through conferences and academic visits. Dr Austin was able to identify with the situation on the

ground in S Africa and both during the visit and subsequently to provide selected information that he knew would be of value to us in South Africa.

In the course of the visit it became apparent that:

- There is a remarkable similarity in purpose between the South African National Water Act (1998) and the New South Wales Water Management Act 2000 but there are significant areas of difference in the institutional and administrative approaches to implementation. **Implementation in NSW is well ahead of S Africa affording us the opportunity to learn from their successes and failures.**

- There is close co-operation between the Department of Land and Water Conservation and the Department of Agriculture in NSW and **both departments have shown dedication and innovation in providing support to the irrigation sector in the interests of promoting more effective water use.** However, this is not to say that organised agriculture is satisfied with all aspects of the Act, or its implementation, and the debates continue.

- In NSW every effort is being made to ensure that **the implementation of the act is being geared to the genuine situation on the ground** and not to what is perceived by administrators, academics, researchers or engineers to be the situation.

- Particular attention is being given to **ensuring that the irrigation sector has clarity on what is expected and on providing unbiased professional support** to all involved in the inevitable negotiations that are part and parcel of implementation. The "hands-on" publications that have been developed are outstanding.

- There are **important well-documented initiatives** including "Waterwise on the farm" that comprises extensive farm oriented training supported by regular popular publications.

- As a consequence of the complexities of the Australian institutional and political systems NSW has **developed innovative techniques for achieving inter-State and inter-Sector co-operation** in respect of water and irrigation management.

While there is no reason to believe that S African legislators, administrators, farmers, researchers, engineers or academics fall short of their NSW counterparts it does appear, however, that there are lessons to be learned from the NSW experience and initiatives. It might even be worthwhile to reach agreement with NSW on the formal exchange and use of appropriate information and publications.

Approach to the establishment of Catchment Management Agencies

There are significant differences in the structures of CMAs and the NSW Water Management Committees (WMCs) although the overall objectives are similar. Dr Austin attended the inaugural meeting of the Orange-Vaal WUA demand management pilot project meeting and commented that he was struck by the academic nature of stakeholder discussions. This was in contrast to NSW where WMC meetings were characterised by realistic and sometimes bitter

negotiations on sectoral water sharing. One of Dr Austins tasks is to sit in at these meetings in order to provide objective and authoritative advice and support to all participants. The NSW process is covered in some detail in Sections 3,4 and 5 in the Appendix and will not be discussed here.

Possibly as a consequence of the controversial nature of the process NSW has given particular attention to documenting clearly and simply the procedures to be followed by all concerned so reducing the adverse effects of uncertainty. South Africa is nearing the confrontational phases of CMA implementation and should possibly take a careful look at the communication approaches that have been developed by NSW.

The advice to WMCs series of short publications dealt with in Section 4 of the Appendix is of particular importance. Guidelines are provided for virtually all aspects that may confront these committees. The extract from Section 4 that follows gives an indication of the range covered.

> These consist of a series of pamphlets that set out the basic principles and regulations applicable to the implementation of the New South Wales Act. They are of value firstly because the whole process is clearly spelt out and one can very quickly become familiar with the process as it is being applied and secondly they illustrate the care that has been taken to fully inform the people who will be implementing the Act on the ground.
> They deal with such matters as:
> No. 1 Managing to Diversion Limits in Regulated Rivers
> No. 2 Supplementary Water Access
> No. 3 Floodplain Harvesting
> No 4 Regulated Rivers (High Security) Access Licences
> No. 5 Managing to diversion limits in inland unregulated rivers
> No. 6 Water extraction volumes and daily flow shares in unregulated rivers
> No.7 Diversion limits for coastal unregulated rivers
> No. 9 Groundwater Dependent Ecosystems
> No. 10 Freshwater flows to estuaries and coastal waters
> No. 11 Integrating water quality and river flow objectives in water management plans
> No. 12 Conservation of biodiversity and threatened species development
> No. 13 Incorporating the results of the weir review into the water sharing plans
> No 14: Aboriginal issues and cultural heritage protection
> No. 15 Water transfers

The development of a complete "how to do it" programme for all concerned at local level in the process of implementing the National Water Act (1998) is obviously the responsibility of DWAF. The development of the material and the way in which it is presented both to departmental personnel and the irrigation fraternity has obviously received in-depth attention in NSW. Interchange of ideas would seem to be warranted.

PROMOTING INTEGRATED ACTION THROUGH AGREED AND APPROVED OUTCOMES

One of the major problems in South Africa is the co-ordination of the activities of service-providers, this is true of all development in the deep rural areas. Australia and NSW in particular seem to have found a way around this problem by developing procedures based on "desired outcomes" that are endorsed right at the beginning at top level by all participating agencies. This approval promotes horizontal communication between officials employed by various departments and sectors.

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5	State Water Management Outcomes Plan and Water Sharing	13
7	National Action Plan for Salinity and Water Quality	15

Sections 5 and 7 of the Appendix details how this methodology was applied

> The state Water Management plan, Appendix Section 5 sets the overarching policy context, targets and strategic outcomes for the development, conservation, management and control of the state's water resources.
>
> The plan sets out what might be termed initial enabling targets. These typically require mapping and assessment to be completed within a specified period as an essential prerequisite of expected management action. **This appears to be a bold and innovative move to ensure inter-departmental co-operation by establishing agreed detail guidelines before implementation. The agreement of the relevant Ministers is required ensuring top-level participation and authority for action. This promotes horizontal communication and obviates the need for officials to constantly refer back to their departments for approvals.**
>
> Appendix Section 7 outlines a national action plan that identifies as a high priority, immediate actions to address salinity, particularly dry land salinity, and deteriorating water quality in key catchments and regions across Australia. The goal of this action plan is to motivate and enable regional communities to use coordinated and targeted actions to prevent, stabilise and reverse trends in dry land salinity improve water quality, and secure reliable allocations for human uses, industry and environment.

South Africa does not have the same salinity problems as Australia but the documentation of the process is valuable. It is a massive national project and South Africa has other problems such as the renewal of rural villages that requires comparable action.

There could be merit in the WRC initiating a project to analyse and evaluate the water management applications of the "outcomes" approach in co-ordinating the activities of diverse agencies. A study of this nature could have a major impact not only on water related matters but also on rural development in South Africa as a whole.

SUPPORTING THE WATER USER ASSOCIATIONS (WUAS)

We have seen that it is the WUAs that will be bearing the brunt of the changes once they are officially constituted. This process has now commenced and will gain momentum. The aspects dealt with so far in this report dealt with the wider issues of policy and implementation and where appropriate recommendations have been made. These generally dealt with what could be gained through closer liaison with NSW. The balance of the report is concerned with WUAs and the tasks their management and personnel will be facing together with their farmer members.

Unfortunately the irrigation sector is not highly regarded in water management circles. There are perceptions, amongst others, that:

- the majority of farmers do not "schedule",
- water supplies are not well managed,
- distribution losses are high,
- existing systems both on scheme and on farm are not well maintained,
- few farmers are concerned about actual crop irrigation requirements,
- water wastage is excessive, and
- water management has a low priority, and
- irrigation should be reserved for "high value" crops.

These are universal perceptions that are not confined to South Africa and may or may not be justified. What is disturbing, however, is that while most developed countries, our competitors in global markets, are taking active steps to improve irrigation farming effectiveness and water use efficiency South Africa is only paying lip service to these processes. There are, of course, individual outstanding exceptions but they remain exceptions.

It is noteworthy that WUAs are expected to present comprehensive water management plans annually that incorporate audits of past performance and future projections. They are also expected to identify and formulate Best Management Practices (BMPs) and bench marking procedures. Neither the Departments of Agriculture or the Department of Water Affairs have the mandate, funding or trained personnel to assist the WUAs to achieve these requirements. The only recourse is to consultants but they are spread thinly on the ground and tend to have specialised expertise.

Both PS van Heerden and CT Crosby can testify to this situation. They developed the WRC publication, ***Using SAPWAT to estimate water requirements of crops in selected irrigation areas managed by the Orange-Vaal and Orange-Riet Water User Associations,*** undertook the training of DWAF personnel and consultants engaged in the water use registration procedure and have involvement in the WUA demand management pilot studies. They were particularly interested in hearing from Dr Austin how NSW were approaching a similar situation.

The support services provided in NSW are outlined in the following paragraphs:

- DIRECT SUPPORT BY GOVERNMENT
- FARMER TRAINING
- COMMODITY ORIENTED SUPPORT FOR IRRIGATION FARMERS
- SCHEDULING AND BENCHMARKING
- ESTIMATING CROP IRRIGATION REQUIREMENTS FOR VOLUMETRIC CONVERSIONS

The concluding paragraph will attempt to summarise possible action

- THE WAY FORWARD

DIRECT SUPPORT BY GOVERNMENT

The Water Use Efficiency Advisory Unit plays an important part in the drive for greater efficiency.

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2	Functions of the Water Use Efficiency Advisory Unit, NSW	2

The following note is extracted from the above

> **Each of the 10 water management regions in NSW has two irrigation officers, one a technical specialist and the other a training officer directly supported in technical and policy matters by the Water Use Efficiency Advisory Unit.** The unit is accepted by all concerned in this period of difficult negotiation as being a well-informed neutral source of unbiased information and advice. The value of a professional group with a direct line to both concerned departments and with a close link to dedicated specialists in each region cannot be overestimated.

If South Africa had two dedicated irrigation specialists in each province supported and co-ordinated by a small central professional group they could go a long way towards providing the WUAs, particularly the person officially charged with the promotion of irrigation and water use efficiency, with training and guidance. It is appreciated that in the light of current official policies and budget constraints it would be difficult to create new posts but it may be possible to "convert and divert" interested existing officials from both the DOAs and DWAF to fill these roles. Coordination and support would be a problem that will be discussed in the concluding sections of this report that will also consider ways and means of phasing in the provision of services starting with small beginnings.

FARMER TRAINING

Dr Austin noted the almost non-existence of training opportunities for irrigation farmers in S Africa and discussed and later forwarded details and course materials of the **NSW Water Wise on the Farm programme.** This is a relatively new programme but has gained satisfactory acceptance. It is a key element of NSW water management strategy.

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This training is part of Water Wise on the Farm programme, an education and awareness programme that promotes the adoption of best irrigation management practices and technologies. Water Wise on the Farm aims to provide farmers with basic irrigation skills.

The course program consists of four workshops:

- Assessing your soil and water resources,
- Evaluating your irrigation system,
- Scheduling and benchmarking,
- Irrigation and drainage management planning

The course is taken to the WUA. The complete program requires about 18 hours of attendance spread over four workshop sessions and about 8 hours of the farmers time assessing the soils and irrigation system on his own property. The Introduction to Irrigation Management course is aligned to formal competencies developed by the Irrigation industry and ratified by the Rural Training Council of Australia (RTCA). Consequently to be assessed as 'Competent" in the topics covered there is some assessment. This takes the form of workshop activities, discussions with the trainer and some activities to complete at home. There are no exams or tests!

Each of the nine regions in NSW has a technical irrigation specialist and a training specialist who runs the courses in the districts. The course material is outstanding and includes trainer manuals, detailed course notes and related practical exercises, and complete competency specifications and evaluation procedures. All usual irrigation methods are catered for but only one irrigation method is dealt with on a course. The courses are aimed at farmers and the instructor has ample opportunity to pass on his own field experience.

We have nothing like this in South Africa. The courses are generic in that they are as applicable to South Africa as they are to NSW. There would probably no objection from NSW to our using (with due acknowledgement) the information that obviously represents many months of preparation but this will only be effective in conjunction with appropriate infrastructure and man power. It is possible that this could be a private sector initiative. Discussion of possible approaches that can be explored will be discussed in conjunction with other proposed activities in a later section.

COMMODITY ORIENTED TECHNICAL SUPPORT

Dr Austin indicated that the ability of the government authorities to technically support the various branches of irrigated agriculture in NSW is falling short of the requirements arising from changing circumstances. More and more the industries are themselves assuming a large measure of this responsibility. One of the first to this task is the all important cotton industry and they have developed a comprehensive draft Best Management Practice manual to meet this need. The draft manual has been submitted to the Irrigation Efficiency Unit for editing and authoritative recommendations. Despite the limited capacity of government to undertake

all the necessary support, industries in Australia recognise the important contribution that can be made by government technical personnel and an effective partnership has been built up over the years. For further detail see section 9 of the Appendix.

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9	Technology transfer: Commodity oriented technical support	15

The introduction to the cotton industry draft best management practice manual is worth quoting in detail because it indicates the direction in which technology transfer is moving in Australia.

> Successful cotton production relies on the sustainable use of land and water resources. Soils, water, and crops need to be managed so that the farm is profitable well into the future, and so that the risk of any adverse environmental impacts is minimised.
>
> Effective management of land and water resources requires growers to be familiar with the resources on the farm, and to plan for the use of these resources. For example, the types of soil found on the farm, and their condition will affect how those soils are managed. Similarly, the quality of water available for irrigation can affect how that water is best used. The core best management practice for land and water management is to develop a plan that describes the resources of the farm, and how these are to be used sustainably. This type of plan is often called a land and water management plan or an irrigation and drainage management plan. Both the New South Wales and Queensland governments have developed guidelines for the development of these plans. Plans consist of a farm map and overlays, and written information on land, water and crop management.
>
> The planning guidelines and practices outlined in this manual are consistent with these government guidelines. Growers who have addressed the issues outlined in this book will have gone a long way to meeting any legal requirements for land and water management established under state government legislation. Many growers will have already adopted the practice as recommended in this booklet. Recording these practices and a plan provides evidence of good practice, and can be used to make changes and improvements in the future

It is recommended that the possibility of developing similar manuals for South Africa covering the main commodities should be assessed and this should include incorporating in-depth irrigation guidelines. Ways and means of achieving this will be considered in the concluding section of this report.

SCHEDULING AND BENCHMARKING

It is apparent that the NSW specialists and the irrigation industry are fully aware of scheduling techniques including the most advanced developments. The farmer training programmes include excellent information and "hands on" practical work on scheduling principles. At the same time one gains the impression that the number of farmers actually "scheduling" is confined to the limited group producing high value crops and applying intensive methods. Australia has concentrated on scheduling based on the measurement of

soil water content and a wide range of instruments and attendant software is available. In other words much the same position as in S Africa.

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11	Scheduling and Benchmarking	18

A matter discussed in detail with Dr Austin on his visit was the stereotyped perceptions of scheduling held by the irrigation industry as a whole. The empirical computer model BEWAB enables pre-season programmes to be drawn up and has produced exceptional results in the extensive area where it was developed. All that is required of the farmer is to keep a record of the depth of irrigation water applied on a weekly basis and to correct if the depth applied is not in line with the programme. In the case of pressure systems a rain gauge is placed in the field and read weekly. In addition the profile water content should be checked periodically, preferably under the supervision of an experienced scheduling consultant.

Rain can present a problem but in the more arid areas the pre-season programme is set-up in terms of "water in the rain gauge", irrigation or rainwater. A methodology, nick-named "dipstick", has been developed to a fine art in the semi-arid area along the Orange river by the Douglas Cooperative and this year is mandatory over an area of some 20 000 hectare of centre pivot wheat. This is a practical affordable form of scheduling suitable for most field and vegetable crops.

Dr Austin acknowledged that in Australia scheduling based on soil water balance utilising water measuring devices was favoured but that programmed irrigation based on atmospheric demand required further attention. He was fully exposed here to the "dip stick" low cost "entry level" approach and it will be interesting to see what develops in the future. Low cost simplified scheduling presents opportunities for extending farmer awareness of irrigation efficiency in South Africa.

ESTIMATING CROP IRRIGATION REQUIREMENTS FOR VOLUMETRIC CONVERSIONS

New South Wales is implementing the new Water Management Act 2000 and the volumetric conversion process has established annual volumetric entitlements based on representative crop 'classes' and climatic zones. The calculation method is based on A-pan evaporation and crop factors utilising a water balance model. As the State has been divided into relatively compact climatic zones and there has been extensive ground-truthing there is no reason to doubt the practical applicability of the estimates. This is similar to the position in the Western Cape where traditional A-pan based estimates and independently developed SAPWAT values are within reasonable limits of each other. However, both remain estimates.

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12	Crop Irrigation Requirements for Volumetric Conversions	19

The NSW authorities appreciate that there are vulnerabilities in their procedure and have created an independent anomalies review panel to cater for appeals. Anomalies must be based on verifiable differences in water usage compared with "typical" requirements. One of the

difficulties with the A-pan approach is that it is not transparent. It is difficult to explain anomalies and to arrive at agreed and motivated compromises.

This task is very similar to the one currently being undertaken by DWAF in S Africa where "normal" irrigation water usage by farmers outside of schemes and irrigation boards, where current quotas are accepted, are being registered together with what were previously "private" water sources. In South Africa DWAF had nominated SAPWAT as the program to be used for registering irrigation water use and selected DWAF staff and consultants were trained in the use of the program before the onset of the interviews. If in the course of discussion an irrigator queries the default values his practices and conditions are run through with him on the computer and if it is apparent that he has a valid point it is accepted and a printout of the results attached to his file. The big advantage of SAPWAT is its transparency and objectivity as well as the property of being able to simulate non-standard management and cropping situations.

Dr Austin is, particularly after his trip to the USA, thoroughly well informed on the alternative methodologies available and he and Mr Crosby are in complete agreement on the application of atmospheric demand procedures. It must be realised that conversion rates are at best a compromise and the methodology applied will depend on the practicalities of the situation facing the officials managing implementation. Dr Austin has still to submit his report but it is suspected that in due course the FAO will leap frog SAPWAT, currently the state of the art procedure, and develop a GIS based program incorporating updated algorithms and the principles pioneered in SAPWAT. Should this be achieved it would become the next generally accepted international standard.

THE WAY FORWARD

There can be no doubt that the South African National Water Act (1998) and the New South Wales Water Management Act 2000 have, and will continue to have, a significant impact on the irrigation industries in their respective countries. Dr Nick Austin has provided us with valuable insights into how NSW and Australia is coping with the challenge and in the process given us a good deal to think about. While there is a general trend internationally for the state to reduce both direct technical and financial support to irrigation farmers this has been far more drastic in South Africa (other than in the case of the previously disadvantaged) than in NSW so that if we are to "play catch up" and ensure global competitiveness while managing water efficiently we must find ways and means of mobilising the irrigation industry.

It would be ideal if it were possible to establish a similar centralised unit similar to the NSW Water Use Efficiency Advisory Unit backed up by an irrigation specialist and a trainer in each DWAF regional office but it is appreciated that this is probably not feasible in the short term. Are there alternatives?

It has been mooted that a recent report dealing with water management at WUA level that has been favourably received might point the way to an interim solution.

The aim of this project ***Using SAPWAT to estimate water requirements of crops in selected irrigation areas managed by the Orange-Vaal and Orange-Riet Water User Associations*** by PS van Heerden, CT Crosby & CP Crosby, WRC Report No: TT 163/01, October 2001 was to apply the SAPWAT in a specific target area with the following objectives:

- to test the applicability of SAPWAT for planning purposes,
- to estimate crop irrigation requirements for a selected irrigation scheme,
- to make inputs for the development of a water management plan by WUAs

The conclusions reported in the executive summary are reproduced here.

> SAPWAT was evaluated in the study area against results obtained with a neutron water meter-based scheduling service and it was found that it gave reliable results within the framework of the complex irrigation management environment. Furthermore, it was found that the farmers of the area have generally accepted the application of SAPWAT as a planning aid and the results are seen as being credible.
>
> The potential role that SAPWAT can play in water use and water management planning has been tested and a methodology for the application of SAPWAT in such a role has been demonstrated. The conclusion is that SAPWAT can be used with confidence to do the following:
>
> - estimation of the irrigation requirement of individual crops,
> - estimation of the irrigation requirements of crop rotation systems,
> - estimation of the irrigation requirements of areas and sub areas,
> - evaluation of existing management strategies,
> - estimation of the irrigation requirements of alternative crop combinations,
> - support the development of irrigation strategies and pre-programmed irrigation schedules,
> - support the "dip stick" entry level irrigation scheduling method.

SAPWAT based training at WUA level

The suggestion that was mooted was that the first steps in empowering WUA management and leading farmers would be to provide them with training in the application of SAPWAT on their WUAs. Experience with training DWAF personnel and consultants in the use of SAPWAT prior to the water use registrations disclosed that this was possibly the "students" first exposure to basic irrigation and crop production practice. It was well received. It is suggested that should it be possible to develop a programme that provided for WUAs as they came on stream in their new guise it would be valuable if regional / provincial personnel could assist with the training courses developing a nucleus of knowledgeable people for the future intensification of irrigation efficiency initiatives

Water Wise training for farmers based on NSW methods and materials

This suggestion does not cover the provision of basic Water Wise type training that would follow the SAPWAT training and would target farmers and provide the basics of irrigation management. The approach and material developed in NSW would be almost directly applicable in South Africa and it should be possible to train a number of trainers from the ranks of officials, WUA personnel and committee members.

Establishment of "Irrigation Organisation of South Africa" (IOSA)

Possibly the biggest shortfall would still lie in the area of a group of objective, practical irrigation professionals that could fill the role of the NSW Water Use Efficiency Advisory Unit. Here is a possible suggestion. Some 25 years ago the grain handling industry worldwide were shocked when two huge silos were destroyed in the USA by grain dust explosions. The industry in South Africa realised that they must put their house in order and this lead to the founding of the Grain Handling Organisation of South Africa (GOSA) that included representatives of the grain control boards, Land Bank, Co-operatives, Railways, millers, consulting engineers, construction firms, Departments of Agriculture, researchers, academics etc. **The core of the organisation was two committees, the training committee and the research committee**. Both functioned very effectively. The research committee became the neutral source of specialist advice and dealt with issues ranging from fumigation, optimum intake rates, designing to eliminate structural cracks to the standards to safeguard against grain dust explosions. The certificates issued by the training committee became the recognised requirement throughout the industry. GOSA has gone from strength to strength despite the major changes in the grain marketing industry in recent times.

Could it be that the time is ripe for the establishment of a similar organisation for the irrigation industry? The immediate reaction is to suggest that SABI assume this responsibility. SABI is a very successful organisation but over the years has developed a character of its own. The emphasis is on the designing, manufacturing and marketing of irrigation systems. The proposed organisation IOSA would, however, be concerned with irrigation policy, administration, training, technical and economic implications of farming practices and demand management. The WUAs would be key members of the organisation and a major objective would be to develop the effective participation of all concerned with the irrigation industry.

IOSA could probably also deal with the coordination and monitoring required to develop commodity oriented technical support for irrigation farmers.

APPENDIX

Additional information provided to supplement the main report.
The appendix items 1, 6, and 8 are not discussed in the main report.

1) New South Wales Irrigated Agriculture

There are great similarities between New South Wales and South Africa as far as irrigation is concerned. The climatic zones in the state range from sub-tropical in the North to winter rainfall in the South and from humid on the coast to arid inland. The total area under irrigation at just under 1 million hectare is similar to the area under irrigation in South Africa and 70 per cent of diverted water is utilised for irrigation. While a wide range of crops is produced the trend is towards irrigated pastures for dairy production and in common with South Africa there is a potential for increasing the proportion of high value crops under irrigation. Flood irrigation still dominates usually in the form of modern furrow irrigation systems but all methods of irrigation are represented. New South Wales has already reached a point where the water resources cannot meet requirements. The state is divided into nine regions.

The NSW farm-gate value of production attributable to irrigation is $ 2.5 billion per annum. While NSW accounts for almost half of Australia's irrigation water use and irrigated land, the State returns only about 30% of the national value of irrigated agriculture. This occurs because a greater proportion of water is used on lower value crops such as pastures than in other states: NSW receives an average return, per megalitre of irrigation water, of only $290 compared with the $680 realised in the remaining Australian states. There is significant potential to increase the returns from irrigated agriculture through the adoption of improved irrigation practices and technologies as well as the growing of higher value crops.

Australia/New South Wales Irrigated Agricultural Production 1995/96

COMMODITY	AUSTRALIA	NSW	PERCENTAGE
PASTURE & GRASS	$ 125 m	$ 74 m	59
CROPS FOR HAY	$ 35 m	$ 13 m	37
CEREALS FOR GRAIN	$ 365 m	$ 345 m	95
OTHER CROPS	$ 2314 m	$ 784 m	34
VEGETABLES	$ 1481 m	$ 172 m	12
FRUIT	$ 1324 m	$ 254 m	19
GRAPES	$ 614 m	$ 115 m	19
LIVESTOCK (MEAT)	$ 83 m	$ 57 m	69
LIVESTOCK (OTHER)	$ 1426 m	$ 291 m	20
TOTAL	$ 7766 m	$ 2106 m	27

Irrigation contributes 30% of the total agricultural production in the State, being generated from just over one million hectares of land. This is comparable to S Africa where the contribution of irrigation is also about 30% and the official irrigated area is 1.3 m hectare. Irrigation diversions account for 70% of water use in NSW as compared with 50% in S Africa. NSW is divided into nine regions for administrative purposes and the climatic variations mirror those of S Africa ranging from sub-tropical in the north to winter rain in the south. The coastal east has a high rainfall while the western interior is arid

In Australia surface irrigation at 70% of the total remains dominant but all established irrigation systems are in use. In NSW the irrigation of pastures for dairy production is of major importance. The surface irrigation of crops such as cotton by furrow irrigation in the arid areas is modern and labour effective and is reminiscent of the Western USA.

The similarities between NSW and S Africa are striking but there are also major differences largely on account of labour being scarce and expensive.

2) Functions of the Water Use Efficiency Advisory Unit, Dubbo, NSW

This unit, lead by Dr Austin and established in 1999, is in many respects unique. It is a joint initiative of the New South Wales equivalent of the Department of Agriculture and of Water Affairs and Forestry in South Africa. It is administered by the Department of Agriculture but has personnel from both departments and is jointly funded. It plays a key role in delivery of the agricultural components of the New South Wales water conservation strategy. The unit is accepted as being a well-informed neutral source of unbiased information and advice. The value of a neutral professional group of this nature to both departmental management and to the stake holders involved in difficult negotiations can not be over estimated.

The Water Use Efficiency Advisory Unit, located in Dubbo, is assisting irrigators to identify and move towards higher water use efficiency, and increase the value of irrigated agricultural production to the State.

The Unit is a joint initiative by the DLWC & NSW Agriculture, under the Government's water reform process. It plays a key role in delivery of the agricultural component of the NSW Water Conservation Strategy.

The primary functions of the Unit are to:

- Provide information to irrigators on irrigation methods and technologies and water access and licensing;
- Coordinate research activities relevant to efficient use of irrigation water;
- Collect and collate data from Australia and overseas on irrigated agricultural water use efficiency; and,
- Disseminate irrigated agricultural water use efficiency data to extension staff and related irrigation and water management organisations.

Examples of the Unit's activities in relation to the above functions include:

- operating a Freecall number (1800 255 444), an electronic discussion list, and contributing to seminars and workshops with client and stakeholder groups;
- providing technical input to underpin the conversion of 11,000 licences in unregulated streams from area to volume basis;
- documenting the availability, reliability and accuracy of information on the number of irrigators, the area irrigated, the water used, irrigated crop types, yields, values and irrigation method for each major river valley in NSW; and,
- Actively participating in the shaping of policies arising from the new Water Management Act, including development of State Water data collection protocols, and advice on access and use approvals. The water use approval process may provide a valuable mechanism for encouraging water use efficiency.

The Unit has also been successful in attracting $0.8 million funding for a project to assess 'whole-of-system' water use efficiencies in two, yet to be determined, NSW river valleys and recently has been commissioned to write the second in a series of Irrigation Insights publications for the National Program for Irrigation Research (NPIRD). The subject is Water Use Efficiency.

The Minister launched the Water Use Efficiency Advisory Unit on 24 February 1999 to assist irrigators achieve higher value of production with reduced negative impacts. The Unit had a staff of five, including a Technical Specialist and Advisory Officer with expertise in water use efficiency from NSW Agriculture, and two Resource Management Officers from the Department of Land and Water Conservation but has recently been expanded.

The creation of this unit has significance. It is a component of NSW Agriculture but includes personnel of the Department of Land and Water Conservation (NSW equivalent of DWAF) and has direct access to both Departments. Each of the 10 regions has two irrigation officers, one a technical specialist and the other a training officer directly supported in technical and policy matters by the Water Use Efficiency Advisory Unit. The unit is accepted by all concerned in this period of difficult negotiation as being a well-informed neutral source of unbiased information and advice. The value of a professional group with a direct line to both concerned departments, and no need for hidden agendas, cannot be overestimated.

3) The main features of the NSW Water Management Act 2000:

There are great similarities between the New South Wales and South African Acts but there are all-important differences in institutional and administrative arrangements for implementation. Probably motivated by the urgency of their situation New South Wales has followed a pragmatic approach to implementation. In practice the role of CMAs and WUAs have been incorporated in the Water Management Committees that were appointed for river valleys some two years before they were legalised by the Act. All water users are represented on these committees. A State water outcomes plan is developed that outlines the policy context, targets and strategic outcomes desired from the management and use of water. The Committees are required to develop Water Management Plans incorporating bulk access regimes (BARs), water sharing rules that will determine how much water will be available for extraction by licensed water users. The plan is then submitted to the minister for approval and becomes law valid for 10 years. The Act provides for compensation to be claimable if changes made during this term reduce the water available for extraction.

The negotiations for water sharing are placed squarely on the shoulders of the local community and they are expected to analyse the present situation and to develop management rules for the future. The minister must still approve the plan developed and support is provided during the process by organisations such as the Water Use Efficiency Advisory Unit. Where possible, hydrological a modeling will be undertaken but this is not a prerequisite. Practical workable solutions are acceptable. The deadline for the submission of the final Plans was December 2001.

This act has much in common with the latest S African legislation and the essentials are clearly spelt out in the leaflet ***Water Management Act-what it means for NSW***.

The Water Management Act 2000 is the culmination of the Government's water reform program. It was driven by the need for NSW to secure a sustainable basis for water management for several reasons:

- NSW is now at the limits of its available water resources - both licence embargoes over much of the State and our commitment to the Murray-Darling Basin Cap are causing uncertainty over access to water. However our major water using industries still depend on continued access to water.

- Clear evidence of degradation in our rivers, groundwater, floodplains and estuaries is seen in problems of water quality, loss of species, wetland decline and habitat loss. However urban, rural and industrial development is being continually sought to support future populations and businesses.

There are important differences between S Africa and NSW as far as institutional arrangements for implementation. In NSW there were local water management committees representing all water users in a "valley" and they started work on water management plans in 1998. These committees have been formalised and have been required to develop a Bulk Access Regime (BAR) for their area that will specify water-sharing rules. The implication of this is that licences legally binding for 10 years are now being finalised.

The position is further explained in the leaflet that deals with a number of aspects

The provisions of the Act provide real security for water users, which in turn will build confidence for business development. The major aspect of this is through the development of a Bulk Access Regime (BAR) for each water source. This is a new component introduced in the Act. Essentially a BAR is the water sharing rules that will determine how much water will be available for extraction by licensed water users. It will cover the environmental water provisions as well as various rules on how the system is operated.

The water management committees will be asked to make recommendations on BARs for the high priority rivers and aquifers. By December 2001, the initial BAR determination for these systems must be made by the Government.

As the BARs form the major component of a water-sharing plan, they will be in effect for a 10-year period. Users will be represented on the committee advising on the plan that defines the BAR. Further, the Act provides for compensation to be claimable if a change is made to the BAR during the term of the Plan that reduces the water available for extraction. All access licences will now be brought under these same provisions.

The role of the Act and the institutional structures are spelled out in greater detail

Water management plans are now to become statutory plans, ie. plans with a legal standing. Plans can be developed on any aspect of water management - such as water sharing, environmental protection, drainage management and floodplain management - for a proclaimed water management area.

A water management committee will be formally constituted by the Minister for Land and Water Conservation and will be given specific terms of reference defining the water management area, the nature of the plan required, and the timeframe for the plan.

Local water management committees have been working on water management plans since 1998. Existing committees will be established under the Act and provided with terms of reference dealing with the development of the bulk access regime.

The Act specifies the membership structure of water management committees and is designed to ensure a fair and balanced representation of all interest groups as well as the government. Water management committees must include water users, local councils, the Aboriginal community, environmental groups, catchment management interests, and the environment portfolio (ie. Environment Protection Authority and/or National Parks and Wildlife Service) and the Department of Land and Water Conservation, with an independent chair. Local representatives are to be appointed as far as possible. All members of the committees, both government and community, are equal partners.

The committees will be required to consult with the community during preparation of a plan. The draft plan submitted to the Minister will be placed on public display for comment and submissions for a 40-day period. Comments on the plan will be referred to the committee. The Minister makes a final plan with the agreement of the Minister for the Environment.

A water management plan will be effective for a 10-year period from the time it is gazetted. A plan will be reviewed in its fifth year to ensure that it is achieving its agreed outcomes. The Minister must also audit a plan at least every five years to ensure that its recommendations are being properly implemented. All public authorities are bound by the plans. This includes local government and State corporations.

It is within the water management committee process that options will be considered and recommendations formulated for future action on a variety of issues. A core part of this process is the requirement for the committees to consider the social, economic, cultural and environmental implications of recommended options and to assess the trade-offs required.

In providing advice on the Bulk Access Regime, the committees will be asked to start with any previously agreed environmental flow sharing rules and consider whether there is a scientific basis for varying these. Any recommended variations will need to address the likely environmental benefits provided and the possible socio-economic effects. The committee will consider all options and, after considering the trade-offs with each, provide a suite of recommended water

The water management committees will operate on a consensus decision-making basis.

A State Water Outcomes Plan will be prepared providing strategic direction and guidance for the committees. This will outline the policy context, targets and strategic outcomes desired from the management and use of water. This Plan will be prepared in draft form by April 2001 and when finalised will operate for a five-year period.

The NSW government will continue to be very much part of the process and have undertaken to provide technical and financial support

A Water Advisory Council to the Minister has been established. This comprises representatives of organisations covering the peak groups - NSW Irrigators Council, NSW Farmers, Nature Conservation Council, Aboriginal Land Council and others. The Water Advisory Council will advise on the State Outcomes Plan, and may review draft water management plans and the Department of Land and Water Conservation's implementation programs.

The government will continue to be represented on the water management committees and provide technical and financial support for their operation. Where possible, hydrologic modelling will be undertaken to allow the effects of water sharing options to be addressed by the committees, while environmental monitoring will provide better information for trade-off decisions. Socio-economic assessment of options will be provided.

The Department of Land and Water Conservation will also prepare implementation programs to ensure the water management plans can be put into effect and that the objectives of the plans are being achieved. The implementation programs are to be reviewed annually and the results published in the Department of Land and Water Conservation's Annual Report.

Organised agriculture in the form of the NSW Farmers'Association and NSW Irrigators' Council have their reservations about the functioning of the committees and expressed this in a news release.

> *The NSW Farmers' Conservation Committee chair says farmers in the bush need to see action to correct a committee process that in some cases is spiraling out of control.*
>
> *We have been telling the government for months how to get the committee process back on track, with four key measures.*
>
> *Government voting rights on the committee need to be removed, as the government gets ample chance to comment on draft plans when they have submitted to the ministers.*
>
> *Committees need to be truly representative of the local community with representatives who actually live and work in the area not flying-ins who impose an external agenda and have no stake in the outcome of the decision-making.*
>
> *The committees need clear guidance as to their statutory requirements, to end the confusion created by conflicting information from the Department.*
>
> *The final measure we have suggested to the government is to make sure that there are funds available to give committees non-regulatory tools to achieve their goals, including the buy-back of water for the environment.*
>
> *The government has a moral responsibility to share the financial costs of its reform process.*

4) Advice to Water Management Committees, Planning Parameters

This consists of a series of 15 pamphlets that set out the basic principles and regulations applicable to the implementation of the New South Wales Act. They are of value firstly because the whole process is clearly spelt out and one can very quickly become familiar with the process as it is being applied and secondly they illustrate the care that has been taken to fully inform the people who will be implementing the Act on the ground.
They deal with such matters as:

- managing releases from dams
- accessing flood flows
- constructing dams to harvest runoff water
- high-security licenses
- managing extractions from unregulated rivers and daily flow shares
- groundwater dependent systems
- freshwater flows to estuaries and coastal waters
- integrating water quality and river flow objectives
- conservation of biodiversity
- incorporating information on farm dams in the Water Management Plans
- Aboriginal issues and cultural heritage protection and water transfers.

The series of pamphlets (15 in all) entitled Advice to Water Management Committees is a well thought through guide to the committees that from the planning and control points of view will be filling much the same role as the proposed S African CMAs. It is felt that all concerned with the development of water management institutions will find the series valuable. It emphasis once again the possible benefits of close liaison between S Africa and NSW during these planning and implementation phases. Pamphlet titles with short notes on key content follow.

No. 1 Managing to Diversion Limits in Regulated Rivers

In all Murray-Darling systems, an **average annual diversion** limit for each regulated river will be determined. This then becomes the benchmark for auditing and reporting purposes.

The diversion limit will be established as part of the bulk access regime of the water-sharing plan. The bulk access regime will also include the water sharing plan's management rules - the environmental flow rules, rules for basic rights and water management arrangements for access licences. In the Murray-Darling Basin, the diversion limit must not exceed the Cap (the long term average water diversion based on the 1993/94 development and management).

The limit will be defined **as a** long-term average level of diversion which would result from the development levels and farm management assumed in the formulation of the water sharing plan and the water sharing plan's system management rules. The computer simulation model for each regulated river will be used to assess the resulting long-term average diversions.

No. 2 Supplementary Water Access

During wet periods or times of low water demand, natural inflows may result in dams overflowing or significant flows in regulated rivers. These uncontrolled flows provide for a range of environmental needs. They are important for maintaining general river system health and providing water for wetlands. Because they are naturally occurring high flows they also provide environmental triggers (season and temperature) for a range of ecosystem processes such as spawning and migration of fish.

When these uncontrolled flows exceed any immediate water needs and any specific environmental requirements as set out in the environmental flow rules they may be made available to licence holders on regulated rivers. Any water extracted is not debited against the licence holder's regulated allocation and therefore supplements their normal regulated allocation. In the past extractions of this supplementary water have been termed 'off allocation'.

Supplementary water is a significant source of supply, especially in the state's northern cotton valleys, and the way it is managed has major environmental consequences.

No. 3 Floodplain Harvesting

Harvesting can generally be put into one of three categories. Diversion or capture of floodplain flows using purpose built structures or extraction works to divert water into storages, supply channels or fields or to retain flows. Capture of floodplain flows originating from outside of irrigated areas using works built for purposes other then floodplain harvesting. Examples are:

- levees and supply works such as off river storages constructed in billabongs or depressions that fill from floodplain flows
- below ground level water channels from which the water is pumped into on-farm storages.

- opportunistic diversions from flood plains, depressions or wetlands using pumps or other means.
- capture of rainfall or runoff from farm irrigation fields, via tail water systems or other means, is not floodplain harvesting.

Floodplain harvesting can no longer be left outside of the State's water management and compliance system or as a source of increase in further water diversions. Given this, it is the Government's intention that floodplain harvesting works and taking of water from floodplains be licensed and managed. It will take a number of years to complete the process. However, the water sharing plans must signal the basic principles that will govern the process.

No 4 Regulated Rivers (High Security) Access Licences

Under the Act higher priority means that, if water allocations have to be reduced, the water allocations of the higher priority licence are to be reduced at a lesser rate than the water allocations of the lower priority licence.

Note that local water utility, major utility and domestic and stock licences are not subject to the principles in this advice note. This is because the WM Act requires that they be given a higher priority status than regulated rivers. Drought management strategies will be developed in consultation with individual local utility licence holders; and major utility licences may have individual water supply reliability and management conditions specified as part of their licence arrangements.

No. 5 Managing to diversion limits in inland unregulated rivers

In 1994, the Murray-Darling Basin Ministerial Council undertook an assessment of water diversions across the Basin. This found that the levels of diversions at that time were placing stress on both the environmental health of our river systems and the reliability of supply to water users; and that diversions were continuing to increase. In response, a diversion limit - the Murray-Darling Basin cap - was introduced in 1995.

The cap means that water diversions are limited to those that would occur had the water management rules and the level of development remained as they were in 1993/94.

The NSW regulated rivers in the Murray-Darling Basin have been subject to cap auditing and action for a number of years. The initial focus on the regulated rivers and was because they represent the majority of water use in inland NSW, and because the licences were already volume based and diversions were metered with good records of past use.

Now that licences on the unregulated rivers have been converted to a volume basis, and with meters to be progressively installed to measure use, cap levels and monitoring of diversions can be applied on the unregulated rivers.

The Department of Land end Water Conservation will shortly be commencing the metering program in unregulated rivers starting with those for which initial water sharing plans are being prepared. The department anticipates that most pumps in the Murray-Darling Basin will be metered by mid 2004.

No. 6 Water extraction volumes and daily flow shares in unregulated rivers

During 2000, most irrigation licences on unregulated rivers were converted from an area basis to a yearly volume basis. All other river licences are also being converted to a yearly volume entitlement.

The volumetric conversion provides water users with greater business flexibility and establishes a better basis for managing river flows. However, the yearly entitlement does not, on its own, fully define users' access to water. Nor can it provide sufficient protection of the water needed to maintain the environmental health of our rivers. Water must be specifically allocated for environmental needs. So while the establishment of a volumetric entitlements is a critical first step, it will be necessary to now progressively move to define access to water for the unregulated rivers on a daily flow basis.

No. 7 Diversion limits for coastal unregulated rivers

A diversion limit is a limit to the amount of water which can be extracted from one or more water sources, expressed as an annual average. On the coast it is proposed that the limit should relate to extraction by licences, and that extraction under basic water rights should be considered and managed separately.

Diversion limits apply to a diversion management unit which can be one or more sub-catchments or water sources. Each diversion management unit will have a diversion limit which applies to the unit as a whole. This means that it will not be aligned to the individual water sharing plans for each water source, but will encompass groups of water sources.

Generally diversion management units will be major river valleys such as the Clarence or the Manning

No. 9 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems are communities of plant, animal and other organisms whose extent and life processes are determined by groundwater.

Some examples of ecosystems which depend on groundwater are:

- wetlands;
- red gum forests, vegetation on coastal sand dunes and other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

Ecosystems vary dramatically in how they depend on groundwater, from having occasional or no apparent dependence through to being entirely dependent. The unique ecosystems which

depend on the mound springs of the Great Artesian Basin, for example, are entirely dependent on groundwater which makes them very vulnerable to local changes in groundwater pressure.

No. 10 Freshwater flows to estuaries and coastal waters

Freshwater inflows from the upper catchment influence estuaries and coastal waters in many ways. They are a major determinant of the environmental conditions in estuaries due to their impact on salinity gradients, estuarine circulation patterns, water quality, productivity and the distribution and abundance of many species of plants and animals.

Considering the scope of its effects, freshwater inflow is one of the more important factors influencing estuary health today.

Freshwater flows also affect the availability of food for organisms at the base of an estuary's food web. They do this in at least two ways by influencing the abundance and distribution of prime organisms within an estuary's waters, and by affecting the influx of organic carbon and freshwater to the estuary and coastal waters from outside sources.

As a result, estuaries are diverse, dynamic, productive and highly valued ecosystems.

No. 11 Integrating water quality and river flow objectives in water management plans

Water Quality and River Flow Objectives are a crucial part of the agreed framework to guide, plans and actions to achieve healthy rivers in NSW. As Water Management Committees now focus on developing Water Sharing Plans for priority rivers, River Flow Objectives provide an essential tool to assist in developing flow rules that provide for the management of the riverine system as a whole.

Whilst Water Sharing Plans cannot address all elements of water quality in a river system, implementing key River Flow Objectives can protect the components of the natural flow regime which positively influence water quality. In this way, the protection and enhancement of water quality can be a key outcome of Water Sharing Plans.

No. 12 Conservation of biodiversity and threatened species development

Conservation of biodiversity can occur at the species, population, ecological community or landscape scale.

The State's rivers, lakes, estuaries, wetlands and floodplains form complex ecosystems and are an integral part of them. They support a diverse range of plant and animal species and communities that depend on natural processes for survival.

Regulation of free flowing rivers and water extraction and diversion from rivers and aquifers have changed natural water regimes, adversely affecting many water dependent species, ranging from aquatic invertebrates, amphibians and reptiles, fish, and birds (including waterfowl).

No. 13 Incorporating the results of the weir review into the water sharing plans

There are 3328 licensed dams and weirs on freshwater rivers of NSW. These structures provide water supply to towns and properties but this has been at a significant environmental cost. The structures can reduce water quality, obstruct the passage of native fish and create an environment that favours introduced species, such as carp.

The NSW Weirs Policy was developed to 'halt, and where possible, reduce and remediate the environmental impacts of weirs. A 'weir', under the Policy, is defined as a structure (including a dam, lock, regulator, barrage, causeway or floodgate) across a defined watercourse that will pond water, restrict f low or hinder the movement of fish along natural flow paths, in normal flow conditions. This definition therefore incorporates more structures than the 3328 licensed dams and weirs above.

The State Weir Review Committee (SWRC) *is* responsible for overseeing the implementation of the NSW Weirs Policy and the development of a program to assess the current status of weirs in NSW. This program is known as the 'Weir Review Program' and was established in November 1998.

The Department of Land and Water Conservation (DLWC) coordinates the Weir Review Program for the SWRC, the aim of which is to examine the impacts of existing works and to develop a strategy which would lead to benefits for the environment. This will be achieved by first undertaking an initial assessment of all weirs throughout the State, and assessing each weir against a set of established criteria.

From the results of this initial review, options for modifications to a weir will be explored. These might include structural changes, changes in weir operational rules, installation of a fishway, or removal of the weir. However, weirs will not be removed or changes made, without consideration of the needs of the communities they serve and the socio-economic impact of removal.

NSW Fisheries carried out the initial review of licensed weirs in NSW. This review was completed in 2000 for all catchments. The initial review included a desktop assessment and site inspection of each of the structures. Recommendations on the management options to reduce the environmental impacts of each structure were recorded. A report and photograph of each structure has been produced and will be incorporated into a Weir Review report for each catchment.

No 14: Aboriginal issues and cultural heritage protection

Aboriginal people have a close association with the Australian landscape that is tens of thousands of years old. Over this time, the land has been a source of both physical and spiritual sustenance, evident today through unique cultures and heritage, that features both tangible and intangible aspects.

Rivers, floodplains, billabongs, marshes, swamps, lakes and mud f lots have traditionally been resources of water and food (fish, crustaceans, oysters, grasses, tubers, fruits, kangaroo, birds, snakes etc), as well as traditional medicine plants. Additionally, the waterways themselves provide travel routes, particularly in the summer months or during periods of drought

Activities to maintain water quality and facilitate resource acquisition include:

- constructing stone fish traps;
- clearing sink holes to retain water during periods of low f low (eg summer);
- identifying the location of water holes in remote dry regions with stone cairns; and
- conducting practices to prevent water fouling.

Being able to use natural resources and maintain the strong spiritual links to the landscape are important issues for Aboriginal people.

No. 15 Water transfers

Temporary transfers apply to all or part of the water allocations that accrue to an entitlement, from one licence to another. It is achieved by adjusting the buyer's and seller's water accounts in accordance with the amount of water transferred. It does not result in any long-term changes to the licensed entitlements of either the buyer or seller.

Permanent transfers involve the permanent reduction of the seller's entitlements and the issue of a new entitlement to the buyer.

All transfers must be approved by the Department of Land and Water Conservation.
Water management committees should consider the importance of water transfers. With licence embargoes in place on most river end aquifer systems, transfers are an increasingly important aspect of water management. They are the means by which new or expanding businesses can obtain access to water. They also provide greater flexibility for existing businesses in how they can most effectively use their water entitlements.

5) State Water Management Outcomes Plan and Water Sharing

The state Water Management plan sets the overarching policy context, targets and strategic outcomes for the development, conservation, management and control of the state's water resources. The plan promotes the objects of the Act and its water management principles, and seeks to give effect to the governments salinity strategies. It is also consistent with government obligations, Commonwealth international agreements and government policy. The plan provides clear direction for all water management action including the creation of water sharing and other Water Management plans addressing water use, drainage management, flood plain management, controlled activities and aquifer interference, and environment protection. The plan has effect for five years from its date of gazetall at which time it will be reviewed and updated.

In some cases the plan sets out what might be termed enabling targets. These typically require mapping and assessment to be completed within a specified period as an essential prerequisite of expected management action. The documentation included in the appendix is confined to the five-year target outcomes that are, in fact, very specific. **This appears to be a bold and innovative move to ensure inter-departmental co-operation by establishing agreed detail guidelines before implementation of action. The agreement of the relevant Ministers is required ensuring top-level participation and authority for action.**

6) Integrated Quantity and Quality Model (IQQM)

IQQM is a hydrologic modeling tool developed by the NSW Department of Land and Water Conservation (DLWC), with collaborative assistance from the Queensland Department of Natural Resources (QDNR). It is intended for use in investigating the impacts of water resource management policies on stakeholders. For example, it can be used to investigate and resolve water-sharing issues at the inter-state level and it can be used to investigate water-sharing trade-offs between competing groups of users, including the environment.
There are several computer models currently being either applied or assessed in S Africa and it is not known if IQQM is known here. If this is not the case it might, in the light of the similarity between the acts and the countries, be worthwhile to initiate liaison with NSW.

The notes that follow have been extracted from the introduction to the booklet on the program.

IQQM can be applied to river systems with and without dams, and is designed to be capable of addressing water quality issues as well as water quantity issues. It can also be used to investigate new water resources developments or modifications to existing developments.

The model operates on a continuous basis and can be used to simulate river system behaviour, including water quality, periods of hundreds of years. It is designed to operate at a daily time step but some processes can be simulated at time steps down to one hour.

IQQM is structured as a modelling shell with component modules linking together to form an integrated package. Each component of IQQM has been designed in a modular form with emphasis on structure and efficiency of coding.

The structure of the coding facilitates the incorporation of additional features and component modules as required. The model is configured to run under 32-bit Windows platforms on high performance personal computers.

Flexibility has been achieved by using advanced programming techniques (dynamic memory allocation and pointer array addressing). The selection of computational algorithms for IQQM was based upon the practicability of obtaining calibration data and computational efficiency. Proven modelling techniques have been used where available.

IQQM is operated via a 32-bit Windows based, interactive menu system developed with support from QDNR.

The main menu gives access to eight modules:
River system model,
Rainfall-runoff model (Sacramento Model),
Gate operation model,
Climate model,
Graphical output tools,

Statistical analysis tools,
Data retrieval and utilities, and
System set up (for configuring IQQM for a computer).

7) National Action plan for Salinity and Water Quality

This action plan identifies as a high priority, immediate actions to address salinity, particularly dry land salinity, and deteriorating water quality in key catchments and regions across Australia. The goal of this action plan is to motivate and enable regional communities to use coordinated and targeted actions to prevent, stabilise and reverse trends in dry land salinity improve water quality, and secure reliable allocations for human uses, industry and environment. **South Africa does not have the same salinity problems as Australia but the documentation of the process is valuable. It is a massive national project and South Africa has other problems such as the renewal of rural villages that requires comparable action**.

8) The National Programme for Irrigation Research and Development

The National Program for Irrigation Research and Development (NPIRD) is one of 16 Programs administered by the Land and Water Resources Research and Development Corporation (LWRRDC). The Program involves partnership funding from irrigators and State Agencies in NSW, Victoria, Queensland, and Western Australia. In addition, the Federal Government contributes to the partnership through LWRRDC and CSIRO Land and Water. NPIRDs mission is to provide leadership for national irrigation research and development facilitate the effective transfer of this knowledge by participatory involvement and improve natural resource sustainability, economic viability and environmental quality.

It is assumed that the WRC is fully aware of the initiatives planned by NPIRD. Those relating to technology transfer appear to be particularly appropriate.

9) Technology transfer: Commodity oriented technical support

The ability of the government authorities to technically support the various branches of irrigated agriculture in NSW is falling short of the requirements arising from changing circumstances. More and more the industries are themselves assuming a large measure of this responsibility. One of the first to this task is the all important cotton industry and they have developed a comprehensive draft Best Management Practice manual to meet this need. The draft manual has been submitted to the Irrigation Efficiency Unit for editing and authoritative recommendations. Despite the limited capacity of government to undertake all the necessary support, industries in Australia recognise the important contribution that can be made by government technical personnel and an effective partnership has been built up over the years.

Effective management of land and water resources requires growers to be familiar with the resources on the farm, and to plan for the use of these resources. The core best management practice for land and water management is to develop a plan that describes the resources of the farm, and how these are to be used sustainability. This type of plan is often called an

irrigation and drainage management plan. The guidelines are not confined to irrigation and water management but deal with all aspects of cotton production. It is an authoritative "how to do it" regional guide for the irrigation farmer. There was a time when similar publications were developed in South Africa, although few focused on irrigation. The secret is probably that the first priority then for experienced senior staff was the production of manuals of this nature for the farming community. Times and priorities have changed and few now have the necessary scientific knowledge combined with practical on-the-ground experience that is required.

The introduction to this draft best management practice manual is worth quoting in detail because it indicates the direction in which technology transfer is moving in Australia.

> Successful cotton production relies on the sustainable use of land and water resources. Soils, water, and crops need to be managed so that the farm is profitable well into the future, and so that the risk of any adverse environmental impacts is minimised.
>
> Effective management of land and water resources requires growers to be familiar with the resources on the farm, and to plan for the use of these resources. For example, the types of soil found on the farm, and their condition will affect how those soils are managed. Similarly, the quality of water available for irrigation can affect how that water is best used. The core best management practice for land and water management is to develop a plan that describes the resources of the farm, and how these are to be used sustainably. This type of plan is often called a land and water management plan or an irrigation and drainage management plan. Both the New South Wales and Queensland governments have developed guidelines for the development of these plans. Plans consist of a farm map and overlays, and written information on land, water and crop management.
>
> The planning guidelines and practices outlined in this module are consistent with these government guidelines. Growers who have addressed the issues outlined in this book will have gone a long way to meeting any legal requirements for land and water management established under state government legislation.
>
> Many growers will have already adopted the practice as recommended in this booklet. Recording these practices and a plan provides evidence of good practice, and can be used to make changes and improvements in the future

This approach mirrors that of the South African Demand Management Strategy being implemented by the Department of Water Affairs and Forestry. Essentially, what is provided is a comprehensive guide to cotton production including irrigation and water management. People with scientific knowledge and a wealth of practical experience have written it. The document comprises sixty-four pages and for that reason the appendix includes only the table of contents to provide a broad overview of the subjects covered. The only possible criticism is that the sections dealing with irrigation are too generalised.

It is recommended that the possibility of developing similar manuals for South Africa covering the main commodities should be assessed and this should include incorporating in-depth irrigation guidelines.

10) Technology transfer: Water Wise on the Farm training

This training is part of Water Wise on the Farm programme, an education and awareness programme that promotes the adoption of best irrigation management practices and technologies. Water Wise on the Farm aims to provide farmers with basic irrigation skills. The course program consists of four workshops:
Assessing your soil and water resources
Evaluating your irrigation system
Scheduling and benchmarking
Irrigation and drainage management planning
The complete program should require about 18 hours of attendance spread over four workshop sessions and about 8 hours of the farmers time assessing the soils and irrigation system on his own property.

The Introduction to Irrigation Management course is aligned to formal competencies developed by the Irrigation industry and ratified by the Rural Training Council of Australia (RTCA). Consequently to be assessed as 'Competent" in the topics covered there is some assessment. This takes the form of workshop activities, discussions with the trainer and some activities to complete at home. There are no exams or tests!

The training follows the modern pattern of competency-based training and the courses are aligned to *National Competency Standards*, those successfully completing, can seek *Recognition of Prior Learning* (RPL) towards formal qualifications in Agriculture or Horticulture.

Each of the nine regions in NSW has a technical irrigation specialist and a training specialist who runs the courses in the districts. The course material is outstanding and includes trainer manuals, detailed course notes and related practical exercises, and complete competency specifications and evaluation procedures. All usual irrigation methods are catered for but only one irrigation method is dealt with on a course. The courses are aimed at farmers and the instructor has ample opportunity to pass on his own field experience.

We have nothing like this in South Africa. The courses are generic in that they are as applicable to South Africa as they are to NSW. There would probably no objection to using the information that obviously represents many months of preparation but this will only be effective in conjunction with appropriate infrastructure and man power. It is possible that this could be a private sector initiative.

11) Scheduling and Benchmarking

It is apparent that the NSW specialists and the irrigation industry are fully aware of scheduling techniques including the most advanced developments. The farmer training programmes include excellent information and "hands on" practical work on scheduling principles. At the same time one gains the impression that the number of farmers actually "scheduling" is confined to the limited group producing high value crops and applying intensive methods. In other words much the same position as in S Africa.

Development in Australia has concentrated on scheduling based on the measurement of soil water content and a wide range of instruments and attendant software is available. The

equipment is well known in S Africa where it has been effectively marketed. The application of weather data base methods has received less attention although training course content on the principles of weather data based methods cannot be faulted.

A matter discussed in detail with Dr Austin on his visit was the concept of "scheduling" and why so few farmers are prepared to apply available methodology. Atmospheric evaporative demand fluctuates violently from day to day, quite impossible to map or follow, but over a week or a month this smoothes out and, unless there are exceptional weather systems, seasonal variations are not great.

It has been found in S Africa that it is possible to irrigate according to a pre-season programme that can even go as far as justifying equal applications weekly right throughout the season! The empirical computer model BEWAB enables pre-season programmes to be drawn up and has produced exceptional results in the extensive area where it was developed. All that is required of the farmer is to keep a record of the depth of irrigation water applied on a weekly basis and to correct if the depth applied is not in line with the programme. In the case of pressure systems a rain gauge is placed in the field and read weekly. In addition the profile water content should be checked periodically for major deviations, using an appropriate method.

Rain can present a problem but in the more arid areas the pre-season programme is set-up in terms of "water in the rain gauge", irrigation or rainwater. A methodology, nick-named "dipstick", has been developed to a fine art in the semi-arid area along the Orange river by the Douglas Cooperative and this year is mandatory over an area of some 20 000 hectare of centre pivot wheat. The Cooperative develops the crop factors for a range of crop varieties and planting dates, a task simplified by the application of the FAO four-stage crop factor curve as built into SAPWAT. The pre-season programmes can also be set up in accordance with various irrigation methods and application strategies by running these scenarios on SAPWAT or if warranted on SWB. During the season the Cooperative each week calculates the water use for each cultivar, variety and planting date utilising the Penman Monteith reference evaporation calculated from an automatic weather station and the matching crop factor. This is sent to farmers by e-mail, fax or telephone. The farmer can see immediately if the demand during the past week was as targeted or above or below and can make minor adjustments to irrigation application depths during the coming week to compensate. Nobody tells the farmer to add so many mm of water that is left to him.

It is important that the water content of the profile be checked periodically, just as one needs to check the oil level of an engine, and hence the name of the neutron probe service provided by the Cooperative viz. "dip stick". Before commencing this service the technicians of the Cooperative determine the water release curve of the soil and the farmer is regularly provided with a table and graph indicating the progressive "oil level" throughout the season.

The NSW training course material is an excellent introduction to the principles of scheduling but depending on the experience of the instructor may leave the farmer up in the air and not sure as to what to do next. It is understood that the courses have appealed to the smaller and newer farmer and experience has shown that the "dipstick" a first step in scheduling, is acceptable to virtually all farmers. This, or something like it, could be a next step following on after training in NSW. This would appear to be a situation where S Africa could use the training developed by NSW and NSW could use the technology that in this case has been refined in S Africa.

12) Estimating Crop Irrigation Requirements for Volumetric Conversions

New South Wales is implementing the new Water Management Act 2000 and the volumetric conversion process has established annual volumetric entitlements based on representative crop 'classes' and climatic zones. The calculation method is based on A-pan evaporation and crop factors utilising a water balance model and because the State has been divided into relatively compact climatic zones and there has been extensive consultation there is no reason to doubt the validity of the estimates. However, they remain estimates.

The NSW authorities appreciate that there are vulnerabilities in their procedure and have created an independent anomalies review panel to cater for appeals. Anomalies must be based on verifiable differences in water usage compared with the typical requirements. A disagreement with the general crop conversion rates for the specific climatic zone, or with the process as a whole, is not enough to form the basis of an anomaly. One of the difficulties with the type of model applied is that it is not transparent. It is difficult to explain anomalies and to arrive at agreed and motivated compromises.

This task is very similar in principal to the one currently being undertaken by DWAF in S Africa where "normal" irrigation water usage by farmers outside of schemes and irrigation boards, where current quotas are accepted, are being registered together with what were previously "private" water sources. In South Africa DWAF had nominated SAPWAT as the program to be used for registering irrigation water use and selected DWAF staff and consultants were trained in the use of the program before the onset of the interviews. Regional DWAF staff have developed SAPWAT spreadsheet schedules for crop irrigation requirements for the sub-zones in their provinces. These schedules are similar to the ones generated by NSW but include monthly values to facilitate discussion with irrigators and are based on the characteristics of crop varieties and the irrigation methods and strategies practiced in the sub-zone. If in the course of discussion an irrigator queries the default values his practices and conditions are run through with him on the computer and if it is apparent that he has a valid point it is accepted and a printout of the figures attached to his file. The big advantage of SAPWAT is its transparency and simplicity. Staff are requested to report valid modifications back to the SAPWAT website for possible incorporation in the program.

License holders on regulated rivers in NSW (those with major dams controlling releases for irrigation) have operated under a volumetric system for many years. However, the 11 000 or so license holders on unregulated rivers are now being 'converted'. Different conversion rates apply in different parts of NSW. This is because crop irrigation water requirements and the crop types that can be grown, vary considerably with rainfall, temperature, and evaporation rates.

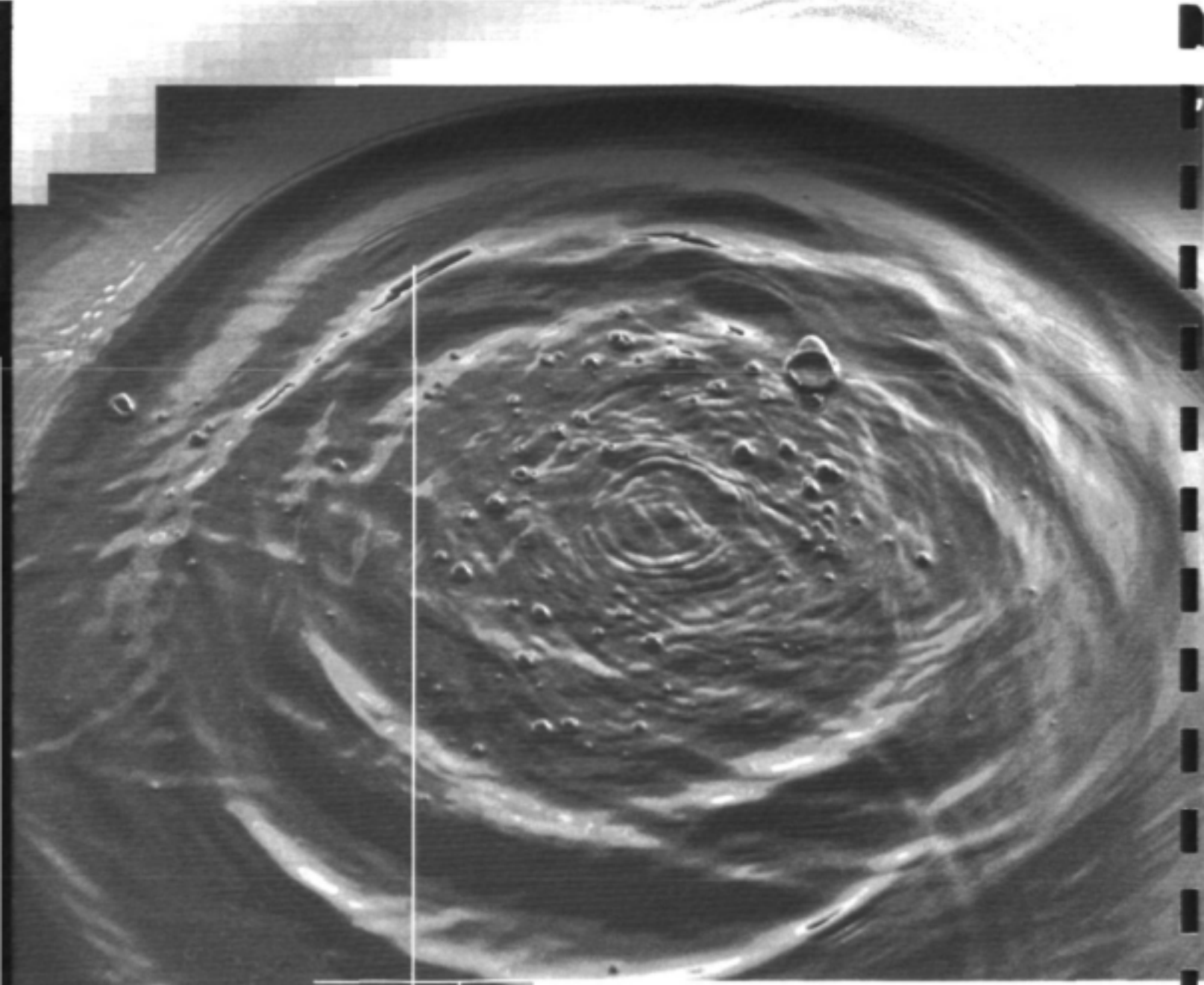
Rates for different crop classes in NSW have undergone a thorough review since the draft rates were prepared. This was done by a joint task group of Department of Agriculture and DLWC staff.

It is conceded, given such a wide range of irrigation and water use practices, that it is inevitable that some license holders will consider that the volume is not appropriate to their specific situation. That is, they believe there is an anomaly - something different or special about their circumstances. For this reason the government will be establishing an **independent anomalies review panel** to deal with special cases. Some irrigators may be

able to substantiate water usage that is higher than the relevant conversion rate but with the methodology being applied this may prove difficult in practice and this can lead to conflict.

SAPWAT is a Water Research Commission funded S African development of the internationally accepted program CROPWAT and is designed to facilitate the estimation of crop irrigation requirements and the planning and management of irrigation projects. It is based on the Penman-Monteith short grass reference evaporation and the four-growth stage method for developing crop factors according to established norms, the FAO procedure. SAPWAT is an advance on CROPWAT in that by incorporating the facility to manipulate crop factors, quantify the effect of partial surface cover and wetted area, separate treatment of transpiration and evaporation and new approaches to irrigation efficiency it is possible to simulate most irrigation methods and strategies. This has been achieved without losing the user-friendly characteristics of CROPWAT that have made it so well accepted. SAPWAT makes it possible to rationalise anomalies so reducing the danger of conflict.

Dr Austin is, particularly after his trip to the USA, thoroughly well informed on the alternative methodologies available and he and Mr Crosby are in complete agreement on the application of atmospheric demand procedures. It must be realised that conversion rates are at best a compromise and the methodology applied will depend on the situation facing the officials managing implementation. Dr Austin has still to submit his report but it is suspected that in due course NSW will leap frog SAPWAT and develop a GIS based procedure incorporating similar principles. Should this be achieved it could become the next international standard.



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