Australian Government
Department of the Environment, Water, Heritage and the Arts

RURAL PLAN

NATIONAL AUDIT OF ON-FARM IRRIGATION INFORMATION TOOLS

FINAL REPORT FOR THE AUSTRALIAN GOVERNMENT DEPARTMENT OF THE ENVIRONMENT, WATER, HERITAGE AND THE ARTS.

Prepared by: **Murray Chapman, Liz Chapman, and David Dore**
RuralPlan Pty. Ltd.
968 Baddaginnie-Goomalibee Rd., Goomalibee Vic 3673.
Phone: (03) 57633214. Email: rplan@benalla.net.au

This report should be cited as: Chapman, M., Chapman, L., and Dore, D. (2007). National Audit of On-farm Irrigation Information Tools. Final report prepared for the Australian Government Department of the Environment, Water, Heritage and the Arts by RuralPlan Pty. Ltd.

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Commonwealth Government, the Commonwealth Minister for the Environment, Heritage and the Arts or the Commonwealth Minister for Climate Change and Water. This project was funded by the Australian Government Department of the Environment, Water, Heritage and the Arts through the national water plan.

Published by the Australian Government Department of the Environment, Water, Heritage and the Arts. Printed on recycled paper, March 2008.

“If we lose our soil moisture data for more than three days, the farm is blind”

Johan Mouton, Citrusdal, South Africa

CONTENTS

EXECUTIVE SUMMARY

This project was instigated to undertake a national audit of on-farm irrigation information tools. The outcomes of this project will be used to assist in improvements to water use efficiency.

A contact list of relevant government agencies, industry organisations, researchers and other key regional stakeholders was developed and contact made outlining the project and requesting input. At the same time a desk top study was commenced to identify irrigation information tools and initiatives. From the initial contact with 257 stakeholders, multiple discussions were held with 139 contacts over a four week period. The desk top study and the semi-structured interviews and general discussions informed each other, and a picture was built up of the mechanisms in practice throughout Australia to optimise water use efficiency on-farm. These include initiatives by industry and governments to achieve changes on-farm by resourcing irrigation assessments, the research and development of comprehensive Whole Farm Management Plans, cost-share grants for improvements to the irrigation system and providing specialist extension personnel to work with irrigation managers on improving irrigation decision making. Considerable investment has also been made in developing web-based knowledge bases, as well as hard copy and electronic "how to" information. Over the past few years Irrigation Australia Limited has developed and implemented a vocational approach to irrigation practice and irrigation systems audit.

There is a vast array of equipment that allows the irrigation manager to receive objective data on every water input and output within the farm water system. There are many examples of equipment being under-used by managers because of the time and investment required to make full use of the equipment or because the data produced did not 'ring true' to the farm manager. This is a substantial issue as it could indicate that the equipment has not been correctly calibrated, that the farmer knows that variability across the farm outweighs the point-source data, or that indeed the data is correct and the on-farm practices could be improved. Figuring out the difference between what the data says and what the farmer knows is time consuming but important work.

Measuring and monitoring flow rate, soil water balance, the weather and crop use in the field was for some time seen by technicians as delivering all the information necessary for irrigation managers to make decisions to minimise water losses and optimise water use efficiency. However in seeking to account for the slow uptake of such equipment, the complexity of decision making and the importance of local knowledge have been brought to the fore. Instead of being promoted as the 'be all and end all' of decision making, measuring and monitoring equipment is now recognised as providing valuable input data into more complex calculations. Research agencies and developers of commercial technologies have moved to add value to their equipment by developing information tools that take a range of input data.

An "irrigation information tool" helps transform various data inputs into valuable information for irrigators to optimise their water use efficiency. The tool may be used by the irrigator or by a third party such as a consultant or engineer. The key feature is that it will help provide the very best information for decision making that can be expected to optimise water use efficiency. One hundred and twenty three tools were identified that fit one or more of the following categories:

Forecasting and Record keeping tools

- Tools in this category focus on water budgeting (seasonal, monthly and daily) and financial budgeting; predicting future crop performance and what crop should be grown for a given water allocation; benchmarking water use efficiency; predicting future water availability; costing irrigation systems; irrigation system and equipment performance; forecasting future farm water needs and the risks associated with trading water; data manipulation, storage and display, and seasonal climate outlooks.

Storage and Delivery

- These information tools focus on scenario planning for infrastructure, seepage and evaporation losses, efficient management of storages, costs and benefits of seepage and evaporation control, and design of earthworks.

Controlling water on and off the paddock

- The focus of these tools is on the efficiency of the application including the uniformity of surface application and depth in the soil profile, calibration and efficiency testing of sprinkler and siphon systems, surface and sub surface wetting front detection, soil water capacity, micro system design, water infiltration rates and wetting patterns, optimisation of watering time and layout effects of excessive tailwater and drainage losses for both water and nutrients.

Crop Water Use

- These information tools focus on crop water requirements at various plant physiological stages and climatic zones, determination of refill and full points within the soil profile, optimum irrigation scheduling (seasonal, monthly and daily time steps) and water consumption tracking, crop yield estimates based on different levels of water availability, effects of crop over-watering on yield and nutrient loss, daily Evapotranspiration (ET) and alert systems for daily ET and irrigation scheduling, crop demand models to assist in farm water budgeting, salinity leaching calculations, and refinement of crop coefficients.

The tools demonstrate the array of factors that the manager must consider in his or her decision making if they are to be profitable, sustainable and water use efficient.

The audit has identified a number of tools that operate very effectively. These range in complexity from simple tools that only undertake one task (such as the spreadsheet to calculate distribution uniformity of a centre pivot irrigator, the 'Centre Pivot Calculator') to models that predict crop water demand and devise the irrigation schedule to match it, taking into account short term weather forecasts (e.g. 'Irrigation of Vegetables on Sands', 'VineLOGIC' for viticulture, HydroLOGIC for cotton, 'Yield Prophet' for a variety of crops). More complex models (such as APSIM and SWAGMAN) are also necessary as ways of hypothesising and testing new irrigation and agronomic practices without the expense of field testing and these have a substantial on-going role. Many tools have been identified that have a narrow focus, but operate very effectively in meeting their particular objective. Tools which are flexible in their data demands, such as being able to use either daily or monthly average weather data, are more beneficial and less intimidating than those that are difficult to parameterise. Similarly, a number of the best tools have many default or typical values that make them easy to use. For example the 'Farm Enterprise Budgets' produced by the NSW Department of Primary Industries identify all of the key variables for particular farm businesses and supply average values for the industry.

Another important factor in assessing the utility of the tool has been to assess whether there is a substantial community of users for the tool. User support and the possibility of group learning are critical to maximising the value of many of the tools described in the audit.

1. INTRODUCTION

Optimising water use efficiency on-farm can require adjustments or changes to the enterprise's infrastructure and/or management. From the time water is taken from the river, channel, aquifer or from overland flow, it can be lost or wasted in many ways. This report considers the initiatives, information resources, equipment and tools that are currently available to help optimise on-farm water use and profitability.

The range of data, information and knowledge that the farmer needs to collect and collate to be a skilled irrigation manager is considerable; and ranges from:

- Objective data from equipment such as soil water monitors and weather stations,
- Historic records that enable forecasting of crop yield, financial returns and rainfall events,
- Agricultural and local knowledge of the crop cycle, and especially of the critical periods of plant physiology when, for example, crop stress should be avoided, and
- Engineering understanding of the irrigation system; its limitations and potential.

There are so many factors involved in better managing water on-farm that an understanding of the whole system is necessary. The farm and irrigation system is described in Chapter 2 **Optimising on-farm water use efficiency**.

Public and private agencies and organisations have invested in initiatives to optimise on-farm water use efficiency, and to develop information tools to aid on-farm decision making. **Recent initiatives** are described in Chapter 3.

Many state government agencies and industry bodies have produced training resources, detailed crop or weather information, best management practice guidelines and fact sheets. There are certified training courses for irrigation consultants and managers. These are described by category in Chapter 4 "**Training, Guidelines & Fact Sheets**".

Measuring and monitoring equipment can take many forms, and there is today an excellent array of equipment that provides on-farm objective data. The range of equipment, their uses and limitations, are described in Chapter 5 "**On-farm measuring and monitoring equipment**".

The vast range of 'inputs' that the manager must consider is complex. Public agencies and private companies have responded with the development of tools to undertake calculations and modeling to produce information that both simplifies and adds value for the farm manager. An irrigation information tool helps transform various data inputs into valuable information for irrigators to optimise their water use efficiency. The tool may be used by the irrigator or by a third party such as a consultant or engineer. The key feature is that it will help provide the very best information for decision making that can be expected to optimise water use efficiency.

The range of tools is discussed and summarised Chapter 6 "**Audit of Information Tools**". Full descriptions of each tool are in Appendix 1. A **discussion** of our findings, including the types of tools that are best placed to improve on-farm water use efficiency, appears in Chapter 7.

Throughout this report the following categories are used:

Forecasting & Record Keeping

To be able to achieve improved water use efficiency there is a need to measure, monitor and record both farm and external inputs and outputs. This provides the basis for establishing baselines and benchmarking for a range of indices, future water budgeting and scenario planning. Common data that is required includes — weather records, water use and crop yields by paddock, capital costs and annual budgets, whole farm plans and implementation records. Without these records it is difficult to use some irrigation information tools or understand why there may be variations in yield within a paddock.

Storage and delivery

This includes evaporation and seepage management. There are a number of tools that are focused on measuring evaporation from farm dams and measuring the amount of water delivered on farm. This subset of tools is not very large in this audit because investigations into managing evaporation are at a relatively early stage, and also because much of the software that exists to manage and control delivery of water is designed for water supply companies external to the farm-gate.

Controlling water on and off the paddock

Broadly speaking there are two ways of deciding when to irrigate a crop — irrigators either use some measure of the 'wetness' of the soil to determine when next to irrigate, or they estimate the crop's water needs.

There are a number of technologies that measure soil moisture. These are documented in the extensive review by Charlesworth (2005). Measurement of absolute soil moisture is simple, but the challenge is to measure plant-available water (PAW), that is the amount of water that the plant roots are able to extract from the soil. All instruments only measure an approximation of PAW.

Information to control water on and off the paddock can come via radio links directly from instruments in the ground, it can be manually collected by reading from the instruments out in the field, it can come by measuring the depth of irrigation water as it moves over the crop or it can be done qualitatively by experience and the occasional use of a shovel.

Not surprisingly, there are a large number of tools that focus on helping irrigators to optimise the application of water via the various irrigation systems–furrow, border check (flood), centre pivot & lateral move irrigators, microsprinklers and surface and sub-surface drip systems. Many of these try to integrate expected crop water demand and rainfall events into their calculations. Others include estimates of run-off from the paddock, deep drainage below the root zone and estimates of salinity and leaching of salt from the site.

Crop Water Use

There is frequently some overlap between this category of tools and the preceding category. Crop Water Use tools vary. At the complex end (models that require many parameters) are detailed physiological models that operate at daily or hourly timesteps to estimate crop water needs, taking account of the different physiological growth stages of the plant. Simpler models make many generalisations and usually operate at a daily or monthly timestep to relate estimated crop evapotranspiration to daily standard pan evaporation measurements through the use of crop co-efficients. These published values are simple multipliers that roughly account for the leaf area of the crop at various stages of development.

No single method of scheduling and irrigation event is ‘the right one’. There are many valid ways to plan the application of water to the crop, depending on the degree of finesse required, the precision of the irrigation system and the skill and experience of the irrigator. Many irrigators use tools for a certain time only, until they ‘get their eye in’ and then they can irrigate reasonably effectively. That being said, as water prices escalate and climate variability and change brings about a new irrigating environment, there is increasing pressure on irrigators to constantly improve the water use efficiency of their businesses, and this makes the effective use of on-farm irrigation tools more important than ever.

The development of web-based interfaces to a number of powerful crop modelling tools, and the increasing computer literacy of irrigators also increases the possibilities of deploying tools to benchmark irrigation systems, refine irrigation applications, increase the profitability and efficiency of farming businesses and improve its environmental sustainability.

2. OPTIMISING ON-FARM WATER USE EFFICIENCY

Over the past 10–15 years the impetus for improving on-farm irrigation systems and management has been largely around improving productivity and reducing environmental degradation. More recently national and regional policy and planning approaches have emerged in response to Australia-wide issues such as reduced water availability due to drought, and greater variability of climate; as well as over-allocation of water particularly in the Murray Darling Basin. Reduced water availability now drives many on-farm decisions.

There are so many factors involved in better managing water on-farm that an understanding of the whole system is necessary to achieve sustainable gains in water use efficiency. These are outlined over.

Poor irrigation practice resulting in waterlogging and inefficiency

Photo: M. Chapman

The factors that irrigation managers consider, by category

Category	Factors
Storage and Delivery of water	• Irrigation system specification now and into the future • Design of water storages and surrounds for effective distribution, seepage and evaporation management • Channel/pipe delivery systems design • Managing storages and channels from empty to full • Managing the balance between surface water storages and groundwater — including deciding when to use • Managing water quality • Capturing overland flows effectively and within the licensing rules • Integrating storage and delivery systems when expanding property size • Mitigating evaporation from farm dams and channels • Reducing seepage from dams and channels • Groundwater levels • Capacity of existing channels/pipelines/pumps to deliver volumes of water required • Pump efficiency and running costs • The need for on-farm storage • Automated, 'harmonised' delivery systems • Managing the return of tailwater into the channel and storage system • Managing the energy requirement and costs for pumps and monitoring equipment • System maintenance
Controlling water on and off the paddock	• Paddock infiltration rate including the variability • Volume of water able to be delivered and lead time • Irrigation method • Efficiency of irrigation system layout • Distribution uniformity of water during the irrigation event • Cost of supply eg pumping and other infrastructure • Soil infiltration rates, uniformity and drainage issues • Access to surface drainage to manage tailwater or rainfall flood events • Access and cost of labour • Access to specialists if a complex automated system is installed • Deciding what monitoring equipment is needed to optimise water used eg measuring deep drainage • Soil compaction • Traffic ability for crop establishment, maintenance and harvest • Traffic ability to minimise livestock impacts on the crop

Category	Factors
Crop water use	• Soil water conditions at planting • Plant density and row spacing • Managing fertiliser, weeds, insects and diseases • Planting date • Crop or pasture variety • Soil fertility • Determining Soilwater refill and full points in the rootzone to optimise plant performance • Effect of water stress • Crop waterlogging from over irrigation or rainfall events • Leaching of salt from the rootzone • Daily evapotranspiration • Maximising benefits from rainfall events • Deciding what monitoring is needed to achieve optimum plant performance
Forecasting and Record Keeping — Financial, Crop Yield and Weather	• Whole Farm Planning including a business plan of crops likely to be grown & flexibility to change • Requirement for an irrigation & drainage management plan (state based water planning requirements) as part of development or transfer of water • Plotting weekly water usage and updating the water budget • Forecasting rainfall events • Weather station downloads • Long term weather forecast • History of past water allocations and predicting the forward season allocations and expected water to be on hand • Past crop performance • Water use efficiency measures such as $ yield/ML • Past crop input costs and prices received • New crops to be planted and water budget and schedule • New crop development budget and operating budget • Financial budgets on marginal returns of purchasing additional water • Suitability of climate for current and proposed enterprises

Optimising water use on-farm starts with the design and layout of the irrigation infrastructure (the irrigation system). Many properties suffer from old fashioned irrigation systems that were designed to achieve management goals at a time when water was not a major issue — for example minimising labour requirements may have been the most important goal. New systems today recognise that water is central to management goals. A description of irrigation systems[1] is given in the glossary.

Where landholdings have dated irrigation systems, irrigation managers have to work within the quirks and limitations of that system. The decision to substantially upgrade existing systems or change systems is a major business decision that requires careful assessment and advice; not only to calculate predicted water savings (that may allow additional land to be developed for irrigation or the sale of excess water) but also to assess the financial costs to the business in the short, medium and longer term. It may be possible and preferable to undertake improvements to the current irrigation system, in which case the range of costs and benefits require identification so that a thorough risk assessment can be undertaken. In a number of industries and regions, water requirements per hectare have been benchmarked, so it is possible to know the magnitude of savings that can be made by improving the irrigation design, layout and irrigation method. There are many irrigation design consultants who can advise in these areas. It should also be noted that guidelines and fact sheets developed for specific industries often hold considerable value for all irrigation industries. Queensland's "Irrigation for Profit" technical manual developed for the dairy industry has a section on irrigation systems of value to all operations.

The challenge for the grower is how to juggle the multiple actions to be undertaken to achieve the best sustainable return. This challenge is just as real for a small family enterprise as it is to large corporate farms — although large holdings will often have dedicated irrigation specialists. Even so, at all property sizes priorities shift and change and if water is not at the forefront of planning and management, considerations about continual improvement can be put on the backburner.

The case study shown over demonstrates how a farm can be at the leading edge in managing water for a significant period of time but then have other priority farm issues overtake water management as a principal management objective. The organisation lost best water use as a priority for about six years. These years have also been some of the driest on record. Note also that this example is specific to decision making around irrigation scheduling and does not begin to cover the many other points on-farm where efficiencies can be made.

1 compiled by the Victorian Department of Primary Industries

CASE STUDY:

The Stahmann Farms Story from “Trawalla” a Pecan Orchard at Moree NSW. Historical time line prepared by Matthew Durack.

1987: We used Hand read Potentiometers with 18 and 36” readings graphed for 50 fields every 3 days — very time consuming and relatively random in terms of the real data provided

1988: Moved across to using a Neutron Probe — again no management software but used spreadsheet to capture raw data outputs

1989: Began using Peter Cull’s Probe Software- revolutionary impact — for the first time we had confidence in the data and a forward tracking system to allow field by field scheduling times to be entered . Also began tracking ET values and linking this to Daily Water Use Levels–for review purposes but also predictive purposes.

Began using the system to not only schedule individual fields but also to predict water orders

1992: Probably at our peak Neutron Probe Useage — had a good system and were using it well

1995: Began to reduce our reliance on Probe data and became more confident to use our “Probe Adjusted” gut feel to establish best practice scheduling

2000: On Site Weather Stations put in place and first attempts at ET based scheduling — but all became a bit too hard. Put in place 6 C-Probe sites but it seems these resulted in a bit of an Information Overload which was continually reviewed and discussed but resulted in little significant change to management practice.

2000–06: Water Management took a back seat to other apparently pressing farm management issues and as such scheduling reverted to a pretty accurate but still Gut Feel Based System of rotational schedules. Probes still used to evaluate problem fields and see if we had infiltration or drainage problems

2006: Established our own ET based scheduling system based on Met Data. Reviewed soil testing data from previous years and did RAW and PAW readings on all 50 irrigation blocks in order to establish field by field Water Balance. Used this to predict re-water times and then back checked these predictions with Neutron Probe and C Probe Data.

This started the process of re-evaluating our Crop Coefficients and the quality of the ETo data being received from a private consulting firm.

Also at this time began to install Sub Surface Drip — which increased the need for precision into the entire on-farm water balance equation.

3. INITIATIVES

A number of initiatives to improve water use on-farm were identified, and these are tabled over. The changes achieved on individual farms, are, in aggregate, demonstrating major water savings. Excellent services are delivered by a large number of government agencies, research & development corporations and industry bodies by way of information portals, knowledge bases, fact sheets, training and guidelines. These can be found in the next chapter. Also, some agencies provide information to growers through the local newspaper or television station — eg weekly evapotranspiration figures by district. These services have not been catalogued.

The summary table is largely of service-based programs to achieve changes on-farm by resourcing irrigation system and method assessments, the research and development of Land & Water Management Plans, subsidising improvements to the irrigation system, and providing specialist extension personnel to work with operators on improving irrigation decision making.

The development of an on-farm information tool is not really seen in the irrigation community as an ‘initiative’. For researchers, the development of an on-farm tool is a response to an identified need or gap; and for private irrigation equipment suppliers the development of tools is a response to an identified commercial opportunity.

Whilst the commercial sector is highly competitive, it should be noted that collaboration between researchers, commerce and industry groups is strong and beneficial.

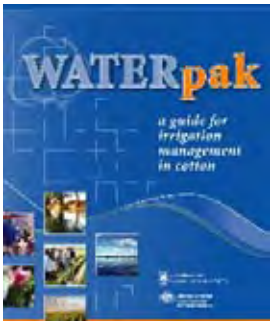
SUMMARY TABLE – INITIATIVES TO IMPROVE WATER USE ON-FARM

Lead Agency	Initiative — Title & Description
Victorian Dept. Primary Industries	**Irrigation Water Use Efficiency Benchmarking** http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_water_use The project increased the ability to compare water use efficiency between Victoria's irrigated regions and industries. A framework for benchmarking farm WUE for irrigated industries was published in the 'Farm Water Use Efficiency Technical Reference Booklet'.
Victorian Dept. Sustainability & Environment in conjunction with Catchment Management Authorities	**Water Smart Farms Program** http://www.dse.vic.gov.au/DSE/wcmn202.nsf/childdocs/-C3018EA63F35B1BBCA256FDD00136E19-3CFE0523B0FC8BA4CA256FE30006F7B8?open Funding for on-farm programs to help irrigators implement water management plans, install drainage reuse systems and upgrade on farm technology.
NSW Dept. Primary Industries/ Murrumbidgee Catchment Management Authority	**Farm Wise — EnviroWise** http://www.dpi.nsw.gov.au Funding for training, planning and capital works to improve water use efficiency on-farm. Funding assistance via National Action Plan for Salinity & Water Quality.
NSW DPI via irrigation companies — Colleambally Irrigation Co-op, Murrumbidgee Irrigation, Murray Irrigation, Western Murray Irrigation, & Jemalong Irrigation.	**Land & Water Management Plans** http://www.agric.nsw.gov.au/reader/water-irrig-funding Funding for development of LWMPs
South Australia	**On-ground Water Use Efficiency Project** http://www.samdbnrm.sa.gov.au/BoardProjects/ Assist the adoption of on-farm irrigation best management practice, and improve on-farm irrigation water use efficiency to a target of 85%. The project area includes approx.55,000 hectares of irrigation in the SA Murray Darling Basin; over 4,500 irrigators within Irrigation Trust Districts as well as private diverters. Implemented in partnership between local action planning areas; Central Irrigation Trust, Renmark Irrigation Trust, and the River Murray Catchment Water Management Board.
Western Australia	**W.A. Water Reform Initiative** http://portal.water.wa.gov.au/portal/page/portal/PlanningWaterFuture A state-wide policy initiative with components that include water recycling guidelines, benchmarks for each industry sector and research, development, education and training in water efficient technologies

Lead Agency	Initiative – Title & Description
Qld Dept. Natural Resources & Water	**South east Queensland Irrigation Futures** http://www.nrw.qld.gov.au/rwue/seqif.html Aims to achieve gains in WUE of up to 10% through participating industries. Activities include incentive schemes to assist irrigators, assessments of irrigation systems, encouraging farmer uptake of tool 'Irrimate', demonstrations, extension services, etc. **Rural Water Use Efficiency** http://www.nrw.qld.gov.au/rwue/rwue current.html Current program is a partnership involving 7 industry groups with state government to provide services to growers to improve water management practices and efficient use of water. Includes adoption/ extension activities, on-farm trials, demonstrations and system assessments, and financial incentives to upgrade irrigation and effluent management systems. One project funded by RWUE is **Water for Profit,** a Growcom project aimed at improving horticulture profitability through better management of irrigation water. It includes a free irrigation advisory service. RWUE also funded the National Centre for Engineering in Agriculture **(RWUE project 10)** to overcome performance weaknesses in travelling spray irrigators. The project resulted in the development of a decision support program as part of a 'toolkit'
Lower Murray Darling Catchment Management Authority	**Mallee Irrigation Incentive Program Incentives to adopt Best management Practices in Irrigation** http://www.lmd.cma.nsw.gov.au Incentives offered with funds from the National Action Plan for Salinity & Water Quality to improve water efficiencies on farms. Specifically: Irrigation Drainage Plans, Irrigation System Upgrades; Installation of irrigation scheduling equipment such as soil water monitors; Irrigation Management Training
Qld. Dept Primary Industries	**Water Efficiency — cotton and grains** http://www2.dpi.qld.gov.au/cropresearch/13283.html A financial incentives scheme administered by Cotton Australia to help irrigators implement changes to their management necessary for best practice. Finalised 2003
Fitzroy Basin Association	**Dawson Valley Irrigation Project** http://www.ncea.org.au Adopt improved methods for applying water in the Dawson Valley Qld to improve wue and reduce environmental impacts.
Tasmanian Dept. Primary Industries	**Irrigation Partnership Project** http://www.dpiw.tas.gov.au/inter.nsf/WebPages/JMUY6X66H3?open#3.IrrigationPartners Cost subsidy for environmental studies to progress new irrigation proposals that increase agricultural productivity / production and help to procure the 150,000 ML of water identified as needed to meet the 10 year growth forecasts for agriculture.
W.A. Dept. Agriculture	**WaterWise on the Farm** Cost subsidy for on-farm WUE measures including: installation of measuring and monitoring equipment and storage and delivery upgrades.

4. TRAINING, GUIDELINES & FACT SHEETS

Many industry bodies and government agencies have produced public information resources on the many factors that impact water-use on farm. The catalogue of resources on the following pages demonstrates the depth and breadth of material available to inform managers regarding on-farm water issues.



Resources range from :

Example :

- **industry-specific detailed information on how to optimise on-farm water use** — Best irrigation management practices for vegetables
- **"How To" information** — Using Recycled Water in Australia — a growers guide
- **Government services** — Climate data Commonwealth Bureau of Meteorology
- **Training programs** — Diploma in Irrigation for farm managers or owner operators

They are catalogued as follows:

Open Category	**The resource ranges across all facets of the on-farm operation ie Best Irrigation Management Practice Guidelines**
Storage & Delivery	Dams / tanks, channels, re-use water
Controlling water on and off the paddock	Irrigation systems, irrigation methods, relevant equipment. Soil water monitoring equipment can span both this category and Crop Water Use.
Crop Water Use	Irrigation scheduling, water quality, Re-use water
Forecasting & Record Keeping	Crop Yield (historic), Annual financial budgets, Annual operating water budgets, rainfall charts, climate records

The catalogue is not exhaustive. Many commercial irrigation suppliers offer training courses and information that can be accessed from dealers or the web.

Title	Which industries?	Web address or contact
Category: Open		
Best Irrigation management Practice for specific crops	various	http://www.agric.nsw.gov.au/reader/irrigation-manage
Best Irrigation management practice guidlines	dairy	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22water+management%22+s%3A%22water+management%22&meta_x_sand=&sort=title&x=34&y=12
Best Irrigation Management Practices — vegetables	Vegetables W.A.	http://www.vegetableswa.com.au/irrigation/
Best irrigation management practices for viticulture	viticulture in Murray Darling Basin	http://www.raa.nsw.gov.au/reader/irrigation-cropman/bimpv1.htm
Best irrigation practices for vegetables	vegetables	http://www.raa.nsw.gov.au/reader/irrigation-cropman/bimpv1.htm
Best management practice in water management — orchard crops	orchard crops	www.publish.csiro.au/home.htm
Best Management Practices — cotton	cotton	http://www.cottonaustralia.com.au/environment/intro.aspx
Best management practices — Water Management	vegetables — W.A.	Phone vegetables WA on 9266 0244
Best Management Practices in irrigation	All — S.A.	http://www.pir.sa.gov.au/pirsa/nrm/water_management/irrigation_best_management_practices/
Best Practice Guidelines — dairy	dairy	http://www.agric.wa.gov.au/content/aap/dc/5_efficientirrigation
Best practice management guidelines	various	http://www.irrigate.net.au/management/on_farm/best_practice.shtml
Certified Irrigation Operator	all	http://www.irrigation.org.au/iaa_c_and_q.html
Code of Practice—on-farm irrigation	all	http://www.irrigation.org.au/
Cotton Facts on Friday	cotton	http://www.crdc.com.au/
Dairy Information fact sheets	northern Dairy	http://www.dairyinfo.biz/index.cfm?MenuID=0

Title	Which industries?	Web address or contact
GreenBook — a guide to managing the environment	perennial horticulture in the MIA	02 69642420
Irrigation decisions	all	http://www.irrigate.net.au/management/on_farm/decision_support.shtml
Irrigation efficiency — what is it?	all	http://www.sardi.sa.gov.au/pages/hort/sustainable_environment/irrigation_efficiency.htm:sectID=516&tempID=1
Irrigation fact sheets relating to W.A.	all	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigation%22+s%3A%22irrigation%22&meta_x_sand=&sort=title&x=34&y=12
Irrigation for horticultural crops	horticulture	http://www.agric.nsw.gov.au/reader/hort-soil-irrig
Irrigation for Profit—technical manual	Dairy	http://www.dairyinfo.biz/Manual/main.cfm?SectionID=839
Irrigation System Selection and Design Guidelines	all	http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_efficient_irrigation_wheel
Options for managing with less water	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Sustainable irrigation on-farm information	all	http://www.irrigate.net.au/management/on_farm/sustainable_irrigation.shtml
Training — EnviroWise	all in MIA	(02) 69620200
Training — FarmBis	all	www.farmbis.gov.au
Training — IAL Certification Program	all	http://www.irrigation.org.au/about.html
Training — irrigation workshops	cotton & grains	http://www.cottonandgrains.irrigationfutures.org.au/default.asp
Training — smarter water & irrigation management program	dairy	contact Vic DPI 03 54821922
Training — Waterwise Irrigation Management Training	all	http://www.dpi.nsw.gov.au
Training — wise watering on farm	all — tasmania	http://www.dpiw.tas.gov.au/inter.nsf/WebPages/JMUY-5FJVP7?open
Training courses	all	http://www.irrigation.org.au/iaa_c_and_q.html

Title	Which industries?	Web address or contact
Training: Irrigation Learning Guide — measure system performance	all	http://www.irrigate.net.au/subjects/education/handbooks.shtml
Water Use Efficiency : an information package	all	http://www.npsi.gov.au/Publications_and_Tools/Irrigation_Insights/index.aspx
Water use efficiency on dairy farms	dairy in south west Victoria	(03) 5561 9946
Water use efficiency on-farm	various	http://www.irrigate.net.au/management/on_farm/water_use.shtml
Water use efficiency on-farm technical reference booklet	all	http://www.dse.vic.gov.au/DSE/wcmn202.nsf/LinkView/
WATERpak — a guide for irrigation management in cotton	cotton	http://cotton.pi.csiro.au/content/Industry/Publications/Water/WATERpak.aspx
	all	http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_efficient_irrigation_wheel
Category: Controlling water on and off the paddock		
Bananas — methods of irrigation	bananas	http://www2.dpi.qld.gov.au/horticulture/5269.html
Basic design requirements for irrigation systems	horticulture	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Better drainage for banana plantations	bananas	http://www2.dpi.qld.gov.au/horticulture/5054.html
Centre Pivot irrigation	various	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Centre Pivot Irrigation in the Riverina	various	http://www.dpi.nsw.gov.au/aboutus/resources/factsheets/primefacts/centre-pivot-irrigation
Centre Pivots	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Checking above-canopy sprinkler performance	various	http://www.agric.nsw.gov.au/reader/waterwise-briefs
Controlling surface water above salt affected areas	all	http://www.agric.wa.gov.au/content/lwe/water/fn066_1985.htm
Training courses	all	http://www.irrigation.org.au/iaa_c_and_q.html

Title	Which industries?	Web address or contact
Converting readily available water to hours of irrigation — drip systems	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Drainage	all	http://www.irrigate.net.au/management/on_farm/drainage.shtml
Flood irrigation — Automation	all flood	Vic.Dept.Ag (Echuca)
Furrow irrigation — measuring performance	various, but aimed at canegrowers	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Gun irrigators — tips	various	http://www.agric.nsw.gov.au/reader/waterwise-briefs
Irrigation & Drainage management plans	all	http://www.agric.nsw.gov.au/reader/wwidmp
Irrigation application systems	all	http://www.irrigate.net.au/management/on_farm/application_systems.shtml
Irrigation methods — Lateral moves and low pressure booms	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Irrigation methods — Solid set and hand shift sprinkler systems	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Irrigation methods — Sub-surface drainage design & management practices	various	http://www.npsi.gov.au/Publications_and_Tools/Irrigation_Insights/index.aspx
Irrigation methods — Sub-surface drip irrigation	various — cotton, curcurbits, lucerne, maize, mung beans, navy beans, sorghum, wheat	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Irrigation methods — sub-surface irrigation	various	http://www.npsi.gov.au/Publications_and_Tools/Factsheets/index.aspx
Irrigation methods & system selection	all	http://www.irrig8right.com.au/banners/Introduction.htm
Irrigation methods: Drip and micro systems	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Irrigation standards & codes	all	http://www.irrigation.org.au
Irrigation system design, layout	all in Murray Valley	http://www.murrayirrigation.com.au/content.aspx?p=20175
Irrigation System evaluation tools	all	http://www.irrigate.net.au/management/on_farm/system_evaluation.shtml
Irrigation systems	all	http://www.agric.nsw.gov.au/reader/waterwise-briefs

Title	Which industries?	Web address or contact
Irrigation systems	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigation+systems%22+s%3A%22irrigation+systems%22&meta_x_sand=&sort=title&x=34&y=12
Irrigation systems — Meters & Pumps	all	http://www.irrigate.net.au/management/on_farm/meters_pumps.shtml
Irrigation systems — Pump efficiency — factors and costs	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Irrigation systems — Pumps — efficiency	all	http://www.agric.nsw.gov.au/reader/pumps
Maintenance	all	http://www.irrigate.net.au/management/on_farm/maintenance.shtml
Metering systems incl. telemetry & dataloggers	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Scheduling — When and for how long should I irrigate? scheduling calculation sheets	various	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Scheduling calculation sheets	various	http://www.irrigate.net.au/management/on_farm/scheduling_calculation.shtml
Scheduling irrigation	various	http://www.irrigate.net.au/management/on_farm/scheduling.shtml
Soil texture	all	http://www.agric.nsw.gov.au/reader/waterwise-briefs
Soils — Improving soil structure	all	http://www.npsi.gov.au/Publications_and_Tools/Factsheets/index.aspx
Soils — on farm irrigation	all	http://www.irrigate.net.au/management/on_farm/soils.shtml
Training — Centre Pivot & Lateral Move irrigation systems	all	www.irrigationfutures.com.au
Training — Flow Metering training guide	all	http://www.ancid.org.au/ktf/
Training — irrigation management courses (various)	all	Ph. Vic DPI (03) 50514500
Training: Irrigation tutorials on-line	all	http://www.irrigationtutorials.com/
Travelling gun irrigation systems	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Uniformity of Distribution (DU) — calculating	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37

Title	Which industries?	Web address or contact
Water use efficiency. Making the most of irrigation water in south west Victoria	Dairy	hard copy from Vic DPI http://www.dpi.vic.gov.au
Waterlogging and inundation	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22waterlogging%22+s%3A%22waterlogging%22&meta_x_sand=&sort=title&x=34&y=12
Efficient irrigation techniques	tomatoes, table grapes, wine grapes	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22water+stress%22+s%3A%22water+stress%22&meta_x_sand=&sort=title&x=34&y=12
Irrigated pastures	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigated+pastures%22+s%3A%22irrigated+pastures%22&meta_x_sand=&sort=title&x=34&y=12
Irrigating horticulture crops with reduced water availability	horticulture	http://www.pir.sa.gov.au/factsheets
Monitoring — Fullstop wetting front detector	all	http://www.fullstop.com.au/
Soil Water Monitoring 2nd edition : an information package	all	www.npsi.gov.au
Sugar cane — Improving irrigation	sugar cane	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22water+use+efficiency%22+s%3A%22water+use+efficiency%22&meta_x_sand=&sort=title&x=34&y=12
Systems and equipment — selection and evaluation	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigation+equipment%22+s%3A%22irrigation+equipment%22&meta_x_sand=&sort=title&x=34&y=12
Water management — surface water management workbook	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22water+management%22+s%3A%22water+management%22&meta_x_sand=&sort=title&x=34&y=12

Title	Which industries?	Web address or contact
Water use and water use efficiency for pulses in W.A.	pulses	http://www.agric.wa.gov.au/content/fcp/lp/growwater.htm
Monitoring — Pressurised Irrigation Monitoring System (PIMS)	various	http://www.ncea.org.au/
Irrigation systems	tree fruits	http://www.sardi.sa.gov.au/pages/hort/hort_crops/apricots/systems.htm%3AsectID=1126&tempID=1
	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Category: Crop water use		
Best Practice Irrigation	all	http://www.irrigate.net.au/about/case_studies/best_practice.shtml
Crop management	various	http://www.irrigate.net.au/management/on_farm/crop_management.shtml
Crop water use efficiency benchmarking	various horticultural	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Estimating crop water use based on evaporation measurements	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Estimating how much water should be applied	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Evapotranspiration data	all	http://www.bom.gov.au/climate/averages/
High water use plant options for the Fitzgerald River catchment	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22water+use+efficiency%22+s%3A%22water+use+efficiency%22&meta_x_sand=&sort=title&x=34&y=12
How much water is in my soil?	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Irrigation — water balance scheduling	various	http://www2.dpi.qld.gov.au/fieldcrops/10908.html
Irrigation of wine grapes on deep sands. No.67/2004	wine grapes	www.agric.wa.gov.au

Title	Which industries?	Web address or contact
Irrigation requirements of various crops	various in W.A.	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigation+requirements%22+s%3A%22irrigation+requirements%22&meta_x_sand=&sort=title&x=34&y=12
Irrigation scheduling — how and why; evaporimeters	all	http://www.agric.wa.gov.au/content/lwe/water/irr/f02390.htm
Irrigation scheduling — minipans	various	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Irrigation Scheduling — what is it?	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Irrigation scheduling using evaporation and crop factors	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Monitoring — plant monitoring sensors	all	http://www.ncea.org.au/
Partial rootzone drying & regulated deficit irrigation	wine grape	http://www.npsi.gov.au/Publications_and_Tools/Irrigation_Insights/index.aspx
Salinity — Managing Irrigation Salinity	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Salinity in Queensland	Qld industries	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Salts — Ensuring an acceptable level of salt in the crop root zone	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Salts — Estimating the level of salt in the root zone	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Salts in the crop root zone	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Scheduling tools — pros and cons	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Sodicity Managing irrigation sodicity	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Soil Moisture Monitoring tools	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton

Title	Which industries?	Web address or contact
Irrigation requirements of various crops	various in W.A.	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigation+requirements%22+s%3A%22irrigation+requirements%22&meta_x_sand=&sort=title&x=34&y=12
Irrigation scheduling — how and why; evaporimeters	all	http://www.agric.wa.gov.au/content/lwe/water/irr/f02390.htm
Irrigation scheduling — minipans	various	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Irrigation Scheduling — what is it?	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Irrigation scheduling using evaporation and crop factors	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Monitoring — plant monitoring sensors	all	http://www.ncea.org.au/
Partial rootzone drying & regulated deficit irrigation	wine grape	http://www.npsi.gov.au/Publications_and_Tools/Irrigation_Insights/index.aspx
Salinity — Managing Irrigation Salinity	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Salinity in Queensland	Qld industries	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Salts — Ensuring an acceptable level of salt in the crop root zone	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Salts — Estimating the level of salt in the root zone	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Salts in the crop root zone	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Scheduling tools — pros and cons	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Sodicity Managing irrigation sodicity	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Soil Moisture Monitoring tools	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton

Title	Which industries?	Web address or contact
Soil water characteristics database	specific to cropping regions	http://www.apsru.gov.au/apsru/Products/APSoil/default.HTM
Soil Water Monitoring — Choosing a tool	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Soil Water Monitoring — Gopher — calibration	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Soil Water Monitoring — Gopher — probe readings	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Soil Water Monitoring — Installation of Tensiometers	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Soil water monitoring — interpreting tensiometers and testwell readings	all	http://www.pir.sa.gov.au/pirsa/more/factsheets/soil
Soil Water Monitoring — Positioning of tools	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Soil Water Monitoring — Tensiometers in irrigation	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Soil water monitoring — tensiometers, capacitance probes, scheduling	all	http://www.agric.nsw.gov.au/reader/waterwise-briefs
Soil Water Monitoring device tube installation	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Understanding the annual growth cycle of citrus	citrus	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Water & Soil Quality — Australian Cotton Industry	cotton	http://cotton.pi.csiro.au/content/Industry/CRChome.aspx
Water Balance Calculator AgET	all	http://www.agric.wa.gov.au/content/lwe/water/aget_index.htm
Water quality parameters	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Water use efficiency — measuring effects of salinity on root zone	primarily horticulture in lower Murray	http://www.npsi.gov.au/Publications_and_Tools/Research_Bulletins/index.aspx
Deep Drainage–problem or asset?	all	http://www.nrw.qld.gov.au/factsheets/pdf/land/109.pdf

Title	Which industries?	Web address or contact
Categories: Crop water use; Controlling water on and off the paddock		
Soils — understanding soils	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Efficient irrigation for determinate tomatoes in the Gascoyne River area. No.27/90	tomatoes	www.agric.wa.gov.au
Irrigation Scheduling	various	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22irrigation+scheduling%22+s%3A%22irrigation+scheduling%22&meta_x_sand=&sort=title&x=34&y=12
Salinity	all	http://www.irrigate.net.au/management/on_farm/salinity.shtml
Soils and Irrigation management	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Sustainable farming systems for bananas in FNQ	bananas	http://www.irrigate.net.au/about/case_studies/sustainability.shtml
water use efficiency framework — terms and definitions	all	http://www.npsi.gov.au/Publications_and_Tools/Factsheets/index.aspx
Water use efficiency in the Peel-Harvey region	dairy: other	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22water+use+efficiency%22+s%3A%22water+use+efficiency%22&meta_x_sand=&sort=title&x=34&y=12
Drought–check list; irrigation in drought conditions	various listed	http://www.pir.sa.gov.au/pirsa/more/factsheets/soil
Category: Forecasting & Record Keeping		
Monitoring Tools	all	http://www.irrigate.net.au/management/on_farm/monitoring_systems.shtml
Weather & Climate forecasting	Qld industries	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton

Title	Which industries?	Web address or contact
Benchmarking	Almonds, dried vine fruit, open hydroponics, table grapes	http://www.dpi.vic.gov.au
Benchmarking water use	all	http://www.growcom.com.au/home/inner.asp?pageID=50&main=26&sub=37
Common irrigation unit conversions	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Cropping options for dry seasons	various — specific to Qld industries	http://www2.dpi.qld.gov.au/fieldcrops/6538.html
Farm enterprise budgets — crop gross margins	all irrigated crops grown in NSW are detailed	http://www.agric.nsw.gov.au/reader/budget-related/budget-list.htm
GIS — digital biophysical data	all within the researched areas of NSW	http://www.terragis.bees.unsw.edu.au/index.html
Planning frameworks for on-farm	various	http://www.irrigate.net.au/management/on_farm/plans.shtml
Water budgeting guidelines	Almonds, PomeFruit, Avocado, Citrus, Pistachios, Vines, StoneFruit, Olive	http://www.pir.sa.gov.au/pirsa/drought/irrigation__and__water_management/water_budgeting_and_water_trade_decision_tools
Weather — the hydrologic cycle	all	http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Weather & Climate	all	http://www.irrigate.net.au/management/on_farm/weather_climate.shtml
Weather & Climate	all	http://www.bom.gov.au/climate/averages/
Weather & climate — outlook	all	http://www.bom.gov.au/climate/
Weather Stations	all	http://www.growcom.com.au/home/inner.asp?pageID=36
Category: Storage & Delivery		
Dams — Excavated tanks and ring tanks	all	http://www.nrw.qld.gov.au/factsheets/pdf/water/w30.pdf
Dams — Farm dam construction	all	http://www.nrw.qld.gov.au/factsheets/pdf/water/w10.pdf
Dams — How to build a farm dam	all	http://www.agric.nsw.gov.au/reader/dams-storage/e57.htm

Title	Which industries?	Web address or contact
Dams & Storages	all	http://www.agric.nsw.gov.au/reader/dams-storage
Dams, Gully — estimating earthworks and storage volumes	all	http://www.nrw.qld.gov.au/factsheets/pdf/water/w18.pdf
Drilling for water	all	http://www.nrw.qld.gov.au/factsheets/pdf/water/w16.pdf
Evaporation	all	http://www.irrigate.net.au/management/on_farm/evaporation.shtml
Evaporation — new tools for measuring evap from farm dams	all	http://www.npsi.gov.au/Publications_and_Tools/Research_Bulletins/index.aspx
Evaporation — storage covers	all	http://www.ncea.org.au/Evaporation%20Resources/index_files/Page2007.htm
Evaporation — understanding evaporation	all	http://www.npsi.gov.au/Publications_and_Tools/Factsheets/index.aspx
Evaporation — using windbreaks to reduce evaporation from farm dams	all	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22evaporation%22+s%3A%22evaporation%22&meta_x_sand=&sort=title&x=34&y=12
Evaporation data for W.A.	all in W.A.	http://www.agric.wa.gov.au/search/search.cgi?collection=external&form=custom&meta_y_not=0ARCHIVE0&query=t%3A%22evaporation%22+s%3A%22evaporation%22&meta_x_sand=&sort=title&x=34&y=12
Evaporation losses from farm dams	all	http://www.npsi.gov.au/Publications_and_Tools/Factsheets/index.aspx
Evaporation mitigation from storage dams	all	http://www.ncea.org.au/
Farm Dams	all	http://www.irrigate.net.au/management/on_farm/evaporation.shtml
Geophysics for the Irrigation Industry	all	http://www.npsi.gov.au/Publications_and_Tools/Irrigation_Insights/index.aspx
Groundwater & Bores	all	http://www.irrigate.net.au/management/on_farm/bores_groundwater.shtml
Groundwater access trenches	various — S.A.	http://www.dwlbc.sa.gov.au/water/publications/index.html
Groundwater concepts	all	http://www.pir.sa.gov.au/pirsa/more/factsheets/soil
Groundwater flow modelling and groundwater investigations	south–west Yarragadee Blackwood groundwater area — W.A.	http://portal.water.wa.gov.au/portal/page/portal/Publications/ListingByCategories/Groundwater

Title	Which industries?	Web address or contact
Recycling Water	all, specific to Qld	http://www.epa.qld.gov.au/register/p00414aa.pdf or http://www.nrw.qld.gov.au/rwue/factsheets.html#cotton
Seepage	all	http://www.irrigate.net.au/management/on_farm/seepage.shtml
Selecting pipes for the farm dam	all	http://www.agric.wa.gov.au/content/lwe/water/eng/fn065_1987.htm
Wastewater recycling in nurseries	nursery	http://www.npsi.gov.au/Publications_and_Tools/Factsheets/index.aspx
Water Bores — testing yield	all	http://www.nrw.qld.gov.au/factsheets/pdf/water/w4.pdf
Water Bores — troubleshooting	all	http://www.nrw.qld.gov.au/factsheets/pdf/water/w5.pdf
Water supplies for irrigating the small farm	hobby	http://www.agric.wa.gov.au/content/fm/small/lwe/fn073_1994.htm
Reclaimed water	various	http://www.irrigate.net.au/management/on_farm/water_reticulation.shtml
Recycled water — use in irrigation	various	http://www.recycledwater.com.au/index.php?page=information_brochures or http://www.npsi.gov.au/Publications_and_Tools/Reports/index.aspx
Recycled water in horticulture	horticulture	http://www.irrigate.net.au/about/case_studies/sustainability.shtml
Water quality & treatment	all	http://www.agric.nsw.gov.au/reader/waterwise-briefs
Dairy environmental management series: Dairy effluent management systems	Dairy	http://www2.dpi.qld.gov.au/environment/13255.html

5. ON-FARM MEASURING AND MONITORING EQUIPMENT

Today there is a range of on-farm measuring and monitoring equipment that allows the irrigation manager to receive objective data on every water input and output within the farm water system. This chapter outlines the range of equipment and technologies used at different stages of the water on-farm 'journey'.

Water Delivered to the Farm

Water can reach the farm gate via:

- Regulated or unregulated river
- Water Channel (from a water authority)
- Groundwater
- Overland flow

Dethridge wheel metering the water taken off the water authority channel and on to the farm. Photo: L. Chapman

With government moving to tighten up accounting for water for all purposes, meters are to be installed (where they are not already) to measure volumetric flow onto a landholding for irrigated agriculture purposes. There are many different kinds of water meters that can fulfil this task.

Once received, the water may be immediately used, or it may be stored.

- If it is being delivered directly to the field the equipment used for measuring it onto the field it is likely to be the same meter that measured the water delivered to the farm. If it is being delivered to the field by an on-farm channel system, there could be losses from that channel system that are not measured (losses by way of seepage or evaporation). If it is a piped system, there should be zero losses.
- If the water goes into storage, it is likely that the storage will have a gauge to assess how much is going into it (e.g. a scaled vertical upright that the manager can calculate from i.e. 10 cm rise on the scale = 50 ML). If stored, there can be losses from evaporation and seepage. This accumulated loss can be measured by deducting the reducing height from the full height. Equipment is available for measuring evaporation and seepage separately, but such equipment is not generally used on-farm. Pan evaporation can also be used, but this doesn't take into account additional effects such as seepage or increased evaporation caused by wind.

Water conveyed on-farm to the required field/s.

Water can be delivered to the field from the storage by gravity or pumping into pipes or the on-farm channel system. The performance of the pump can be measured in terms of the volume and delivery pressure. Of course the usual engine gauges are also present — fuel, oil etc. As mentioned above, there can be losses from the channel system–evaporation and or seepage — which are not generally monitored.

Water arrives at the required field location on-farm

Whether stored on-farm or used directly at time of off-take, once conveyed via the irrigation system to the particular field the water is deployed using an irrigation method (eg drip, furrow, centre pivot, etc.). For flood or furrow (surface) irrigation, there is often no metering at the field. For pressure irrigation methods such as centre pivot and lateral moves there is generally a gauge on the irrigator, so the amount applied to the particular field can be measured. Drip systems may rely on the farm-gate meter or the pump meter to estimate on-field application. Some farms may have individual meters for each field or for a group of fields. The precision of the measurement depends on whether they irrigate one or multiple blocks at a time.

An on-farm channel at a corporate farm near Hay, NSW. The channel is used for delivering groundwater, and for delivering water that the farm pumps from the Lachlan River. Photo: M.Chapman

Irrigation event measured and monitored (if installed)

During the watering, in-ground soil-water sensors detect the rate of water infiltration through the soil profile. Such sensors, placed at the bottom of the root zone show whether 'deep drainage' has occurred — that is, water passing below the plant's root zone (beyond the point that the crop can make use of the water). There are also sensors for turning the irrigation on and off. Plant sensors may be installed to monitor crop water use/evapotranspiration. Specialist consultants may install their own preferred equipment and software systems for intensive water use analysis.

Water run-off from the irrigation event collected for re-use

Tail water from the end of the field is generally not measured as it comes off the paddock. Where best practice occurs, the tail water is conveyed to a re-use dam. The re-use dam may have a vertical scale device which would help measure actual run-off from the field (again there could be losses from conveying the tail water to the re-use dam). Future irrigations may 'shandy' the re-use water with fresh water, and water quality measurements are required to ensure nutrient and salinity levels are suitable for the crop (see below).

Other on-farm equipment that provides data as inputs to decision making are:

- Equipment to monitor aspects of climate including rainfall events, evaporation, etc. Often district groups may have the one weather station at a specific site and the data is shared. This is particularly the case where reliable district weather information is not supplied by state agencies or the Bureau of Meteorology.
- Soil Solution Extractors. A number of measures such as nutrient, EC and pH should be taken to indicate water quality relating to crop health. It can be important to monitor quality when it is highly variable, for example where re-use water is to be mixed with the main water supply for conjunctive use.
    - o Nutrient monitoring. Ensuring effective use of nutrients to maximise crop growth is an important component of water use efficiency. It is possible to use some soil water monitoring devices such as FullStop™ or the Sentek Solusampler™ to collect water samples within and below the root zone. Tailwater measures can also be taken to track excess loss of nutrients.

Determining the most suitable combination of measuring and monitoring equipment for particular irrigation enterprises is a challenge.

There are many examples of equipment being under-used by managers because of the time and investment required to make full use of the equipment or because the data produced did not 'ring true' to the farm manager. Note that this is a substantial issue as it could indicate that the equipment has not been correctly calibrated, that the farmer knows that variability across the farm out-weighs the point-source data, or that indeed the data is correct and the on-farm practices could be improved. Figuring out the difference between what the data says and what the farmer knows is time consuming but important work. The role of irrigation consultants in helping managers to establish and effectively use their monitoring systems cannot be understated. Irrigation Australia Ltd (IAL)[2] has many members who specialise in providing such services and/or who specialise in the development and commercial sale of measuring and monitoring equipment, with information support backup. IAL also run a range of certified training courses for the farm irrigation manager.

Equipment developers have recognised that a greater volume of data or greater attention to accuracy adds to complexity without necessarily making water use decisions any easier for irrigation managers. Information tools are now being developed or are already being used to convert myriad data into usable, useful information. Measuring and monitoring equipment has moved from being promoted as "the" decision maker to being recognised as providing important objective input data to complex decision making.

It is important that the data can be readily accessed and integrated with other internal or external data. This requires open platform software and a cost effective telemetry network that has the ability to link farm and external systems. A good example of one is the Colleambally umbrella communications network that can support both growers and the water company's needs at a cost effective price. In the long term such a system has the greatest opportunity for providing optimal water allocation to the farm, and district benchmarking of various WUE indices. It will also make water statistical reporting easier.

Irrigation scheduling

The most obvious — and in some ways most complex — decision that irrigation managers need to make is when to turn the water on and off. The aim of irrigation scheduling is "to apply water before the crop experiences an unacceptable stress and to replenish, but not overflow, the crop's root zone storage"[3]. A range of information is needed for the manager to match the irrigation schedule with the crop's requirements and soils and weather conditions.

2 IAL is the new company formed by the merger of Irrigation Association of Australia and the Australian National Committee on Irrigation & Drainage. See www.irrigation.org.au

3 Stirzaker,R. 2006. He adds "There are exceptions where deficit or leaching irrigations are required at specific times of the year."

From the earliest days of irrigation in Australia, managers have relied on a combination of subjective forms of knowledge to make such decisions. This included-

- taking the shovel out to the paddock and digging in areas to check soil moisture by look and feel,
- local knowledge of rainfall patterns,
- accepted "normal" agronomic practice,
- visual inspection/judgement of crop stress based on past experience,
- awareness of limitations of the installed irrigation system.

Maximising crop yield was the measure of success in bringing these observations, experiences and judgements together.

Awareness of environmental problems such as waterlogging led to the development of monitoring equipment to provide objective data on crop water needs. Soil water monitoring equipment from the 1950's provided data on how much water was in the soil, thus giving objective cues as to when irrigation was required

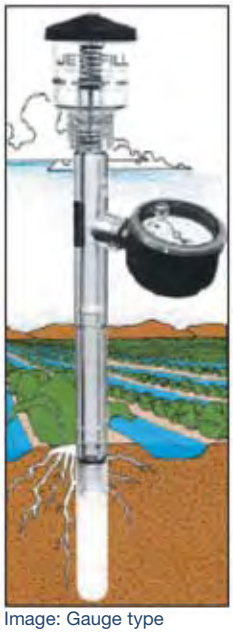


Image: Gauge type tensiometer. Soil Water Monitoring, 2nd edition (P.Charlesworth) NPSI

The uptake of soil water monitoring equipment has been promoted as essential to irrigators wanting to optimise water use on-farm. Uptake has been slow for many reasons, including awareness by irrigation managers of the variability that exists across their paddocks and the large number of monitors that would reasonably be required to overcome some of these variability issues. Some equipment is complex to install, calibrate and maintain. There is often a need to be computer literate. These problems can be overcome through the use of specialist irrigation consultants, however there remains reluctance by many to pay for what has been seen as a non-essential service.

Many of the concerns that result in slow up-take or sub-optimal use of equipment have continued to be addressed by researchers and developers of commercial products. There appear to be different responses to the issue: Some are now promoting scheduling software as the 'pre-season and throughout season' decision support tool; used in conjunction with subjective reinforcement (i.e. taking the shovel to the field and checking the look and feel of the soil). Others are persisting with monitoring equipment, concentrating on addressing the field variability issue.

There is also a strong argument that re-evaluating the farm, including soil type and infiltration testing[4], may allow redevelopments over a period of time to achieve more uniform irrigation.

Whatever the developer's responses to the issue of slow-uptake, soil water monitoring (SWM) equipment is now generally widely accepted as important in irrigation scheduling decision making. This view has probably been influenced by the acute awareness of the need to stay profitable with less or variable water availability.

A thorough information package relating to Soil Water Monitoring was prepared by Dr. Philip Charlesworth (CSIRO/ CRC Irrigation Futures) as part of the Irrigation Insight series of publications commissioned by the National Program for Sustainable Irrigation (see bibliography). Many fact sheets and web-based resources are also available and listed in the "Training, Guidelines & Fact Sheets" chapter.

Conclusion

Measuring and monitoring equipment has been developed to provide objective data that managers can rely on to help optimise water use on-farm. The need for open platform systems that can integrate in with water suppliers has been recognised. "Harmonised" systems at the catchment scale are one new area of establishing water savings. Although the term tends to relate to catchment-scale systems, there is plenty of opportunity to also harmonise the on-farm water conveyance, storage and in-field water systems. These opportunities begin with obtaining objective data that lead to improved understanding of where water is under-used or lost to the farm system.

Measuring and monitoring flow rate, soil water balance, the weather and crop use in the field was for some time seen by technicians as delivering all the information necessary for irrigation managers to make decisions to minimise water losses and optimise water use efficiency. However in seeking to account for the slow uptake of such equipment, the complexity of decision making and the importance of local knowledge have been brought to the fore. Instead of being promoted as the 'be all and end all' of decision making, measuring and monitoring equipment is now recognised as providing valuable input data into more complex calculations.

Research agencies and developers of commercial technologies have moved to add value to their equipment by developing information tools that take a range of input data. Tools that assist in turning such inputs into useful information to optimise crop yield and water use on-farm are described in the next section.

4 An extensive review of technology available for soil sampling to better understand 'leakiness' and aquifer systems is provided by Allen, D. (2005).

6. AUDIT OF ON-FARM IRRIGATION INFORMATION TOOLS

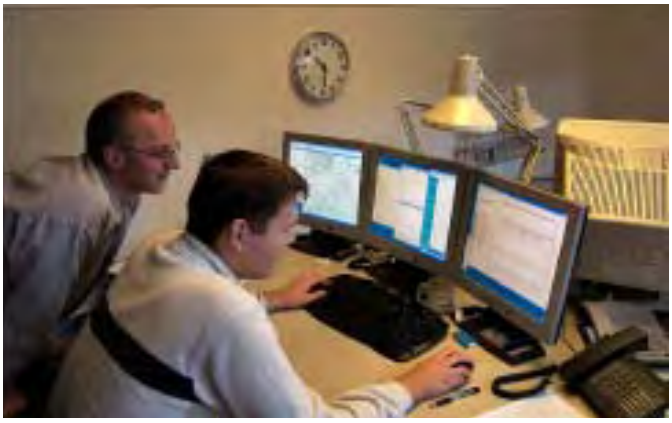


Image: Geophysics for the Irrigation Industry (D.Allen) NPSI

As previously discussed, irrigators have many factors to consider to stay viable. Both public and private organisations have developed training resources, measuring and monitoring equipment and information tools to support the irrigator. Whilst this support has been useful, there is on-going pressure to increase each individual's on-farm productivity for the enterprise to remain viable. Tools that either save time, or can lead to better use of resources have captured the attention of irrigation managers, particularly if the tool is within the capability of the operator or there is a reliable consultant or contractor to use the tool and achieve results.

This Chapter outlines by category the range of tools available, and the areas of operation in which the tools can be expected to improve water use efficiency.

What is an information tool?

An irrigation information tool helps transform various data inputs into valuable information for irrigators to optimise their water use efficiency. The tool may be used by the irrigator or by a third party such as a consultant or engineer. The key feature is that it will help provide the very best information for decision making that can be expected to optimise water use efficiency.

Categories of Information Tools

The irrigation enterprise has been categorised throughout this report as follows:

- Forecasting and record keeping
- Storage and Delivery
- Controlling water on and off the paddock
- Crop water use

Some tools provide information across two or more categories, and are therefore included in multiple categories.

Forecasting and Record keeping tools

- Tools in this category focus on water budgeting (seasonal, monthly and daily) and financial budgeting; predicting future crop performance and what crop should be grown for a given water allocation; benchmarking water use efficiency; predicting future water availability; costing irrigation systems; irrigation system and equipment performance; forecasting future farm water needs and the risks associated with trading water; data manipulation, storage and display, and seasonal climate outlooks.

Storage and Delivery

- These information tools focus on scenario planning for infrastructure, seepage and evaporation losses, efficient management of storages, costs and benefits of seepage and evaporation control, and design of earthworks.

Controlling water on and off the paddock

- The focus of these tools is on the efficiency of the application including the uniformity of surface application and depth in the soil profile, calibration and efficiency testing of sprinkler and siphon systems, surface and sub surface wetting front detection, soil water capacity, micro system design, water infiltration rates and wetting patterns, optimisation of watering time and layout, effects of excessive tailwater and drainage losses for both water and nutrients.

Crop Water Use

- These information tools focus on crop water requirements at various plant physiological stages and climatic zones, determination of refill and full points within the soil profile, optimum irrigation scheduling (seasonal, monthly and daily time steps) and water consumption tracking, crop yield estimates based on different levels of water availability, effects of crop over-watering on yield and nutrient loss, daily ET and alert systems for daily ET and irrigation scheduling, crop demand models to assist in farm water budgeting, salinity leaching calculations, and refinement of crop coefficients.

  The tools demonstrate the array of factors that the manager must consider in his or her decision making if they are to be profitable, sustainable and water use efficient.

  The 123 information tools identified through a desk-top study and discussion with 135 irrigation stakeholders (researchers, commercial developers, irrigators, consultants and industry leaders) are tabled over. Each tool is described in more detail in the appendix. Those marked with an asterisk (*) are under development.

  The tools audit also found that there have been many tools created by irrigation designers and surveyors, farm consultants and some industry groups who do not want to openly share the tool. Reasons for the lack of willingness to share essentially fall into two camps — either they see a benefit for their own interests and are not inclined to spread the gain, or they see the tool as rudimentary, in need of improvement and want to hold back the tool until it is improved. There are also irrigators who have developed their own tools which rarely come to wider attention and many would be happy to share.

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
AgWISE	Website and Executable file	Any region	All industries	All irrigators	Controlling water on and off the paddock
AIM	Executable file	All of Australia	Pasture	Irrigators, Consultants	Controlling water on and off the paddock
Centre Pivot Calculator	Spreadsheet	All of Australia	Centre Pivot irrigators	Irrigators	Controlling water on and off the paddock
Centre Pivot Uniformity Calculator	Spreadsheet	All	All	Irrigators and advisors	Controlling water on and off the paddock
Environmental self assessments–Viticulture–Sunraysia region	Worksheet	Sunraysia	Viticulture	Farm Managers	Controlling water on and off the paddock
FarmCONNECT*	Executable file, Website, SMS	Colleambally	All	Irrigators	Controlling water on and off the paddock
FIDO*	Executable file	All of Australia	Furrow and Border Irrigation, Cotton, Pasture, Grains, Horticulture	Irrigators, Consultants, Scientists	Controlling water on and off the paddock
GBReader	Executable file	All of Australia	All industries using Gypsum Block soil moisture sensors	Irrigators	Controlling water on and off the paddock
GBug	Executable file	All of Australia		Irrigators	Controlling water on and off the paddock
Handyshift Side Roll Uniformity Calculator	Spreadsheet	All	All	Irrigators and consulants and trainers	Controlling water on and off the paddock
HowWet?	Executable file	Queensland	Grain, Sugar, Cotton	Irrigators, Consultants	Controlling water on and off the paddock
HydroCalc	Executable file	All	Industries that use piped systems and generally drip.	Irrigators and designers	Controlling water on and off in paddocks
HydroLOGIC	Executable file	NSW, Queensland	Cotton	Irrigators, Consultants	Controlling water on and off the paddock
IBIS Pasture Tool		Victoria, NSW	Dairy, Pasture	Irrigators	Controlling water on and off in paddocks
INFILT v5	Executable file	All	Furrow and surface irrigation	From irrigators to consultants to researchers. All Levels	Controlling water on and off the paddock

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
IPARM	Executable file	All of Australia	Broadacre (furrow) irrigators	Irrigators, Consultants	Controlling water on and off the paddock
IRRICAD Pro Ver 9	Executable file	All regions that use tape systems	All that use tape systems	Designers of on farm irrigation systems. It could be used for urban environments such as golf courses	Controlling water on and off the paddock
Irrigation System Evaluation for overhead and under canopy micro sprinklers*	Spreadsheet	Swan Catchment	Horticulture	irrigators and industry officers	Controlling water on and off the paddock
Irrimate™	Executable file	All of Australia	Broadacre — cotton, grains, sugar	Irrigators, Consultants	Controlling water on and off the paddock
Irrimate™ Seepage and Evaporation Meter	F. instrument	All	All	irrigators	Controlling water on and off the paddock
Irrisoft SIPHON	Website	All of Australia	Broadacre irrigators who use siphons		Controlling water on and off the paddock
IrriWiseTM	Executable file	All	All	Irrigators and advisers	Controlling water on and off the paddock
OVERsched	Website	All of Australia	Broadacre irrigators — Cotton, grains, grazing	Irrigators	Controlling water on and off the paddock
PERFECT	Executable file	Queensland	Grains, Pasture	Consultants	Controlling water on and off the paddock
Pressure irrigation system uniformity evaluation	Spreadsheet	ALL	ALL	Irrigators	Controlling water on and off the paddock
Pump Costs v.2	Executable file	Queensland	Horticulture	Irrigators	Controlling water on and off the paddock
Safe Gauge	Executable file	Queensland	Sugar	Irrigators	Controlling water on and off the paddock
SIRMOD	CD ROM	All	Furrow and border irrigation	Consultants, Scientists	Controlling water on and off the paddock

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
SMART Metering System*		All	Regions using closed pipe irrigation systems — generally drip	Irrigators	Controlling water on and off the paddock
Solid Set Sprinkler uniformity calculator	Website	All	All	Irrigators and advisors	Controlling water on and off the paddock
Solute Signatures*	Equipment and Executable file	All of Australia	Primarily Horticulture but applicable to all industries	Consultants, Irrigators	Controlling water on and off the paddock
Travelling irrigator distribution uniformity calculator	Spreadsheet	All of Australia	Broadacre irrigators	Irrigators, Consultants	Controlling water on and off the paddock
Travelling irrigator uniformity Calculator	Spreadsheet	All	All	Irrigators and advisors	Controlling water on and off the paddock
Uniformity Calculator				Advisors	Controlling water on and off the paddock
WaterBalance		Queensland	Sugar	Irrigators	Controlling water on and off the paddock
WETSUP	Executable file	All of Australia	Drip Irrigators	Consultants	Controlling water on and off the paddock
WinSRFR 1.0©	Executable file	All	Surface Border Check and Furrow Irrigation	Irrigation specialists, Irrigators, extension agents and researchers	Controlling water on and off the paddock
IrriMAXTM 7	Executable file	All of Australia	All industries which use soil water monitoring instruments. The products have applications in agriculture, turf, mining and environmental management	Consultants and irrigators	Controlling water on and off the paddock
PIMS*	Spreadsheet	All	All	Consultants	Controlling water on and off the paddock
WATERTRACK RAPID ™	Website	All of Australia	Broadacre, Grains, Cotton, Sugar, Rice, Dairy	Consultants and irrigators	Controlling water on and off the paddock
AgET	Executable file	Western Australia	All Industries	Irrigators, Consultants	Crop Water Use
Annual Irrigation Requirement for Horticulture Crops 2nd ed	Spreadsheet	S.A.	Horticulture	Irrigators	Crop Water Use
APSIM	Executable file	All of Australia	Grains	Consultants	Crop Water Use

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
Aquaflex software	Executable file	All	All except rice	irrigators and advisors	Crop Water Use
Aquaman	Executable file	Queensland	Peanut	Irrigators	Crop Water Use
Cane-Grower implemented drying-off irrigation scheduling on the Tableland*		Atherton Tablelands	Sugar cane	Cane growers	Crop Water Use
Crop Check 500		Northern Victoria	Grains	Growers, Extension	Crop Water Use
Crop irrigation requirement calculator	Executable file	Western Australia	Annual and perennial crops	Irrigators	Crop Water Use
Crop Optimiser*	Executable file	All	All	Government Agencies/ strategic planners.	Crop Water Use
DailyET	Executable file	All locations	All industries	Consultant	Crop Water Use
HowLeaky?	Executable file	All	All	Consultants, extension and trainers	Crop Water Use
HowMuch?	Executable file		Grains	Irrigators	Crop Water Use
IrriCalc	Executable file	All. The program has no geographical limitations as each copy is tailored to suit the local climate.	Cropping, Grazing, Pasture	Irrigators	Crop Water Use
irriGATEWAY Precision Irrigator*	Executable file	All of Australia	All industries	Consultants, Scientists	Crop Water Use
irriGATEWAY SMS ETo	SMS message	All of Australia	All industries	Irrigators	Crop Water Use
irriGATEWAY SMS Scheduler	SMS message and some equipment	All of Australia	All industries	Irrigators	Crop Water Use
Irrigation Informatics System(TM)*					Crop Water Use

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
Irrigation of Vegetables on Sands in WA	Website and Spreadsheet	Western Australia vegetable growing regions — Albany to the Ord	Vegetable	Vegetable growers and industry officers	Crop Water Use
Irrisoft BUDGET	Executable file	International	All industries	Consultants	Crop Water Use
MaizeMan	Executable file	Southern NSW	Maize	Consultants	Crop Water Use
NPRO	Executable file	All	All	Irrigators, consultants,researchers, training institutions	Crop Water Use
PRIDE	Executable file	Victoria	All industries in the region	Water supply companies, or those responsible for extraction on a large property.	Crop Water Use
Probe for Windows	Executable file	All of Australia	All industries	Irrigators, Consultants	Crop Water Use
SWAGMAN Destiny GIS	Executable file	NSW	Grains	Irrigators, Consultants	Crop Water Use
SWAGMAN® Farm	Executable file	Southern Australia	Grains, Pastures	Irrigators, Consultants	Crop Water Use
Tools for Irrigation Profitability and Longevity*	Executable files and spreadsheets	All of Australia	All industries	Irrigators, Consultants	Crop Water Use
VineLOGIC™	Executable file	All of Australia	Viticulture	Consultants, Trainers	Crop Water Use
Water Budget Calculator*	Spreadsheet	Swan Catchment	Any industry	Irrigators and industry officers	Crop Water Use
Water Quality Calculator	Website	Queensland, NSW	Cotton	Irrigators	Crop Water Use
Water Usage Stewardship protocol	Worksheet	All	Grazing Horticulture Cotton Dairy Sugar	Irrigators, commercial extension services.	Crop Water Use
WaterSense	Website	Queensland, Western Australia (Ord)	Sugar	Irrigators, Consultants	Crop Water Use
WeatherFare*	Spreadsheet	NSW	Broadacre and Horticulture	Consultants	Crop Water Use

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
Yield Prophet®	Website	Australia	Grains	Irrigators, Consultants	Crop Water Use
Irrigation Performance Benchmarking*	website	Queensland	Dairy, Horticulture	Irrigators	Crop Water Use, Controlling water on and off the paddock
RART	Spreadsheet	ALL	ALL	ALL	Crop Water Use, Controlling water on and off the paddock
Salinity and Leaching Calculator*	Executable file	All	Primarily horticulture, but suitable for all irrigated enterprises	Irrigators, Consultants	Crop Water Use, Controlling water on and off the paddock
WATERTRACK OPTIMISER™	Executable file	All	All	Irrigators	Crop Water Use, Controlling water on and off the paddock
AquaSpy TM Viewer	Executable file	All regions	All regions	All irrigators and advisors	Crop Water Use, Forecasting & Record keeping
CropMan		WA	Grains	Irrigators, Consultants	Crop Water Use, Forecasting & Record keeping
IRRIGATE*	Website	All of Australia	All industries	Irrigators, Water supply companies,	Crop Water Use, Forecasting & Record keeping
MMMR systems*		All	All	Irrigators, water suppliers and regional planners	Crop Water Use, Forecasting & Record keeping
Almond Daily Water Budgeting Spreadsheet	Spreadsheet	Not known	Almond industry	Irrigators	Forecasting & Record keeping
Consumption Tracker	Spreadsheet	South Australia	All irrigators	South Australian irrigators	Forecasting & Record keeping
Continuous Sharing	online	St George Irrigators.	All	Irrigators	Forecasting & Record keeping
Costing an irrigation system (net margin calculator)	Website	All of Australia	All industries	Irrigators	Forecasting & Record keeping
Daily soil moisture records analyser	Executable file	WA	Horticulture	Irrigators and industry officers	Forecasting & Record keeping

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
Farm Enterprise Budgets	Website	NSW, but readily adapted for other areas	Grazing, Grains, Horticulture	Irrigators, Consultants	Forecasting & Record keeping
FARMWEATHER	Fax	All of Australia	All rural industries	Irrigators	Forecasting & Record keeping
Forecasting System*	Website	Sunwater districts in Queensland	All	Irrigators	Forecasting & Record keeping
HARTT Hydrograph Analysis — Rainfall and Time Trend	Spreadsheet				Forecasting & Record keeping
HowOften?	Executable file	All of Australia	All industries	Irrigators	Forecasting & Record keeping
IPART*				Consultant, Trainer	Forecasting & Record keeping
IRESTM	Worksheet or spreadsheet	South Australia	Horticulture	Intended for use by growers on irrigated horticultural properties with pressurized irrigation systems.	Forecasting & Record keeping
Irrigation Risk Management Toolkit	Worksheet or spreadsheet	All of Australia	Horticulture, Dairy, Rice	Irrigators	Forecasting & Record keeping
Magpie	Executable file	All	All	Irrigators, Consultants	Forecasting & Record keeping
Multi-Log	Executable file	All of Australia	All industries	Irrigators, Consultants	Forecasting & Record keeping
Patch tool for vines	Spreadsheet	Mallee SA	Viticulture	Grape growers	Forecasting & Record keeping
Property Rationing Tool CCW	Spreadsheet	Mallee SA	Primarily viticulture	Growers	Forecasting & Record keeping
Pump Efficiency Cost Calculator	Spreadsheet	All	All	Irrigators and advisors	Forecasting & Record keeping
Rainfall Reliability Wizard*	Website	All of Australia	All	Irrigators	Forecasting & Record keeping
Rainfall to Pasture Growth Outlook tool	Website	All of Australia	Grazing	Irrigators	Forecasting & Record keeping

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
RAINMAN	CD-ROM based software package	All of Australia	All industries	Irrigators, Consultants, Scientists	Forecasting & Record keeping
SCOPIC	Executable file	This software has specifically been designed for the Pacific Island Countries It has been used in many case studies in Australia.	Any climate sensitive industries with measurable monthly time-series data.	Users trained in the basics of climate science.	Forecasting & Record keeping
SILO	Website	All of Australia	All industries	Grower, Consultant, Engineer/Surveyor, Trainer	Forecasting & Record keeping
terraGIS	website	Cotton growing regions in NSW	Cotton and grains	Consultants, irrigators, government	Forecasting & Record keeping
Water Benchmarking Tool	Website	NSW, Queensland	Cotton	Irrigators	Forecasting & Record keeping
Water Budget Tool	Spreadsheet	Northern Victoria but it could be adapted for other regions	Dairy	Irrigators and consultants	Forecasting & Record keeping
Water Budgeting Tool — Monthly	Spreadsheet	SA Mallee	Horticulture	Irrigators and advisors	Forecasting & Record keeping
Water Budgeting Tool — Seasonal	Spreadsheet	Mallee SA	Horticulture	irrigators and advisors	Forecasting & Record keeping
Water Trade Decision Tool	Spreadsheet	SA Murray irrigators	Known horticulture crops on the Murray.	Irrigators and advisors	Forecasting & Record keeping
Water Use Benchmarking	Spreadsheet	Dairy regions in Victoria	Dairy	Irrigators and trainers	Forecasting & Record keeping
Waterworks	Executable file	All	Grains	Consultants	Forecasting & Record keeping
WISDAM	Spreadsheet	Western Victoria	Dairy	Dairy Irrigators and advisors	Forecasting & Record keeping
FlowCast	Executable file	All	All	Users trained in the basics of climate science.	Forecasting & Record keeping,
Catcher	Executable file	Western Australia	All industries	Consultant	Forecasting & Record keeping, Crop Water Use
Crop Irrigation Water Requirement Tool	Spreadsheet	Katherine, N.T.	Mango — this is likely to expand	Irrigators, DPIFM staff	Forecasting & Record keeping, Crop Water Use

On-farm Irrigation Information Tool	Type of tool	What Regions?	What industries?	Which users?	Category of tool
Channel Seepage Decision Support Tool: Cost_ Calculator_V08_June2004. xls	Spreadsheet	Originally regions serviced by water supply authorities.	All.	Likely to be large irrigation farm advisors where the farm has its own extraction and storage facilities	Storage & Delivery
DAIRYBAL	Spreadsheet	Queensland	Dairy	Irrigators	Storage & Delivery
DamEa$y	Executable file	Queensland	Sugar	Irrigators, Consultants	Storage & Delivery
Evaporation Ready Reckoner	Spreadsheet	Australia-wide	All	Growers, Consultants, Engineers, Surveyors	Storage & Delivery
Storage Dam Evaporation Mitigation*	Equipment and Executable file	All of Australia	All industries	Irrigators	Storage & Delivery
Terramodel Engineering and Surveying software	Executable file	All	Industries using channels and landformed irrigation areas — generally surface	Irrigation designers	Storage & Delivery
WaterSupply		All of Australia	All industries	Consultants	Storage & Delivery
Winflume	Executable file	Australia	Channel irrigation systems	Engineer/Surveyor	Storage & Delivery

7. ON-FARM IRRIGATION INFORMATION TOOLS — DISCUSSION

Each irrigation manager and their enterprise are unique in their requirements but there are some general criteria that can be considered in deciding the usefulness of an on-farm irrigation information tool — such as that the tool will help provide the optimum financial return and be based on improving environmental sustainability.

The tool should match the irrigation manager's current skill level. For example it is of little value providing EXCEL spreadsheets to the irrigator if they are computer illiterate or lack an understanding of the input measurements required. There is a need for either training, or extension support; and this is what a number of initiatives have been addressing. In these cases, managers could be encouraged to consider purchasing the services of specialist consultants. Irrigation managers can be expected to progress with the irrigation tools that they use. The tools that are the entry point for managers may lead to usage of more complex tools in the future which offer a greater range and/or depth of useful information.

Irrigators are versatile and can adapt to the changing circumstances that the industry faces. They are likely to make the greatest water use efficiency gains in fixing losses due to infrastructure problems, seepage or evaporation; or in improving management decisions that improve crop yield and optimise water use. Many managers are well aware that gains can be made. However on-farm improvements may not translate to an increase in income because of additional capital and/or recurrent investment required to realise the gains. It may not be in the business interests of the manager to implement changes.

In our opinion, the most useful information tools in terms of meeting the Department's objective will focus on one or more of the following substantial water use efficiency issues:

1. mitigation of seepage and evaporation from farm dams and farm channels through better tools to identify losses and cost-effective remedies,
2. measurement and better management of the root zone's soil water profile and leaching fraction; and as a result, better management of any deep drainage,
3. tailwater return for re-use,
4. ensuring that the irrigation method in the field matches the soil infiltration rates, and
5. refinement of crop coefficients and local evapotranspiration rates for use in irrigation scheduling calculations.

Tools are generally available in some form to support best practice for the first three issues, but there is a need to analyse whether:

(a) there are a range of tools suitable for the various skill levels irrigators have,

(b) there is sufficient support for their adoption and long term use,

(c) it will be cost effective to undertake any remedial work to act on the information provided by the tool i.e. to undertake the investments required to improve the water use efficiency, and

(d) it will be a sufficient priority for the irrigator to dedicate time to solving the issue.

For issues four and five there are a number of constraints. Detailed soil surveys are lacking and considerable variation exists in the quality of current information on water infiltration rates within irrigation paddocks. There is a need to better characterise the infiltration rates of soils which occurs at the irrigation paddock level and how these vary due to the effects of 'preferred drainage pathways' through the soil which decrease the effectiveness of infiltration and reduce the efficiency of processes to leach salts from the root zone (see for example Currie et al., 2004 and Grant et al., 2001). Finally more work is needed to better understand how soil infiltration rates change with repeated wetting and drying of different soils and other effects of human intervention within the root zone, such as laser grading, vegetation management and chemical additions to the soil (such as polyacrylamide).

Within-paddock variation in soils can be measured using various geophysical survey techniques (Allen, 2007) and these can lead to recommendations for re-design of irrigation layouts to better match soil types. While many farm layouts may be sub-optimal, there is a cost-benefit trade-off in deciding whether to re-engineer the farm layout (and not create different environmental and technical problems)[5].

Developing local crop coefficients has been an issue for sometime. The Irrigation Futures CRC has a project "Development of a nationally standardised Evapotranspiration reference and regional crop coefficients" that is designed to address this shortfall in data[6]. In the mean time best estimates are being applied in areas where the detailed work has not occurred.

5 There has been considerable investment in initiatives to help address this issue, such as to promote and subsidise farm management plans (Land & Water Management Plans, Whole Farm Plans etc.)

6 www.irrigationfutures.org.au/projects.asp?ID=23

As water supply organisations move closer to on-demand ordering, there is the opportunity for the irrigation manager to further refine irrigation scheduling and reduce the amount of water applied to the crop. There is also the opportunity — even with surface irrigation–to run regulated deficit irrigation in some situations to ensure the maximum benefit from any rainfall event. With refinements such as these it is increasingly important that probability and risk information tools be available to help inform the irrigation decision.

All information tools need to offer pathways for the transfer of data via telemetry systems. To be useful, the communication systems must be compatible and data must be available on a common platform that allows it to be used by current and emerging information tools. This has been recognised by some system developers such as Agrilink, Rubicon and Aquatech who are striving towards the use of a common platform for ease of data transfer. Other companies wishing to protect source code are looking at ways to be able to easily convert and transfer the data by a common code e.g. Netafim. This issue needs further investigation in the gap and needs analysis.

Bibliography

Allen, D.	(2005) A review of geophysical equipment applied to groundwater and soil investigation. 77pp. National Program for Sustainable Irrigation www.npsi.gov.au
Allen, D.	(2007). Geophysics for the Irrigation Industry. Irrigation Insights No. 7, National Program for Sustainable Irrigation (NPSI), Land and Water Australia (LWA): 180 pp. **http://products.lwa.gov.au/downloads/publications_pdf/PR071288.pdf**
Allen, R. G., Pereira, L.S. Raes, D., Smith, M.	(1998) Crop Evapotranspiration – guidelines for computing crop water requirements FAO Irrigation & Drainage Paper 56. Food & Agriculture Organisation of the United Nations http://www.fao.org/docrep/X0490E/x0490e04.htm#evapotranspiration%20process accessed from the web 230907
Cape, J., Agbodo,E.	(1997) Development of value selection method of choosing between alternative soil water sensors. NPIRD Land & Water Australia. http://knowledgebase.npsi.gov.au/
Currie, D.R., Grant, C.D. Murray, R.S., McCarthy, M.G.	(2004). Soil structural degradation in irrigated viticulture: the impact of irrigation on the integral water capacity of vineyard soils. SuperSoil 2004 conference, University of Sydney, Australia. http://www.regional.org.au/au/asssi/supersoil2004/s14/oral/1504_curried.htm
Charlesworth, P.	(2005). Soil Water Monitoring. 2nd edition Irrigation Insights No. 1. National Program for Sustainable Irrigation (NPSI), Land and Water Australia (LWA) Land & Water Australia: 100pp. http://www.lwa.gov.au/downloads/publications_pdf/PR050832.pdf
Fairweather,H., Austin,N., Hope,M.	(2003) Water Use Efficiency: an information package. Irrigation Insights No. 5 Land & Water Australia. http://www.lwa.gov.au/downloads/publications_pdf/PR030566.pdf
Grant, C.D., Angers, D.A. Murray, R.S., Chantigny, M.H., Hasanah, U.	(2001). "On the nature of soil aggregate coalescence in an irrigated swelling clay." Australian Journal of Soil Research 39: 565-575.
Horticulture Australia Ltd	(2006) Water Recycling in Australia. National Program for Sustainable Irrigation, Arris Pty. Ltd., Victorian Dept. Primary Industries. http://knowledgebase.npsi.gov.au/?Ref=1227
Inman-Bamber, G. Attard, S.	(2005). Inventory of Australian Software Tools for On Farm Water Management. Technical Report No. 02/05. Cooperative Research Centre for Irrigation Futures, 78pp.
Irrigation Association (USA)	Glossary of irrigation terms http://www.irrigation.org/gov/default.aspx?pg=glossary.htm&id=106 accessed from the web 230907
Jarwal, S., Boland,A-M., Stevens,D., Faggian,R.	Using recycled water in Australia — a growers guide http://knowledgebase.npsi.gov.au/?Ref=1229 Department of Primary Industries, Victoria. http://knowledgebase.npsi.gov.au/?Ref=1229
Kriedemann, PE., Goodwin,I	(2003) Partial Rootzone Drying & Regulated Deficit Irrigation. Irrigation Insight #4 National Program for Sustainable Irrigation
Meldrum, D., Adams,T	(2004) Tools for improving irrigation water use efficiency: a case study of actitivities in the South Australian Riverland, 2001–03 and beyond. Irrigation Association of Australia conference 2004
Montagu, K. et al	(2006) Understanding Irrigation Decisions — from enterprise planning to the paddock. Irrigation Insight #6 National Program for Sustainable Irrigation http://www.npsi.gov.au
National Water Commission	Water Resources — glossary and definitions http://www.water.gov.au/Glossary.aspx viewed 230907
NSW Dept. Primary Industries	Glossary of water terms http://www.waterinfo.nsw.gov.au/glossary.html accessed from the web 23 09 07
Okello-Okanya John	(2004) Queensland Rural Water Use Efficiency Initiative (RWUEI), Its Impact on the Irrigation Industry and its Role in the Water Reform Process. Irrigation Association of Australia conference 2004

Purcell & Associates	(2003) Gaining Acceptance of Water Use Efficiency Framework, Terms & Definitions. National Program for Sustainable Irrigation AQC1 http://knowledgebase.npsi.gov.au/knowledge.asp?Ref=19
Qld. Dept. Primary Industries & Fisheries	**(2004) Irrigation for Profit–Three years from March 2000–June 2003. Agdex 410/560**
Stirzaker, R.	(2006) Soil Moisture Monitoring: State of Play and Barriers to Adoption. CRC Irrigation Futures irrigation Matters Series No.01/06
Stirzaker,R., Sunassee,S., Wilkie,J	(2004) Monitoring water, nitrate and salt on-farm: a comparison of methods. Irrigation Association of Australia 2004 conference http://www.irrigation.org.au/2004Proceedings/Richard%20Stirzaker.doc accessed from the web 180907
Victorian Dept. Primary Industries	Irrigation system selection and design guidelines http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_efficient_irrigation_wheel accessed from the web 250907
Victorian Dept. Sustainability & Environment	Water use efficiency on-farm technical reference booklet http://www.dse.vic.gov.au/DSE/wcmn202.nsf/LinkView/C25069B0D392E4E2CA256FE100157CA8D236CD5640C79B2ECA256FDD00136E2F accessed from the web 021007
Ward,G., Jacobs,J., McKenzie,F.	(2006) Making the most of irrigation water in south west Victoria — a guide to improving irrigation water use efficiency on dairy farms. Department of Primary Industries, Victoria.

Glossary

Aquifer	An underground geologic water-bearing formation capable of transmitting quantities of water to bores or other abstraction facilities. Removing more groundwater from an aquifer than is naturally replenished can result in a dropping water table, land subsidence (which reduces the future recharge capacity), saltwater intrusion, reduced streamflows in interconnected ground- and surface-water systems, and exhaustion of groundwater reserves
Benchmarking irrigation practice	A process of evaluating various aspects of the irrigation system and method and crop performance that enables comparison of 'like' with 'like' across enterprises or regions. Helps identify areas where improvements can be made.
Best management practice (BMP)	An irrigation BMP is a voluntary irrigation practice that is both economical and practical and is designed to reduce water consumption and protect water quality while maintaining or improving crop productivity and maintaining a healthy, functional landscape.
Border check irrigation — flood irrigation	The method of irrigating by flooding a paddock that is confined by raised banks. Usually the paddock is subdivided into 'bays' which have a very slight grade down to the tailwater drain.
Centre pivot irrigation	A mechanical irrigation device consisting of a single raised pipe that rotates around a centre pivot point, with sprinklers spaced along the pipe.
Conjunctive water use — "Shandying"	Joint use of water from two or more sources for the purposes of irrigation. Typically water of higher salinity is shandied with fresh water to keep the salinity concentration below a threshold level that would be damaging to the crop.
Crop Water Use Efficiency	This term has a long standing history of use by agronomists defined as: $\frac{\textbf{Crop production (kg)}}{\textbf{Evapotranspiration (mm)}}$ To encourage consistency in understanding of water use efficiency, it is now preferred to refer to this as "Crop Water Use Index".
Crop Coefficients	Dimensionless coefficient used to calculate evapotranspiration requirements of a particular crop from the potential evapotranspiration of a reference crop. Crop coefficients are determined experimentally and take into account leaf area, development of the crop and the crop canopy physiology.
Data Loggers	Data loggers are low power devices designed to automatically record data (e.g. from water meters) in unattended locations. They are powered by internal battery or solar panel and have communication ports which enable download to laptop computers on-site or remotely via telemetry. Send and retrieve programs can download or upload data and/or set the data logger clock. See telemetry.
Deep drainage / deep percolation	Movement of water downwards below the plant's root zone that cannot be used by the plant. This is a substantial waste of water on-farm that can be overcome by best irrigation management practices including irrigation scheduling. There are some instances where irrigation water should be applied in sufficient quantity to move beyond the root zone, such as where water quality is quite saline resulting in a build-up of salts around the root zone. In such cases leaching of salts away from the root zone by application of irrigation and/or rainfall is required. See leaching requirement.
Deficit Irrigation	An irrigation practice where the amount of supplementary water applied as irrigation is reduced to only a fraction of potential evapotranspiration from a well-watered reference crop (ETo). In regulated deficit irrigation, mild to moderate plant moisture stress is allowed to develop at a stage in growth and development that has little or no effect on yield.
Distribution Uniformity	See Uniformity of distribution
Drainage system **- sub surface** **- surface**	A system of drainage pipes, wells, ditches and/or pumps designed to intercept and remove excess groundwater so as to control the water table to be below the root zone A system of open drainage channels, modified natural waterways and/or storages designed to collect drainage from rainfall or irrigation events on rural lands and convey it to a disposal point. A system may include private, public (water authority) and community works. The systems usually comprise regional and on-farm works.

Drip irrigation	A method of applying water to plants, using a low flow rate via dripper emitters, or a small diameter pipe with holes along its length or a small diameter pipe with permeable walls. Mainly used on high value permanent plantings.
Electrical conductivity	A measure of the ability of water to conduct an electric current between electrodes placed in a sample of the water; the value obtained relates to the nature and amount of salts present in the water and increases with concentration. Usually expressed in micro siemens per centimetre (_S/cm) or deci-Siemens per metre (dS/m).
Encoder	A device that translates sensor outputs (eg water level movement) into computer-readable data.
Evaporation	Physical process by which a liquid is transformed to the gaseous state, which in irrigation generally is restricted to the change of water from liquid to vapour. Water evaporates from a variety of surfaces, such as dams, channels, rivers, soils and wet vegetation.
Evaporation Pan	If evaporation figures for the farm district are not available from newspapers or some other source, then another option is to install an evaporation pan. The accepted standard pan for measuring evaporation throughout Australia and overseas is known as the “Class A” pan — a circular galvanized tank 1.2m in diameter containing water 0.25m deep. Evaporation can be calculated in mm.
Evapotranspiration (ET)	The combination of two separate processes whereby water is lost on the one hand from the soil surface by evaporation and on the other hand from the crop by transpiration is referred to as evapotranspiration. At sowing nearly 100% of ET comes from evaporation, while at full crop cover more than 90% of ET comes from transpiration. It is important to be able to quantify evapotranspiration as a component of possible water savings measures.
Crop evapotranspiration (ETc)	ETcrop or ETc refers to an estimate of evapotranspiration from an actual crop (eg orchard). The crop evapotranspiration under standard conditions, denoted as ETc, is the evapotranspiration from disease-free, well-fertilized crops, grown in large fields, under optimum soil water conditions, and achieving full production under the given climatic conditions
Reference evapotranspiration (ETo)	The evapotranspiration rate from a reference crop, not short of water, is called the reference crop evapotranspiration or reference evapotranspiration and is denoted as ETo.
Fertigation	Application of nutrients to the crop through the irrigation system.
Field capacity	A practical measure of soil water-holding capacity. The amount of water remaining in the soil when the downward water flow due to gravity becomes negligible. Field capacity is characterised by measuring water content after wetting a soil profile, covering it (to prevent evaporation) and monitoring the change in soil moisture in the profile. Water content when the rate of change is relatively small is indicative of when drainage ceases and this is called Field Capacity.
Fixed sprinklers / solid set irrigation	A method of irrigating where sprinklers are fixed in place.
Flume	A structure through which water flows that has been specifically designed to enable the volume of water to be calculated.
Furrow Irrigation	A method of irrigating by supplying water to the plants via a narrow earthen channel running beside rows of plants.
Geographic Information System (GIS)	A digital information (computer based) mapping system with features referenced by spatial and geographic coordinates. Maps can be rapidly built or changed by adding in various ‘layers’ of information (such as soil type, drainage, farm boundaries etc.).
Gigalitre (GL)	1,000,000,000 litres or 1 million cubic metres or 1 million kilolitres (kL).
Groundwater	Water held beneath the earth’s surface.
Gypsum block	Electrical resistance block in which the material used to absorb water is gypsum. It is used to measure soil water content in non-saline soils.

Infiltration	The process of water entering and moving through the soil profile.
Input data	To ensure on-farm decisions (e.g. when to schedule the irrigation event) optimise water use efficiency, a range of data is required. To make the range of data usable, it can be treated as input data to calculations or information tools.
Irrigation design	Plan of an irrigation system with pipe sizing, head layout, valve location etc.
Irrigation efficiency	Irrigation efficiency is an important performance indicator in an irrigated cropping context. It is important to recognise the difference between irrigation efficiencies and water use indices. Irrigation efficiencies specifically review the volumetric efficiency of elements of an irrigation system and can be considered in isolation from crop production. When considering irrigation efficiencies, spatial and temporal parameters need to be defined. It is necessary to be very specific about the spatial extent of the area under study and the timeframe over which performance is reviewed. For instance, a single irrigation application lasting less than one day on a single field will have different efficiencies (and water use indices) and measurement challenges than a full season irrigation over a large irrigation region.
Irrigation information tool	An instrument, apparatus or device that helps transform various data inputs (such as from various measuring and monitoring equipment calibrated to produce on-farm data) into information outputs for irrigators to optimise their water use efficiency.
Irrigation Interval	The optimum irrigation interval is the number of days a crop can go between irrigations without suffering reductions in yield.
Irrigation schedule	When to start and finish the irrigation event. A number of methods to determine this are used ranging from the simple (e.g. time based) to more complex (e.g. evaporation measurement) to detailed assessments (e.g. multiple inputs to the calculation including measurements of soil water content). To optimise water use, information tools that value-add to multiple data inputs are required to aid decision making.
Irrigation system	Refers to the type of system and its physical components (pumps, pipes, gates, drip lines etc.) to deliver water to the design area. The irrigation system can affect water use efficiency in a number of ways such as not being capable of applying enough water to the area being irrigated within the required time that would minimise waste and meet crop needs. Different irrigation industries and different regions throughout Australia vary considerably in irrigation system type and language. Some concepts are:
Green Field Site –	A green field site is a site with no or limited existing infrastructure. A detailed planning process is required to develop it to productive flood or pressurised irrigation. Not having an irrigation system already in place allows flexibility in the development to be undertaken.
Laser graded border-check irrigation –	A laser graded border-check system is often (but not always) designed and implemented as part of a whole farm plan. Earth moving using laser-controlled equipment allows for well constructed bays, channels and drains and accurate slopes, allowing efficient irrigation. However, some laser graded irrigation systems may be on permeable soils, resulting in excessive deep seepage, or may be otherwise inefficient. It may be possible to improve such systems with better management, or it may be desirable to replace them with a more efficient system that matches the soil's infiltration characteristics.
Non-laser graded border-check irrigation	These layouts normally follow the natural slope with no or limited disturbance to the soil. They may be developed into a well-designed laser graded border-check irrigation layout or may be changed to a pressurised irrigation system.
Pressurised Irrigation –	These systems use energy to transport water from its source to the paddock. They consist of a water source, a pumping unit, a pipe system, and a means by which water is applied to the crop. There are a variety of irrigation methods available to pressurised systems that can be very efficient, such as centre pivot and lateral moves.
Irrigation Method	The method of applying water to a particular site on the farm. It needs to be compatible with the irrigation system. Examples of irrigation methods are furrow irrigation and drip irrigation (used in pressurised irrigation systems).
Irrigation Tool	See Irrigation Information Tool
Land & Water Management Plan	See Whole Farm Plan

Lateral move	Similar to centre pivot except the supply pipe moves laterally across the paddock.
Leaching	Removal of soluble material from soil or other permeable material by the passage of water through it.
Leaching fraction	Ratio of the depth of subsurface drainage water (deep percolation) to the depth of infiltrated irrigation water
Leaching requirement	Quantity of irrigation water required for moving salts through the soil profile (away from the root zone) to prevent salt build up around the root zone.
Megalitre (ML)	Unit of volume — 1,000,000 litres. About one Olympic size swimming pool.
Meter	A flow measuring device fitted at different points in the irrigation system or method. Meters can be mechanical (e.g. Dethridge wheel), ultrasonic or magnetic.
Millilitre (ml)	Unit of volume–one thousandth of a litre
Monitoring network	The collection of monitoring sites where measurements are taken for a common purpose/ project, e.g. the salinity network is all those sites where electrical conductivity measurements are taken
Plant available water (PAW)	Water that the plant is able to extract from the soil. Measuring absolute soil moisture is simple, but measuring PAW is only ever an approximation.
Permeability	The ability of a material to allow the passage of a liquid such as water through rocks. Permeable materials such as gravel and sand allow water to move quickly through them, whereas impermeable material, such as clay, is resistant to the passage of some or all fluids.
Precipitation	All forms in which water (H_2O) falls to the ground as rain, sleet, snow, hail, drizzle or other specialised forms, and also the amounts measured (mm).
Readily available water (RAW)	The range of plant-available soil moisture between field capacity and the onset of mild moisture stress (as sometimes indicated by temporary wilting under conditions conducive to fast ET as occurs on a hot dry windy day).
Reclaimed water Recycled Water	Waste water that has been treated to make it reusable for one or more applications. The process of treatment produces recycled water.
Refill Point	When the amount of water in the soil falls below a certain point, plant growth slows. This is a survival mechanism and although the plant may still look healthy, it has stopped growing. The plant must therefore be watered before this point (level of soil water) is reached.
Regulated deficit irrigation (RDI)	The practice of using water application (irrigation) to maintain vine water status within prescribed limits of deficit with respect to maximum water potential for a prescribed part or parts of the seasonal cycle of plant development for the purpose of controlling reproductive growth and development, vegetative growth or improving water use efficiency or both.
Re-use Water	Beneficial and planned use of recycled or treated water for purposes such as irrigation.
Root zone	Area of the soil from which the crop roots extract water and nutrients.
Salinity	The amount of salt present in solution. Can be a descriptive term (e.g. good) or can be expressed as a value in milligrams per litre (mg/L) or parts per million (ppm) or dS/m.
Seepage—dam and channel	Loss of water from the dam or channel via infiltration through micropores and soil processes. Generally the term refers to losses from both seepage and leakage as the two are not easily separated.
Sensor	The component of an instrument that responds, detects or measures a physical or chemical property and records, indicates or otherwise responds to it.
Soil Water Content	A volumetric measure of water in the soil expressed either as a percentage of soil volume, or as mm of water per metre depth of soil. For example, a soil water content of 5% is equal to 50 L of water per cubic metre of soil, or alternatively, 50mm of water per metre depth of soil.
Soil Water Monitoring equipment; Soil Water Sensors	Measuring and monitoring equipment that enables the user to determine how much water is in the soil profile, and how much water the crop needs. A soil water sensor is an instrument which, when placed in a soil for a period of time, provides information related to the soil water status of that soil.

Soil Water Tension	The tenacity with which water is held within soil pores and on soil particles and commonly expressed as the suction required (in kPa) to draw water from that soil. Tension increases as soils dry down from field capacity (notionally equivalent to a suction of 10 kPa) to permanent wilting point (notionally equivalent to a suction of 1500 kPa, 1.5 Mpa; or as traditionally cited, 15 bars).
Sub-surface drainage system	See Drainage system
Sub-surface drip irrigation	Application of water below the soil surface through emitters, with discharge rates generally in the same range as drip irrigation.
Surface drainage system	See Drainage System
System capacity	Ability of an irrigation system to deliver the net required rate and volume of water necessary to meet crop water needs plus any losses during the application process. Crop water needs can include soil moisture storage for later plant use, leaching of toxic elements from the soil, air temperature modification, crop quality, and other plant needs.
Tail water	Excess irrigation water that reaches the end of an irrigation field
Telemetry	Enables remote download and upload of data. Typically consists of a data logger and modem, linked to computer via a telecommunications network such as radio networks, mobile or satellite phone.
Tensiometer	An instrument that can be used to measure the availability of water in the soil for plant use. Tensiometers are simple, easy to use and relatively inexpensive. They are an aid to making irrigation management decisions, but should be used in conjunction with other input data to the irrigation management decision.
Transpiration	Transpiration consists of the vaporisation of liquid water contained in plant tissues and the vapour removal to the atmosphere. Crops predominately lose their water through stomata. These are small openings on the plant leaf through which gases and water vapour pass. The water, together with some nutrients, is taken up by the roots and transported through the plant. The vaporisation occurs within the leaf, namely in the intercellular spaces, and the vapour exchange with the atmosphere is controlled by the stomatal aperture. Nearly all water taken up is lost by transpiration and only a tiny fraction is used within the plant.
Uniformity of Distribution	An in-field performance indicator that describes how evenly irrigation water is applied throughout a field. Application efficiency and uniformity of distribution of an irrigation event are closely linked but should be considered independently. E.g. an irrigation event may apply an average application equal to the total average soil moisture deficit, but over irrigation may occur in parts of the field and under irrigation may occur in other parts. The application efficiency of this event could be high but the uniformity of distribution could be low and the irrigation would be unsatisfactory.
Valve	A device that controls the flow of water through an irrigation system
Wastewater	Water that has been disposed of after it has been used
Water Balance	An equation used to describe the flow of water in and out of a defined area such as a field or catchment.
Water Budget	A reliable estimate of the water requirements of the crop. Includes considerations such as the contribution than any rainfall has made, or required losses such as deep leaching.
Water Use Efficiency	The label used to discuss water use indices and irrigation system efficiencies — it is the effectiveness with which an irrigated enterprise converts water obtained from an irrigation supply plus rainfall, into a saleable product. Under each performance indicator is a number of specific indices and efficiencies which are clearly defined and dimensionally correct. See Water use index. See Purcell & Associates 2003

Water use index **Water use indices**	A water use performance index does not necessarily have to fit into the format of: $$\frac{\text{Unit of product}}{\text{Unit of water}}$$ Any performance index can be tailor made to suit the purpose of the study. The index must be clearly defined with units specified. For instance: bottles of chardonnay per megalitre of irrigation water applied, or boxes of oranges permegalitre of irrigation water supplied to the farm gate. The specific index used depends on the systems being compared and the parameters under review. Some examples of performance indices include: Gross Production Water use Index = $$\frac{\text{Total Product (kg)}}{\text{Total Water Applied (ML)}}$$ Irrigation Water Use Index (Applied) = $$\frac{\text{Total Product (kg)}}{\text{Irrigation Water Applied (ML)}}$$ Crop Water Use Index = $$\frac{\text{Total Product (kg)}}{\text{Evapotranspiration (mm)}}$$ Irrigation Water Use Index = $$\frac{\text{Total Product (kg)}}{\text{Irrigation Water Supplied to Farm Gate (ML)}}$$ NB “Applied” means volume of water applied to the field where “Farm Gate” means volume of water supplied to the farm gate.
Waterlogging	Process of soil becoming saturated with water (excluding oxygen from the root zone), generally for an extended period. It can be caused by surface water or groundwater and usually results in a loss of production if oxygen deprivation is extended. Engineered drainage systems and optimal irrigation scheduling are necessary to prevent this from occurring.
Whole Farm Plan	A written document mapping / outlining aspects of land and water management based on ‘best management practices’ for the district or region — taking into account physical and ecological constraints of the land. If it relates specifically to irrigation it will outline how irrigation and drainage will be managed, and include substantial engineering and survey information. Can be prepared at the field, enterprise, district or catchment scales.
Yield–crop	A measure of crop output per unit. The unit has traditionally been of land, but is often now also reported as per unit of water (megalitre)
Yield–water	The amount of water that is abstractable from a bore, (usually expressed in Litres per second (L/sec))

APPENDIX 1 LISTING OF ON-FARM IRRIGATION INFORMATION TOOLS

* indicates that the tool is under development

CATEGORY 1:
CONTROLLING WATER ON AND OFF THE PADDOCK

AddVANTAGE Pro 5.1

What is it?

AddVANTAGE Pro 5.1 collects, stores, processes and graphically displays data. It displays data graphically, as text in a table, and can inform the user about specific events, and provides a number of tools to process the data.

AddVANTAGE Pro 5.1 uses a web server, allowing users to get access from anywhere in the world through an internet connection — using a common web browser.

Regions:

All areas

Industries:

All industries

Users:

Irrigators

What is it written in?

Executable file, written in Java

Is there help available?

Australian and worldwide distribution network

References:

(2007) AddVANTAGE Pro 5.1.Adconhttp://www.adcon.at/english/produkte_software_Addvantage_Pro_51_en.html

Category:

Controlling water on and off the paddock

AgWISE

What is it?

AgWISE is generally used as web-based analysis software that can link in multiple sensor information such as soil moisture, weather and pump monitor sensors.

AgWISE can provide custom information and continuous graphing of daily weather results and estimations of evapotranspiration and risk assessment for diseases such as grape powdery mildew. The package provides details on irrigation scheduling. The program functions on the plug and play concept which makes installation of additional sensors easy and limits the need to configure each sensor. The system is dependant on the sensors available and it is possible to grow the system over time, i.e. with the number and types of sensors collecting data.

The system can be used to help analyse the system water use efficiency performance e.g. to compare a pump's output to the soil water level in the field after an irrigation. The program is written on a common platform which allows it to be integrated into systems such as Rubicon's Water Portal which then provides the opportunity to link in with water providers and, if growers wish, a water use efficiency benchmarking system at a district scale.

Input:

These are variable depending on the complexity required but generally:

- soil water information,
- weather
- irrigation water applications and, for pumping dependant systems, pump performance.

Output:

These are variable but generally include:

- Soil water moisture content is in relation to refill points,
- Days to next irrigation,
- 24 hour graphs on soil water movement in the profile,
- Evapotranspiration,
- Risk of various diseases and continuous data on weather.

The outputs can be customised.

Regions:

Any region

Industries:

All industries

Users:

All irrigators

Known Community of Users:

Scattered through all industries and regions

Where do you get it?

Agrilink

What does it look like?

Website and Executable file

What is it written in?

Open platform

Is there help available?

Different levels of commercial support are available from online to personal support. Online questions and answers available.

References:

Agrilink Holdings Pty Ltd (2007) AgWise. Agrilink Holdings Pty Ltd, South Australia. www.agrilink.net

Contacts:

PO Box 2120, Hilton, SA 5033, Australia

Category:

Controlling water on and off the paddock

AIM

What is it?

AIM is a tool for modelling border irrigation of perennial pasture on cracking or duplex soils.

AIM simulates the process of overland water flow for a given irrigation event, considering infiltration as a loss to the overland flow. AIM outputs predictions of advance, recession, infiltration distribution, irrigation uniformity and the volume of runoff.

Input:

- Irrigation bay dimensions (length (m), width (m), slope (m/m)
- Surface roughness co-efficient
- Infiltration parameters: crack fill (mm), final rate (mm/hr)
- Irrigation parameters: Application rate (ML/d), duration (minutes)
- Target irrigation calculator: Days since previous irrigation, rainfall since last irrigation (mm), pan factor, observed evaporation (mm),

Output:

- Irrigation advance and recession (m/hr)
- Maximum and minimum infiltration (mm)
- runoff (%)
- Maximum and minimum ponding time (hr)

Regions:

All of Australia

Industries:

Pasture

Users:

Irrigators, Consultants

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Manual

References:

N. R. Austin, J. B. Prendergast and D. Robertson (2000) AIM. Agriculture Victoria, Department of Primary Industries,

Contacts:

DPI Tatura, Victoria

Category:

Controlling water on and off the paddock

CENTRE PIVOT CALCULATOR

What is it?

This spreadsheet assists irrigators to calibrate their irrigator by calculating the uniformity of water spread across the paddock.

This calculator uses the weighted catch method to calculate Distribution Uniformity (DU) for a Centre Pivot irrigator. The spreadsheet calculates DU and Average Application per Pass. It assumes equal distance between catch can positions. All catch can positions from the centre out must have an entry ('X' for no measurement).

Input:

- Irrigation water at each sampling location (mm/per sample can)
- Number of samples

Output:

- Distribution uniformity (%)

Regions:

All of Australia

Industries:

Centre Pivot Irrigators

Users:

Irrigators

What does it look like?

Spreadsheet

What is it written in?

EXCEL

References:

S. Wedd, A. Palmer and P. Smith (2001) Centre Pivot Weighted Catch can Calculator. NSW Department of Primary Industries, http://www.irrigationfutures.org.au//imagesDB/messageboard/CentrePivotcalcNSWDPI2.xls

Category:

Controlling water on and off the paddock

CENTRE PIVOT UNIFORMITY CALCULATOR

What is it?

This tool allows the uniformity of the centre pivot's water application to be assessed. The results are represented in table and graphical representation.

Input:

- Catch Can Spacing (m):
- Catch Can Diameter (mm):
- Distance To First Can From Centre (m):
- No. of Cans
- Length of machine (m)
- Number of spans
- Sprinkler Wetted Radius (m):
- Last Sprinkler / End Gun Wetted Radius (m):
- Distance Travelled (m):
- Run Time (min):
- Volume in catch cans (l)
- span length (m)
- Overhang length (m)

Output:

- Average Depth (mm)
- Weighted Average Depth (mm)
- Maximum Depth (mm)
- Maximum Application Rate (mm/hr)
- Time of Rotation (hours)
- Graphical representation of the depth of water applied from the centre of the paddock

Regions:

All

Industries:

All industries

Users:

Irrigators and advisors

Where do you get it?

Dairy Australia

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Some cells have additional information if hovered over.

References:

R. Sutton Centre Pivot Uniformity Calculator. Dairy Australia, www.dairyinfo.biz/index.cfm?MenuID=104

Category:

Controlling water on and off the paddock

ENVIRONMENTAL SELF ASSESSMENTS—VITICULTURE—SUNRAYSIA REGION

What is it?

The self assessments are designed to help growers evaluate current performance and identify management areas for improvement in environmental performance. The regional code is a reference document intended to be used by growers to assist with the adoption of environmental best practices. Irrigation is one of the key areas.

Input:

Growers rate their management practices on a scale of 3 to 1 against a set of questions

Output:

Rating of on-farm management for environmental Performance

Regions:

Sunraysia

Industries:

Viticulture

Users:

Farm managers

Where do you get it?

Free from DPI website

What does it look like?

Worksheet

What is it written in?

PDF manual

Is there help available?

Full manual on environmental best practice (free, download).

References:

V. Primary Industries Research (2004) Environmental Self Assessments for Viticulture—Sunraysia Region. Primary Industries Research, Victoria, http://www.dpi.vic.gov.au/dpi/nrenfa.nsf/FID/-9D5D0AFF7C8D9661CA256CBC00042B34?OpenDocument#regional

Contacts:

PO Box 905 Mildura Vic 3502

Category:

Controlling water on and off the paddock

FarmCONNECT*

What is it?

FarmCONNECT provides a real-time linkage to farm soil moisture sensors which generates a soil moisture hydrograph. A system that uses SMS messaging can notify irrigators when soil moisture crosses critical thresholds.

Input:

- Soil moisture data from different depths in the soil (mm)

Output:

- Change in soil moisture over time, at each depth.

Outputs are displayed graphically.

Regions:

Colleambally

Industries:

All industries

Users:

Irrigators

Known Community of Users:

Colleambally Irrigations Cooperative

What does it look like?

Executable file, Website, SMS

Category:

Controlling water on and off the paddock

FIDO*

What is it?

FIDO (Furrow Irrigation Decision Optimiser), which is still under development, is a decision support system for the design and management of furrow irrigation. It integrates an optimisation engine with a proven hydrodynamic simulation-model to allow automatic determination of design and management parameters as well as prediction of infiltration and roughness parameters. The package contains a database from which seasonal trends and variations in performance can be monitored. Contains internet-explorer-like functionality for lower skilled users, but advanced analyses are available for researchers through progressive disclosure mechanisms.

Input:

- Database requires property, paddock, event and monitored-furrow details.
- Simulation parameters include flow rate, time-to-cutoff, field-length, field slope, soil moisture deficit, furrow geometry, roughness estimate, and infiltration estimate (calculated using in built inverse technique).

Output:

A range of graphical and textural outputs. Key outputs include —

- performance parameters,
- optimized design and management variables,
- field-specific design/management curves,
- system response surfaces (for research),
- infiltration and roughness parameter estimates from inverse solution.

Regions:

All of Australia

Industries:

Furrow and Border Irrigation, Cotton, Pasture, Grains, Horticulture

Users:

Irrigators, Consultants, Scientists

Known Community of Users:

Research engineers at the National Centre for Engineering in Agriculture. Software has never officially been released. Although currently fully functional, it will continue to be refined until release sometime in 2008.

What does it look like?

Executable file

What is it written in?

Written in C++, with XML database. Reports are generated using XSLT templates

Is there help available?

None available at this stage.

References:

D.McClymont (2008) FIDO.

Contacts:

David McClymont
Senior Research Scientist
Queensland Climate Change Centre of Excellence
Telephone 07 4688 1630 Faxsimile 07 4688 1490
Email David.McClymont@climatechange.qld.gov.au
Mobile 0421 584 587

Category:

Controlling water on and off the paddock

GBReader

What is it?

The GBReader program is a simple, user friendly software package for the retrieval and display of soil moisture measurements made using the GBug. The reader is limited to storing 100 gypsum block readings, the software is capable of maintaining multiple sites, each with up to 100 gypsum blocks. This gives the GBReader and software the capacity to monitor an unlimited number of gypsum block measurement sites.

Retrieving data from the GBReader into the software is a simple matter of connecting to the computer with the supplied communications cable and pressing a couple of software buttons.

Data Editing
The software incorporates an extensive data editing system which allows results to be manually entered. Existing data can be changed if an erroneous measurement is retrieved from the GBReader. Dates of records can be altered and comments can be entered to tag particular events.

Export
For third party reporting on the data the software allows results to be exported easily into standard text file formats.

These are the basic functions of the software and together they provide a comprehensive, yet simple, solution to soil moisture monitoring that even large scale and expensive measurement solutions can only dream of achieving.

Input:

Soil moisture data:

- Date (dd/mm/yy)
- Block depth in soil (cm)
- Soil moisture tension (kPa)

Output:

Graphical display of soil moisture tension (kPa) at known depth of each gypsum block

The amount of data displayed can be changed from a few days to a few months. A cursor on the graph indicates current soil moisture values. Scaling buttons allow you to zoom in and out to pick up small changes in value. Graphs are easily printed.

Gypsum blocks provide a calibrated result in kPa and often the numbers are as important as the trends in the data. Readings can be compared with other sites and other situations. With the click of a button the software changes from a graphical to tabular display of gypsum block data. The tables are easily printed for further analysis.

The GBReader software also allows the user to show a “snapshot” of values over the entire property for a chosen day. This is useful for indicating the soil moisture status at any chosen moment and the results can be printed as graphs and tables.

Regions:

All of Australia

Industries:

All industries using Gypsum Block soil moisture sensors

Users:

Irrigators

Where do you get it?

http://www.mea.com.au/files/gbreader/SETUP.EXE (992 kB)

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

A manual is available

References:

MEA (2004) GBReader. Measurement Engineering Australia (MEA), http://www.mea.com.au/files/gbreader/SETUP.EXE

Category:

Controlling water on and off the paddock

GBug

What is it?

The GBug and MEA Bug Software are user friendly and simple packages for the retrieval and display of continuous soil moisture measurements made by the GBug, GTBug, ABug, and TBug soil moisture logging devices, which are mounted in the field and store information from sensors buried at known depths in the soil.

The Site Setup tells the software which type of Bugs are installed at each monitoring site, along with the details of the type of sensors installed and the respective sensor depths. Each site can be identified with a suitable name (i.e. Chardonnay Row 23 — 30cm). A unique ID number is used to identify the Bug installed at each measurement site.

Data Retrieval
The data transfer process is the real "wow factor" which gets people excited about the Bugs. You simply take the Retriever out into the field, hold it close to the Bug and tap the Bug to wake it. The Bug then transmits its readings into the Retriever via low power radio. There are no cables to connect or drop in the dirt. Once the transfer has completed, you can review the readings on the screen of the Retriever.

If the batteries inside any of the Bugs are getting low, you will receive a low battery warning message. After visiting each Bug site, take the Retriever back to the computer and download the data into the MEA Bug Software.

The readings from the Bugs can also be displayed in tabular format. This is more suitable for the GBug and GTBug, with their 2 hourly readings, than it is for the ABug and TBug with 15 minute readings.

The MEA Bug Software also allows the user to show a "snapshot" of values for the last 48 hours. This is provides a quick snapshot of changes in moisture levels over the last 2 days.

The MEA website notes that 'The MEA Bug Software may not be loaded up with every bell and whistle, but we feel we have reached a great compromise between functionality and cost. Especially when you remember that we bundle the software with every MEA Retriever and you can get free updates from our web site for life.'

Input:

- Soil moisture sensor ID
- Date
- Time
- Soil moisture (kPa)

Output:

- Tension (KPa),
- Moisture content (%)
- Temperature (degrees C)

Graphical outputs can be zoomed until the desired moisture range is shown. Customised views of the data -e.g. combining readings from the top sensor at each site — can be achieved with a Custom Graph which includes up to 8 sensors chosen from any sites (with common sensor types). The vertical axis will display in units appropriate to the type of sensor (and hence Bug) being used e.g. tension in kPa, moisture content in % or temperature in degrees C.

Regions:

All of Australia

Users:

Irrigators

Where do you get it?

See the list of suppliers at: http://www.mea.com.au/mea/where-to-buy/

What does it look like?

Executable file

What is it written in?

Windows

References:

MEA (2005) GBug. Measurement Engineering Australia (MEA), http://www.mea.com.au/

Category:

Controlling water on and off the paddock

HANDSHIFT SIDE ROLL UNIFORMITY CALCULATOR

What is it?

This tool provides an analysis of the uniformity of the sprinkler system including graphical representation of the application rate across a paddock.

Input:

- Sprinkler Spacing (m)
- Spray Line Spacing (m)
- Catch Can Spacing Along Lateral (m):
- Catch Can Spacing Between Lateral (m)
- Catch Can Diameter (mm)
- Can Grid Size (Along Lateral (Between 3 sprinklers) and between Laterals)
- Catch can contents
- Sprinkler run time

Output:

- Average, minimum and maximum depth of application (mm/hr)
- Graphical paddock representation of the application rate (mm/hr)

Regions:

All

Industries:

All industries

Users:

Irrigators, consultants and scientists

Where do you get it?

Northern Dairy

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

NIL

References:

M. Lindsay Handshift Side Roll Uniformity Calculator. Dairy Australia, www.dairyinfo.biz/index.cfm?MenuID=104

Category:

Controlling water on and off the paddock

HowWet?

What is it?

HowWet? is a simple tool to understand how much water and nitrogen can build up in a given type of soil during a fallow period of defined length.

* How much Rain has been stored as Plant Available Water in the soil
* Available to the next crop
* How much Nitrogen has been mineralised in soil and so how much fertiliser will be required
* How much erosion was caused by runoff water during the fallow period
* How stubble cover improves infiltration
* How long to fallow (or when to plant)
* Pre-crop irrigation requirements
* Expected yields and fertiliser needs

Input:

- Soil type
- Soil depth (m)
- Maximum water holding capacity (mm)
- Slope (%)
- Years under cultivation (yr)
- Organic carbon content (%)
- Daily rainfall (mm)
- Evaporation and temperature data for the area
- Start and finish date of fallow
- Soil water % at start and finish
- % of groundcover at start and finish

Output:

- Gain in soil water (mm)
- Gain in soil nitrate (kg/ha)
- Runoff (mm)
- Plant available water (mm)
- Soil loss (t/ha)

Regions:

Queensland

Industries:

Grains, Sugar, Cotton

Users:

Irrigators, Consultants

Where do you get it?

http://www.apsru.gov.au/apsru

What does it look like?

Executable file

What is it written in?

Version 2.10

References:

D. M. Freebairn, G. Hamilton, P. Cox, S. Glanville, J. Dimes and D. Holzworth (1997) HowWet? Agricultural Production Systems Research Unit, Queensland Government Natural Resources and Mines, http://www.apsru.gov.au/apsru

Category:

Controlling water on and off the paddock

HydroCalc

What is it?

The software is designed to help in the planning of an efficient drip system.

The user defines the parameters of the irrigation system and can run scenarios using different parameters to identify the most appropriate irrigation system set up. Parameters may be selected from a system list or entered by the user according to their own needs. The software package includes an opening main window, five calculation programs, one language setting window and a database that can be modified and updated by the user. The Emitters program calculates the cumulative pressure loss, the average flow rate, the water flow velocity etc. in the selected emitter. It can be changed to suit the desired irrigation system parameters.

The SubMain program calculates the cumulative pressure loss and the water flow velocity in the submain distributing water pipe (single or telescopic). It changes to suit the required irrigation system parameters.

The Main Pipe program calculates the cumulative pressure loss and the water flow velocity in the main conducting water pipe (single or telescopic). It changes to suit the required irrigation system parameters.

The Shape Wizard program helps transfer the required system parameters (Inlet Lateral Flow Rate, Minimum Head Pressure) from the Emitters program to the SubMain program.

The Valves program calculates the valve friction loss according to the given parameters.

The Shifts program calculates the irrigation rate and number of shifts needed according to the given parameters.
The user can use either Metric or the US measuring system.

Input:

The user enters the paddock layout and the hardware specifications for their irrigation design.

Output:

The efficiency of various components of the system.

Regions:

All

Industries:

Industries that use piped systems and generally drip.

Users:

Irrigators and designers

Known Community of Users:

Not known

Where do you get it?

NETAFIM online, no charge

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Online help file, popup help when inputs our outside parametres, may be some phone help.

References:

NETAFIM HydroCalc. NETAFIM, http://www.netafim.com.au/index.php?sectionid=157

Category:

Controlling water on and off the paddock

HydroLOGIC

What is it?

HydroLOGIC is a soil-water-cotton crop model that provides growers with simple information about how frequently they should irrigate. It is designed for furrow irrigation systems.

Input:

- Soil moisture deficit
- Fruit load
- Leaf area index

Weather:

- Date
- Rainfall (mm)
- Maximum Temperature (degrees C)
- Minimum Temperature (degrees C)
- Radiation (MJ/m2/day)

Crop:

- Sowing date, variety, previous crop, plant stand (/m), row spacing (m), seed depth (cm), initial soil Nitrogen (kg/ha)
- Defoliation 1 date (dd/mm/yy)
- Defoliation 2 date (dd/mm/yy)
- Harvest date (dd/mm/yy)
- Yield (bales/ha)
- Estimated irrigation system efficiency (%)
- Plant available water capacity full point (mm)
- Starting soil moisture (mm)
- leaf area index (and date of measurement)
- nitrogen applications (kg/ha) and date of application

Fruit counts:

- Squares (number/m)
- Green bolls (number/m)
- Open bolls (number/m)

Irrigation scenarios:

- Estimated water remaining in river (ML/ha), bore (ML/ha) or storage (ML/ha)
- Deficit to irrigate (mm)

Output:

- Predictions of the total number of irrigations,
- timing of the next irrigation,
- Total water use
- Water Use Efficiency
- Estimated yield

Regions:

NSW, Queensland

Industries:

Cotton

Users:

Irrigators, Consultants

Known Community of Users:

Widespread usage by the cotton industry

Where do you get it?

HydroLOGIC is provided free to Australian cotton growers and consultants. For more information or to receive a copy contact NSW or Qld Cotton Industry Development Officer, the Australian Cotton CRC Technology Resource Centre on 02 6799 1534 or visit http://cotton.crc.org.au/CottonLOGIC/

HydroLOGIC (continued)

What does it look like?

Executable file

What is it written in?

Windows

References:

D. Richards and M. Bange (2007) HydroLOGIC. Cotton CRC, http://tools.cotton.crc.org.au/Assets/Software/HydroLOGIC.exe

Contacts:

For more information contact Dirk Richards, Phone: 61 2 6799 2416, Email: Dirk.Richards@csiro.au or Dr Michael Bange, Phone: 61 2 6799 1540, Email: michael.bange@csiro.au, CSIRO Plant Industry and Australian Cotton CRC, Myall Vale, Wee Waa Road, Narrabri, NSW 2390

Category:

Controlling water on and off the paddock

IBIS Pasture Tool

What is it?

The Tool provides recommendations for improved pasture yield where water use limits pasture growth (low water use farms), and for water savings on farms where irrigation water use exceeds pasture requirements (high water use farms). The Tool potentially assists all dairy farms to improve pasture yield and water use efficiency by ensuring that the appropriate seasonal water allocation provides a short-term match of irrigation supply and pasture water requirement at bay and field scale throughout the irrigation season.

Regions:

Victoria, NSW

Industries:

Dairy, Pasture

Users:

Irrigators

What is it written in?

IBIS Pasture Tool

References:

D. Whitfield (2004) IBIS Pasture Tool. Department of Primary Industries Victoria,

Category:

Controlling water on and off the paddock

INFILT v5

What is it?

INFILT is a program to calculate the Kostiakov-Lewis infiltration parameters of a soil using only furrow irrigation advance and the inflow rate. Cross-sectional area of flow can be used as input (if available) as well as the steady state infiltration rate. This version provides a user friendly interface and requires no user intervention to obtain the parameters.

Input:

Inflow rate, average cross-sectional area of flow, irrigation advance data. Any of the infiltration parameters that we wish to determine can also be fixed as inputs.

Output:

Infiltration parameters (a, k and fo) for the Kostiakov equation and (if required) average cross-sectional area of flow.
Results are presented graphically and updated during each iteration of the optimization.

Regions:

All

Industries:

Furrow and surface irrigation

Users:

From irrigators to consultants to researchers. All levels.

Known Community of Users:

Several thousand users around the world

Where do you get it?

www.ncea.org.au

What does it look like?

Executable file

What is it written in?

Written in C++, with ASCII data formats.

Is there help available?

Help document is included

References:

D.McClymont (1999) INFILT v5. www.ncea.org.au

Contacts:

David.mcClymont@climatechange.qld.gov.au

Category:

Controlling water on and off the paddock

IPARM

What is it?

By predicting infiltration, run-off volumes and water progress along the irrigation furrow, IPARM assists the irrigator to decide when to stop irrigating.

IPARM stands for Infiltration Parameters from Advance and Runoff Model (for furrow irrigation).

This program is designed to estimate the infiltration parameters of the modified Kostiakov equation using the inverse volume balance technique. IPARM also includes the capability to use a variable inflow hydrograph rather than the traditional constant average inflow. IPARM requires at least 2 advance measurements.

Input:

- Inflow (l/s)
- Slope
- Length of furrow (m) (position of run-off measuring device)
- Furrow dimensions and shape
- Rate of advance data — distance in metres and time (minutes) to reach that point

Output:

- Cumulative infiltration (m3/m)
- Runoff volume (m3)
- Advance (along furrow) curve (distance/minutes)

Regions:

All of Australia

Industries:

Boradacre (furrow) irrigators

Users:

Irrigators, Consultants

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Help files are included

References:

M. Gillies (2005) IPARM. CRC for Irrigation Futures, http://www.irrigationfutures.org.au//imagesDB/messageboard/IPARMsetup.exe

Contacts:

gilliesm@usq.edu.au

Category:

Controlling water on and off the paddock

IRRICAD Pro Ver 9

What is it?

Irricad Pro ver.9 is a design tool, to help produce the optimal irrigation design layout. It includes drawing packages, produces detailed plan and for the consultant provides a bill of materials. The software was developed by A.E.I. Software in association with NETAFIM. The system includes Tape block layouts, Subdivision tool, Graphical Management, Connectivity check, Tape calculation and formula, Zone design configuration, Elevation and 3D view.

Input:

Topgraphical, irrigation layout and system needs

Output:

Drawings with irrigation design specifications

Regions:

All regions that use tape systems

Industries:

All that use tape systems

Users:

Designers of on farm irrigation systems. It could be used for urban environments such as golf courses

Known Community of Users:

not known

Where do you get it?

NETAFIM

What does it look like?

Executable file

What is it written in?

Microsoft

Is there help available?

unknown

References:

NETAFIM (2007) IRRICAD irrigation design software. NETAFIM, www.netafim.com.au/index.php?sectionid=157

Category:

Controlling water on and off the paddock

Irrigation Performance Benchmarking* see under 'crop water use'

Irrigation System Evaluation for overhead and under canopy micro sprinklers*

What is it?

This tool, which is under development, is designed to evaluate and show the distribution efficiency of the of the watering system. It includes the average teat catch depth, mean application rate, runtime to refill, readily available water (RAW) and crop water requirement over a calculated number of shifts.

The calculator will be available free of charge. A program with similar input and output parameters is also being developed for drip systems. It is likely that most irrigators will want support for the first time they undertake the task.

Input:

- Grower contact information
- Sprinkler System specifications
- Test parameters including cans used, spacings, soil data, pump and pipe pressures and flow, catch can data,

Output:

- Average test catch depth (mm)
- Mean application rate (mm/hr)
- Distribution uniformity (%)
- Runtime to RAW refill (minutes)
- number of shifts and minutes
- Distribution and depth graphs

Regions:

Swan catchment

Industries:

Horticulture

Users:

Irrigators and industry officers

Known Community of Users:

trial irrigators Swan catchment

Where do you get it?

Swan Catchment Council, Department Agriculture and Food WA

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Some built in instruction worksheets and support from extension officers

References:

S.C. Council (2007) Irrigation System Evaluation for overhead and under canopy micro sprinklers. Swan Catchment Coucil.

Category:

Controlling water on and off the paddock

Irrimate™

What is it?

Irrimate assists irrigators to optimise watering time or identify changes that are needed in the design of their irrigation layout.

Irrimate works in conjunction with Infilt software and SIRMOD to measure the rate of water advance on an irrigation bay and the infiltration rates so that the optimum combination of siphon flow rate, slope, bay length and watering time can be achieved.

Input:

- Bay length (m)
- Flow rate (l/s)
- Slope (degrees)

Output:

- Infiltration
- Run-off

Regions:

All of Australia

Industries:

Broadacre—cotton, grains, sugar

Users:

Irrigators, Consultants

Known Community of Users:

Consultant community around Australia

Where do you get it?

Aquatech Consulting

What does it look like?

Executable file

What is it written in?

Irrimate™

References:

Aquatech Consulting Pty Ltd (2005) Irrimate™. http://irrimate.com.au

Contacts:

Aquatech Consulting Pty Ltd
Water Resources & Irrigation Engineers

1 Bowen Street
PO Box 443
Narrabri, NSW, 2390

Ph 02 6792 1265
Fax 02 6792 4570
Email info@irrimate.com.au

Category:

Controlling water on and off the paddock

Irrimate™ Seepage and Evaporation Meter

What is it?

This meter measures losses from storages, channels and drains. By accurately measuring and logging water level every 15 minutes and relating night time evaporation to weather data, total losses can be split up to separate seepage and evaporation components. The measured evaporation rates can then be linked to standard weather data and evaporation losses calculated daily as required. Similarly, seepage rates (mm/day) can be applied to any storage, channel or drain to calculate losses.

Input:

- Water level (mm), sampled every 15 minutes
- Daily standard evaporation (mm)
- Daily temperature (degrees C)
- Wind speed

Output:

- Seepage (mm/day)
- Evaporation (mm/day)

Regions:

All

Industries:

All

Users:

Irrigators

Where do you get it?

Aquatech Consulting and their agents

What does it look like?

F.instrument

What is it written in?

Irrimate™ Seepage and Evaporation Meter

References:

J.Purcell Irrimate™ Seepage and Evaporation Metre.

Contacts:

Aquatech Consulting Pty Ltd, T: 02 6792 1265 Fax: 02 6792 4570 Email: office@aquatechconsulting.com.au

Category:

Controlling water on and off the paddock

IrriMAX™ 7

What is it?

IrriMAX TM 7 helps to visualise plant-water-salt-soil-atmosphere interactions,

translating these into easy to understand graphs that irrigators and advisers use to manage their day-to-day irrigation, fertigation and soil salinity status.

IrriMAX can be used to display data from other soil water

monitoring devices as well as weather data. It is a service package to be used

together with hardware and agronomic support. It is not an off-the-shelf product for

use in isolation (Inman-Barber & Attard, 2005).

Key Features:

- Display salinity and fertilizer data in conjunction with soil moisture data in the same graph window.
- Directly compare trends of salinity, (including fertilizer salts) and soil moisture data alongside corresponding irrigation, fertigation and rainfall events
- Graph annotations to add management comments anywhere on the graphs
- Manual or automatic input of amount and duration of rainfall and irrigation events.
- Importing and exporting data between various file formats

Input:

Examples of inputs are:

- rainfall (mm)
- irrigation (mm)
- soil water, soil temperature, weather station information

Output:

Graphical displays on :

- a day time step of soil capacity,
- soil water salinity

Regions:

All of Australia

Industries:

All industries which use soil water monitoring instruments. The products have applications in agriculture, turf, mining and environmental management

Users:

Consultants and irrigators

Known Community of Users:

Mainly horticulture, grains, cotton, cane

Where do you get it?

Sentek Pty Ltd

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Web questions and answers, email support service through Sentek

References:

M. Donhersley (2007) IrriMAX. Sentek Sensor Technologies

Contacts:

Email: techsupport@sentek.com.au, Internet: http://www.sentek.com.au/, Phone: +61 8 8366 1900, Facsimile: +61 8 8362 8400

Category:

Controlling water on and off the paddock, Forecasting & Record keeping

Irrisoft SIPHON

What is it?

Siphon assists in designing new irrigation layouts or in estimating the volume of water being applied if the supply is not metered. It is an on-line irrigation tool which allows the user to calculate the volume of water being applied to the paddock for a given size or number of siphons.

Input:

- Number of siphons in use
- Head (m)
- Internal diameter (mm)
- Length (m)
- Roughness coefficient

Output:

- Discharge in l/s or l/min or m3/hr or ML/day

Regions:

All of Australia

Industries:

Broadacre irrigators who use siphons.

Where do you get it?

www.sakia.org

What does it look like?

Website

What is it written in?

IRRISOFT Siphon

References:

T.M. Stein (2006) IRRISOFT Siphon. http://www.irrisoft.org/irrisoft/apps/siphon

Category:

Controlling water on and off the paddock

Irriwise™

What is it?

IrriWise™ Manager is a software management tool that uses internet, GPRS (cellular) and Dial-up to communicate. It continuously updates sensor information and alarms. The system allows authorized remote users to download data.

It can be coupled to a Data Acquisition Module called an Irriwise Receiver. The Irriwise Receiver gathers data from a range of remote wireless transmitters. The receiver can collect information from most sensors e.g. Soil Moisture, weather station, Plant Based, and Irrigation sensors. The Manager allows information to be overlaid from various sensors and displayed using guages and graphs. It helps with activities such as irrigation scheduling, including the current weather conditions.

The software is not an open source. In the future (the next major versions) Netafim are planning to enable “Plug ins” that will help third party developers to extend the application but without touching the source code.

Input:

Water sensor data, usually in depth (mm) or volume (ML) or concentrations (such as dS/m)

Output:

These are dependant on what input sensors are connected. Displays and analysis include: graphs and guages including base information from all inputs. Irrigation scheduling and analysis of irrigation events. Results generally have a volumetric measure.

Regions:

All Regions

Industries:

All industries

Users:

Irrigators and advisors

Known Community of Users:

Primarily horticulturists but there are users across most industries

Where do you get it?

NETAFIM

What does it look like?

Executable file

What is it written in?

software is written in C# on Microsoft’s latest programming platform called “.net 1.1”, The data base uses the current version of Microsoft Access which can be converted into an SQL Server

Is there help available?

Commercial support which maybe part of the package

References:

P. Durand (2007) Farm Management Made Easy. NETAFIM, www.netafim.com.au/

Contacts:

Suite 15, 116-120 Melbourne Street, North Adelaide SA 5006

Category:

Controlling water on and off the paddock

OVERsched

What is it?

This interactive tool provides a visual simulation of the irrigation event. It allows the user to explore the effect that different machine management strategies will have on soil-water stress within different parts of the field and to identify irrigation scheduling and management strategies which match field and machine conditions.

OVERsched is a simple software visualisation tool that enables the user to specify the field, machine, crop and starting soil moisture content for their own farm.

Input:

- Machine length (m)
- Field length (m)
- Area irrigated (ha)
- Average pump flow rate (l/s)
- Average daily flow rate (ML/day)
- System capacity (mm/day)
- Daily plant water use (mm)
- Irrigation start time (hrs)
- Full point (mm)
- Refill point (mm)
- Irrigation duration

Output:

- Total soil moisture (mm)
- Visual simulation of progress of the irrigation event.

Regions:

All of Australia

Industries:

Broadacre irrigators — Cotton, grains, grazing

Users:

Irrigators

Where do you get it?

Freely available on the web

What does it look like?

Website

What is it written in?

OVERSched

References:

CRCIF (2007) OVERSched. CRC Irrigation Futures, http://www.irrigationfutures.org.au/OVERsched/OverSchedv1-0.html

Category:

Controlling water on and off the paddock

PERFECT

What is it?

PERFECT (Productivity, Erosion and Runoff Functions to Evaluate Conservation Techniques) is a biophysical model that simulates the plant-soil-water-management dynamics in an agricultural system. It was developed to simulate the major effects of management and environment and to predict runoff, soil loss, soil water, drainage, crop growth and yield. PERFECT is designed as a cropping systems model in that it simulates both crop and fallow phases through time. Different cropping systems and fallow management options can be simulated by selecting from a library of crop and tillage models.

PERFECT predicts the water balance, soil loss and productivity for a range of crop and fallow sequences, tillage operations and surface residues. It contains submodels that simulate soil water balance, crop growth, soil erosion, crop residue and crop cover.

Model simulation is performed on a daily timestep. Runoff is calculated as a function of daily rainfall, soil water deficit, surface residue, crop cover and surface roughness. Soil water is updated on a daily basis by any rainfall exceeding the daily runoff volume. For a dry soil profile, infiltration can optionally enter lower soil profile layers using a soil cracking algorithm. Infiltration is forced into the soil profile from the surface, filling subsequent layers to total porosity. When a soil profile layer is above its defined field capacity, soil water redistribution occurs but only if the layer immediately below can hold the water. Redistribution from the lowest profile layer is assumed lost to the system as deep drainage.

Water can be lost from the soil profile as transpiration and soil evaporation. Transpiration is represented as a function of pan evaporation, leaf area and soil moisture. It is removed from the profile according to the current depth and distribution of roots. Transpiration can only dry a profile layer to its defined wilting point. Soil evaporation is based on a two stage evaporation algorithm. After infiltration has occurred, it is assumed that drying occurs at potential rate up to a user defined limit. After this limit is reached, the second and slower stage of soil evaporation commences. Evaporation will remove soil water from the two upper profile layers and drying continues below wilting point to the user specified air dry limit. The sum of transpiration and soil evaporation can never exceed pan evaporation on any day.

Soil erosion is estimated on days of runoff using and empirically-based function that expresses soil erosion as a function of runoff volume, cover, soil erodibility, management practice and topography.

Crop growth and yield are estimated using dynamic crop growth models. These models predict crop phenology, leaf area and dry matter using functions of transpiration, transpiration efficiency, potential evaporation, daily temperature and photoperiod. Growth is reduced due to water or temperature stress. Crop yield is related to total dry matter and plant water use around flowering.

A daily balance of crop residue weight on the surface is maintained. At harvest, above-ground crop dry matter is added to any crop residue already present. During the fallow, residue is decayed or incorporated by tillage. Decay and residue incorporation by tillage is related to residue type and tillage implement. Percent cover is estimated from residue weight on a daily basis. Tillage affects both the weight of crop residue and surface roughness.

Crop planting and tillage dates can either be input by the user or generated automatically subject to user defined planting or tillage criteria. For automatic planting, the user must define a range of criteria that defines crop type, a planting rainfall, minimum soil water content and the possible range of planting dates for the crop. A planting will occur when all criteria are satisfied. The automatic tillage model will perform the selected tillage operation based on accumulated rainfall.

Input:

PERFECT uses daily weather inputs and simulates the water balance (runoff, soil evaporation, transpiration, soil water storage, redistribution and deep drainage), crop growth and yield, soil erosion and the surface crop residue balance. In Version 3.0, plant growth for wheat and sunflower can predicted using fully dynamic crop models, while a choice of two less complex but generic crop growth models can be used to estimate water use and yield for any plant or community.

Output:

- Crop yield (t/ha)
- Erosion (t/ha)

Regions:

Queensland

Industries:

Grain, Pasture

Users:

Consultants

What does it look like?

Executable file

What is it written in?

Production Erosion Functions To Evaluate Conservation Techniques (PERFECT)

Is there help available?

An on-line manual is available

References:

M. Littleboy, D. M. Freebain, M. Silburn, G. Hammer and D. Woodruff (1992) Production Erosion Functions To Evaluate Conservation Techniques (PERFECT). Queensland Department of Natural Resources and Water, http://www.apsru.gov.au/apsru

Contacts:

PO Box 2120, Hilton, SA 5033, Australia

Category:

Controlling water on and off the paddock

PIMS*

What is it?

PIMS is under final development. It was developed to continuously monitor; water pump performance, storage water level, water quality, bore water level, water flow, irrigator applicator pressure, fuel consumption and power use over single or multiple irrigation events, whilst providing real-time display and logging capacity of the information in a central coordinator and the capacity for expansion. A wireless array of sensors and loggers are designed to adapt to all pressurised irrigation systems in all terrains under range of operational conditions.

Input:

- Pump pressure (kPa),
- Pump flow rate (l/min),
- Power consumption,
- Head,
- Suction,
- Pump performance characteristics.

Output:

Analysis of the system against the theoretical optimum performance

Regions:

All

Industries:

All

Users:

Consultants

Known Community of Users:

Still in final development

Where do you get it?

NCEA when released

What does it look like?

Spreadsheet

What is it written in?

EXCEL, may become on line

Is there help available?

Expected to be a manual

References:

Agrilink Holdings Pty Ltd (2007) AgWise. Agrilink Holdings Pty Ltd, South Australia. www.agrilink.net

Contacts:

(2007) Pressurised Irrigation Management System (PIMS). NCEA, University of Southern Queensland, Queensland Department of Natural Resources and Water, www.ncea.org.au

Category:

Controlling water on and off the paddock, storage and delivery

Pressure irrigation system uniformity evaluation

What is it?

Water Wise on the farm (north Coast NSW) course utilises provides information and 6 spreadsheets to help determine the uniformity of the irrigation delivery for the most common pressurised irrigation systems. These include micro sprinklers, drip, centre pivots, travelling irrigators and spraylines. They are simple to use and rely on data to be captured via catch cans.

Input:

- Runtime (hrs)
- Diameter can (mm)
- Layout measurements (m)
- Water wise information notes data

Output:

- Average application rate (mm/hr)
- Distribution uniformity (%)

For some spreadsheets graphed results are included.

Regions:

All

Industries:

All industries

Users:

Irrigators

Known Community of Users:

North coast NSW irrigators

Where do you get it?

DPI NSW provides the tools to water wise on the farms attentees

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

via extension offivers running Water Wise on the Farm courses

References:

N. D. o. P. Industries Pressure irrigation systems evaluation — Water Wise on the farm Course. DPI, NSW,

Category:

Controlling water on and off the paddock

Pump Costs v.2

What is it?

This program enables growers to compare the costs of running their electric (or diesel) pumps using different electricity tariffs.

Input:

- Pump pressure (psi)
- Pump flow rate (l/s)
- Hours per week at low pumping costs
- Hours per week at high pumping costs
- Number of weeks in growing season
- Pump efficiency
- Motor efficiency
- Rated pump size (kW)
- Diesel price ($/l)
- Fuel consumption (l/hr)

Output:

- Cost in dollars per week ($/wk)
- Cost in dollars per season ($)
- Cost in dollars per megalitre of water pumped ($/ML)
- Cost in $/ML/PSI

Regions:

Queensland

Industries:

Horticulture

Users:

Irrigators

What does it look like?

Executable file

What is it written in?

Pump Costs

References:

S. Raine (2006) Pump Costs. CRCIF (Irrigation Futures), http://www.irrigationfutures.org.au//imagesDB/messageboard/PumpCostsv2.exe

Category:

Controlling water on and off the paddock

RART—see under 'Crop Water Use'

Safe Gauge

What is it?

A software tool to assist management of risks to surface water and groundwater from pesticide application.

SafeGauge is a software application that assesses the potential risk for pesticide contamination of surface water and groundwater as a result of on-farm pesticide use.

SafeGauge provides average monthly rainfall data for any location in Australia at a resolution of 5km. Data on soil properties is provided for sugarcane growing areas in Queensland. In addition, SafeGauge has data on over 500 pesticide products registered for sugar cane use.

Input:

- SafeGauge incorporates site specific rainfall and soil data (drainage, permeability, slope and erosion characteristics) with
- Time of application and pesticide dissipation rates.

Output:

SafeGauge produces integrated ratings of the potential risk to both surface water and groundwater resulting from on-farm pesticide application.

Using a map interface, the user can zoom in from a large scale to a level that displays property boundaries and topographical features such as roads and rivers. This enables identification of individual farm blocks. Options for pesticide use and site management can be entered and risks are then calculated and displayed.

Regions:

Queensland

Industries:

Sugar

Users:

Irrigators

Where do you get it?

www.nrm.qld.gov.au/about/contactus/service_centres.html

What does it look like?

Executable file

What is it written in?

Safe Gauge

References:

Safe Gauge. Queensland Department of Natural Resources and Water (NRW), www.nrm.qld.gov.au/about/contactus/service_centres.html

Category:

Controlling water on and off the paddock

Salinity and Leaching Calculator*—see under 'Crop Water Use'

SIRMOD

What is it?

SIRMOD is a software package designed to simulate the hydraulics of surface irrigation at the furrow scale, and to optimize the irrigation system parameters to maximize application efficiency. SIRMOD III is a comprehensive software package for simulating the hydraulics of surface irrigation systems at the field level, selecting a combination of sizing and operational parameters that maximize application efficiency

Input:

- infiltration characteristic, hydraulic resistance (Manning's n),
- furrow geometry, furrow slope, furrow length,
- inflow rate and advance cut-off time.

Infiltration characteristics of a furrow are represented in the SIRMOD model with the Kostiakov-Lewis infiltration equation, which is given by:

Z = kta + f0t (1)

where:

- Z is cumulative infiltration (m3/m furow);
- t is the time (min) that water is available for infiltration;
- a, k are fitted parameters;
- f0 (m3/min/m furrow) is the steady or final infiltration rate.

Output:

- Advance and Recession characteristics,
- Ultimate distribution of infiltrated water parameters related to water application, storage, efficiencies and runoff hydrographs.

Regions:

All

Industries:

Furrow and Border irrigation

Users:

Consultants, Scientists

Known Community of Users:

Widely used by scientists around the world

What does it look like?

CD ROM

What is it written in?

Written in C++ for Windows 95 or better.

Is there help available?

Detailed manual is available

References:

W. Walker (2003) SIRMOD III Surface Irrigation Simulation, Evaluation and Design. Biological and Irrigation Engineering, Utah State University, http://www.myoops.org/twocw/usu/Biological_and_Irrigation_Engineering/Surface_Irrigation_Design/usufiles/SIRMOD_III_Manual.pdf

Contacts:

Dr. Wynn R. Walker
Professor, Department of Biological and Irrigation Engineering
Utah State University
4105 Old Main Hill Logan, UT 84322-4105
Fax: (435) 797-1248
E-mail: wynnwalk@cc.usu.edu

Category:

Controlling water on and off the paddock

SMART Metering System*

What is it?

This product is under development. The SMART metering system is a simple technology coupled with an existing meter that allows water use characteristics of irrigation systems to be identified.

The technology differs from other flow recording meters in that flow signature patterns can be derived from logged flow data using software specifically designed to process logged data. This enables shifts in irrigation scheduling to be identified easily, which provides the irrigator with flow data for each plot irrigated. This can be compared with historic application rates to identify leaks and blockages or can be used to determine if an over supply of water is applied to the crop.

Smart metering technology is currently in the development phase and has been trialed under varying conditions.

Input:

High definition water consumption data.

Output:

Volume of water that has been applied and where it was applied down to the sub-farm irrigation plot level.

Regions:

All

Industries:

Regions using closed pipe irrigation systems — generally drip

Users:

Irrigators

Known Community of Users:

under development in South Australia, and Toowoomba

Where do you get it?

TBA

What is it written in?

Not Known

Is there help available?

Not detemermined

References:

D. Pezzaniti (2008) SMART Metering System. University of South Australia and CRC for Irrigation Futures

Contacts:

University of South Australia and CRC for Irrigation Futures;
Division of IT, Engineering and the Environment, Australian Irrigation Technology Centre.

Category:

Controlling water on and off the paddock

Solid Set Sprinkler uniformity calculator

What is it?

This tool allows the irrigator to determine the uniformity of the sprinkler application. The process required is simple and the results are easy to understand.

Input:

Catch Can Record Sheet

- Sprinkler Spacing (m)
- Lateral Spacing (m)
- Catch Can Spacing Along Lateral (m)
- Catch Can Spacing Between Lateral (m)
- Catch Can Diameter (mm)
- Can Grid Size
- Volume Applied Grid (ml)

Output:

- Average Depth (mm/hr)
- Distribution Uniformity (%)
- CU (%)
- Maximum Depth (mm/hr)
- Minimum Depth (mm/hr)

Regions:

All

Industries:

All industries

Users:

Irrigators and advisors

Where do you get it?

Dairy Australia

What does it look like?

Website

What is it written in?

EXCEL

Is there help available?

No manual but some cells have hints attached

References:

R.Sutton Solid Set Sprinkler uniformity calculator 1. www.dairyinfo.biz/index.cfm?MenuID=104

Category:

Controlling water on and off the paddock

Solute Signatures*

What is it?

This project, which is under development, will visualise water and solute movement to aid irrigation management, predict the different pathways of solutes through the profile, produce a leaching requirement ready reckoner tool and produce a nutrient manager tool.

Toolkits will normally include a combination of hardware, software, information, training and /or service components.

Output:

The project will produce:

- Solute monitoring tools and procedures
- Nutrient manager tool
- Leaching manager tool
- Practitioner training in the use of solute monitoring equipment and methods
- Tool to visualise water and solute movement to aid irrigation management.
- Guidelines / threshold values for salt and nitrate solutes from different monitoring systems

Regions:

All of Australia

Industries:

Primarily Horticulture but applicable to all industries

Users:

Consultants, irrigators

What does it look like?

Equipment and Executable file

What is it written in?

Hydrus 3D

Is there help available?

Likely to have training and extension through the CRCIF and Partners organisations

References:

R.Stirzaker (2007) Solute Signatures. CRC Irrigation Futures.

Category:

Controlling water on and off the paddock

Travelling irrigator distribution uniformity calculator

What is it?

This spreadsheet assists irrigators to calibrate their irrigator by calculating the uniformity of water spread across the paddock.

The spreadsheet enables calculation of distribution uniformity from transect catch-can data.

Input:

- Catch can diameter (cm)
- Distance between catch cans (m)
- Towpath spacing (m)
- Right Hand Side throw distance (m)
- Can volumes (mls)

Output:

- Average application rate (mm)
- Distribution uniformity (%)

Regions:

All of Australia

Industries:

Broadacre irrigators

Users:

Irrigators, Consultants

What does it look like?

Spreadsheet

What is it written in?

EXCEL

References:

S. Raine (2006) Travelling irrigator distribution uniformity calculator. CRCIF, http://www.irrigationfutures.org.au//imagesDB/messageboard/Soft7_1.xls

Category:

Controlling water on and off the paddock

Travelling irrigator uniformity Calculator

What is it?

This tool allows the irrigator to understand the uniformity of the application of water onto the paddock, including the minimum and maximum cover. It includes some graphical representation. Simple to use.

Input:

- Type of irrigator
- Lane Spacing (m)
- Catch Can Spacing (m)
- Catch Can Diameter (mm)
- No. Cans Between Tow Path
- Right Side Hand Side of Tow Path
- Can No
- Distance From Tow Path (m)
- Volume Applied (ml)
- Left Hand Side of Tow Path
- Can No
- Distance From Tow Path (m)
- Volume Applied (ml)
- Sprinkler Wetted Diameter (m)
- Gun Arc Angle (degrees)
- Distance Travelled (m)
- Run Time (min)

Output:

- Avg. Depth (mm)
- DU (%)
- CU (%)
- Speed (m/hr)
- Max. Depth (mm)
- Min. Depth (mm)
- Wetted Diameter (m)
- M.A.R (mm/hr)
- RHS Depth Applied (mm)
- LHS Depth Applied (mm)
- Volume Applied with Overlap (ml)
- Depth Applied with Overlap (mm)

Graphical representation — water applied between 2 passes of the irrigator giving R&LHS depth applied, overlap depth applied and average depth.

Regions:

All

Industries:

All industries

Users:

Irrigators and advisors

Where do you get it?

Northern Dairy

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

NIL

References:

R.Sutton Travelling irrigator uniformity Calculator 1. www.dairyinfo.biz/index.cfm?MenuID=104

Category:

Controlling water on and off the paddock

WaterBalance

What is it?

WaterBalance was developed for precise scheduling of irrigation through the coordinated download of daily automated weather station data and predicted canopy cover of sugar cane. Water balance could apply to any crop where canopy cover can be predicted from AWS variables and where the relationship between Kc and cover is known. Water Balance has been oncorporated into WaterSense.

Input:

- Date of irrigation
- Irrigation amount (mm)

Output:

- Current soil water deficit
- Crop development stage
- Days until next irrigation
- Graphical display of water balance

Regions:

Queensland

Industries:

Sugar

Users:

Irrigators

What is it written in?

WaterBalance

References:

G. Inman-Bamber, S. Attard, S. Verrall and M. Spillman (2004) WaterBalance. CSIRO Sustainable Ecosystems,

Contacts:

Geoff Inman-Bamber at 61 7 47538587 or Steve Attard at 61 418 155 844

Category:

Controlling water on and off the paddock

WATERTRACK OPTIMISER™ — see under 'Crop Water Use'.

WATERTRACK RAPID™

What is it?

WATERTRACK™ is a package of software tools designed to assist irrigators obtain the maximum production from their water by monitoring where losses and wastage occur.

WATERTRACK RAPID™ provides a rapid and simple summary of water use performance and total losses. WaterTrack Rapid™ does not have prediction capabilities but provides accurate calculations which account for effective rainfall and the capture of rainfall runoff or captured overland flow.

Input:

- Crop starting dates,
- Irrigation dates, crop yields, and pumping volumes from river, bores, or schemes.
- Measurements or estimates of stormwater captured are entered through the season.
- Weather data can be entered manually or downloaded from the Bureau of Meteorology SILO website automatically.

Output:

- Crop water use and effective rainfall are calculated by the program using water balance calculations, with the results displayed via tables and graphs eg — volume of water stored, used, volume of water stored in the soil profile, water consumption before and after irrigations.

Regions:

All of Australia

Industries:

Broadacre, grains, cotton, sugar, rice, dairy

Users:

Irrigators, Consultants

Known Community of Users:

Irrigation consultants throughout Australia, particularly the cotton and northern grains industry

Where do you get it?

Scolari Software, http://www.watertrack.com.au

What does it look like?

Website

What is it written in?

WATERTRACK RAPID™

Is there help available?

Can be purchased as part of the package

References:

Aquatech Consulting, Sustainable Soils Management and Scolari Software (2007) WATERTRACK RAPID™. Aquatech Consulting Pty Ltd,, http://www.watertrack.com.au/

Contacts:

Free-Call : 1800 886 536
Free-Fax : 1800 899 768
Mailing Address
PO Box 965
DUBBO NSW 2830

Category:

Controlling water on and off the paddock, Storage & Delivery

WETUP

What is it?

This tool models water penetration from trickle systems so that the most efficient irrigation layout can be designed.

Knowledge of the wetted perimeter of soil arising from infiltration of water from trickle irrigation drippers is important in designing and managing efficient irrigation systems. Distance between emitters and emitter flow rates must be matched to the soil's wetting characteristics and the amount and timing of water to be supplied to meet the crops needs.

A model was developed and implemented in the WetUp software which uses data on the approximate radial and vertical wetting distances for different soil types and flow rates calculated using analytical methods. WetUp allows calculation and assessment of wetting pattern dimensions for soils with a wide range of textures and soil hydraulic properties. WetUp is an easy to use and freely available software tool, which will help professionals improve their design of trickle irrigation systems.

Input:

- Soil type,
- Emitter flow rate,
- The maximum time and
- Whether a surface or buried emitter should be simulated starting under dry, moist or wet soil condition

Output:

Graphical display of discharge (l/hr) at distance (m) from the emitter.

Regions:

All of Australia

Industries:

Drip irrigators

Users:

Consultants

Where do you get it?

Freely available from: http://www.clw.csiro.au/products/wetup

What does it look like?

Executable file

What is it written in?

WetUp: A software tool to estimate wetting patterns from drip emitters for better irrigation design

Is there help available?

Manual

References:

F. J. Cook, P. Fitch, P. J. Thorburn and K. L. Bristow (2000) WetUp: A software tool to estimate wetting patterns from drip emitters for better irrigation design. Sakia.org, http://www.irrisoft.org/irrisoft/sdp/wetup

Category:

Controlling water on and off the paddock

WinSRFR 1.0©

What is it?

WinSRFR is an integrated hydraulic analysis application for surface irrigation systems that combines a simulation engine with tools for irrigation system evaluation, design, and operational analysis.

WinSRFR is the successor to irrigation modeling software developed over the past 20+ years by the USDA-Agricultural Research. These were:

* SRFR : One dimensional simulation of basin, border, and furrow irrigation,
* BASIN: Level-Basin irrigation design and operations,
* BORDER: Sloping-Border irrigation design and operations. Other similar software is SIRMOD and FIDO.

Input:

- How much water was applied, how much contributed to satisfy the requirements, e.g., to replace the soil water deficit, and
- How much was lost by deep percolation and runoff.

Comparison of alternative operational scenarios, (discharge rate, application time). WinSRFR has four major defined functionalities. These functionalities, referred to as Worlds in the software, are Event Analysis, Operation Analysis, Physical Design, and Simulation. Scenarios run with these functions are stored in separate data folders. This structure organizes the data into logical groups and allows outputs generated in one World to be used as inputs in a different World (as well as using the same inputs in different Worlds).

Output:

- The analysis may produce an operational recommendation for the assumed average field conditions (infiltration, roughness, target application depth) or may suggest the need for an alternative design.
- The Physical Design World helps optimize the physical layout of Basin and Border fields, specifically, the Length and/or Width of a field is calculated.
- The Operations Analysis World is used to optimize the irrigation operations for your Basin & Border fields. Some of the irrigation parameters calculated in this world are Inflow Rate, Cutoff time and Cutoff Location.
- An irrigation event can be simulated using WinSRFR's Simulation Word. During the Simulation of an Irrigation event, WinSRFR produces an animation of the irrigation water flowing over the field and into the soil.

Similar information is available for furrow irrigation

Regions:

All

Industries:

Surface border check and furrow irrigation

Users:

Irrigation specialists, Irrigators, extension agents, and reseachers, with a moderate to advanced knowledge of surface irrigation hydraulics

Known Community of Users:

Not known

Where do you get it?

©USDA/ARS/Arid-Land Agriculture Research Centre

What does it look like?

Executable file

What is it written in?

Microsoft .NET Framework 1.1.

Is there help available?

WinSRFR is supported by: USDA — United States Department of Agriculture, ARS — Agricultural Research Service, ALARC — Arid-Land Agricultural Research Center

References:

Arid-Land Agricultural Research Center (2006) WinSRFR 1.0©. U.S. Department of Agriculture Agricultural Research Service (USDA ARS), arsserv0.tamu.edu/SP2UserFiles/Place/53471015/WinSRFR.pdf

Contacts:

Arid-Land Agricultural Research Center, 21881 N. Cardon Lane, Maricopa, AZ 85239

Category:

Controlling water on and off the paddock

CATEGORY 2:
CROP WATER USE

AgET

What is it?

AgET is a simple water balance calculator. AgET helps farmers and their advisors to understand how differing climates, plants, soils and rotations influence components of the water balance (i.e. evapotranspiration, runoff and deep flow). The model uses 'average' climate, and 'representative' soil and plant information obtained within the agricultural areas of Western Australia.

AgET compares the water balance between differing farming systems, climates and soils. AgET will indicate likely outcomes to commonly asked questions:-

* What components of the water balance have changed since clearing?
* What do I need to change in my current rotation to reduce deep flow?
* What are the effects of wet as opposed to dry years on the water balance?

To operate AgET, the user selects a site, soil unit, and plant or farming system of interest, and then runs the model against any other farming systems that may be suited to that environment. These calculations can be undertaken for a range of annual or perennial plants used within current farming systems.

AgET allows the user to change a range of soil or plant properties if more accurate information is available. The user can alter soil depth, soil permeability and soil water holding properties as well as rooting depth and potential water use (Crop Factor).

Input:

- Soil type
- Thickness (m)
- Field capacity (m)
- Wilting point (m)
- Initial moisture (m)
- Saturated hydraulic conductivity is derived from these measurements
- Crop minimum, maximum and effective rooting depth (m)
- Number of rotations (1–8)
- Crop evapotranspiration co-efficient for each month.

Output:

Graphs of:

- Rainfall (mm)
- Evapotranspiration (mm)
- Runoff (mm)
- Deep drainage (mm)

Regions:

Western Australia

Industries:

All industries

Users:

Irrigators, Consultants

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Manual is available

References:

R. George and P. Raper (2001) AgET. Department of Agriculture and Food, Western Australia, http://www.agric.wa.gov.au/content/lwe/water/ZAGET.ZIP

Category:

Crop Water Use

Annual Irrigation Requirement for Horticultural Crops 2nd ed

What is it?

This publication has been developed to assist irrigators and irrigation designers in estimating the average irrigation requirements for a range of perennial horticultural crops at different locations in the State of South Australia, which will enable irrigators to match their cropping plans with likely water availability.

The publication outlines a user-friendly method for estimating the water requirements for specific horticultural crops at most major towns in South Australia, based on established principles (Doorenbos and Pruitt, 1977, FAO 24; Allen, Pereira, et al., 1998, FAO 56).

Other sections in the publication discuss the importance and calculation of effective rainfall and leaching requirement.

Input:

- Stored soil water,
- Field application efficiency,
- Leaching requirement,
- Effective rainfall

Output:

- Estimated volume of irrigation water required for a new horticultural development
- Calculated peak water requirements and subsequent Irrigation System capacity.
- Comparison of actual irrigation volumes applied with estimated irrigation requirements

Regions:

S.A

Industries:

Horticulture

Users:

Irrigators

Where do you get it?

Commercially available from: Irrigated Crop Management Service PIRSA — Rural Solutions

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

The spreadsheet is included within a guide book

References:

PIRSA Annual Irrigation Requirement for Horticultural Crops 2nd edition. Rural Solutions — South Australia, http://www.pir.sa.gov.au/pirsa/nrm/water_management/annual_irrigation_requirements/#Annual%20irrigation%20requirements%20for%20horticultural%20crops

Contacts:

PIRSA — Rural Solutions, PO Box 411, Loxton 5333.

Category:

Crop Water Use

APSIM

What is it?

Agricultural Production Systems SIMulator (APSIM) is an advanced farming system simulator which models the growth of crops, pastures and trees from inputs of climate, locations and management information. It contains modules to simulate plant growth and development processes for more than 20 species, with additional modules for water, soil nitrogen, soil organic matter, soil phosphorus, erosion and land management. It includes the capability to interface with seasonal climate forecasts based on the state of the El Nino Southern Oscillation (ENSO) system and has recently been extended to deal with agroforestry systems and crop-weed interactions.

See also Yield Prophet, CropMan, AquaMan, WaterSense, DamEa$y, PERFECT and HowLeaky? which all use APSIM.

Input:

Meteorological, crop, soil and fertiliser data.

Output:

Primarily crop yields, but also moisture and nutritional status of soil

Regions:

All of Australia

Industries:

Grains, Horticulture, Sugar

Users:

Consultants

Known Community of Users:

Wide community of users amoungst agriculture scientists and consultants

Where do you get it?

www.apsru.gov.au/aprsu
www.apsim.info/apsim

What does it look like?

Executable file

What is it written in?

Executable file

Is there help available?

Manual and full help desk

References:

(2007) APSIM. Agricultural Production Systems Research Unit (APSRU), Queensland Government, www.apsim.info/apsim

Contacts:

christopher.murphy@dpi.qld.gov.au
203 Tor Street
PO Box 102
Toowoomba Qld 4350
www.apsru.gov.au
+61 7 4688 1393

Category:

Crop Water Use

Aquaflex software

What is it?

Aquaflex manages data provided through a telemetry device which is then stored on a PC. It then assists in analysing the data and presenting it in a form that is easy to interpret. The data is graphically displayed. Aquaflex supports the setting of full and refill points for each of the soilwater sensors to assist with the irrigation decision making process. . The tool is part of purchasing the sensor products.

Input:

- Temperature
- Soil water %
- Air temperature

Output:

- Daily soil temperature,
- Soil water moisture content in relation to refill points, and
- Air temperature

Regions:

All

Industries:

All except rice

Users:

Irrigators and advisors

Known Community of Users:

Mainly horticulturists

Where do you get it?

Aquaflex Australia

What does it look like?

Executable file

What is it written in?

Not sure

Is there help available?

Aquaflex Australia's agent

References:

Streat Instruments (2007) Aquaflex software. Streat Instruments,, www.streatsahead.com

Contacts:

3 Jeanes St, Beverly, South Australia. 5341

Category:

Crop Water Use

Aquaman

What is it?

Irrigated peanuts have become the highest value rotational legume crop in high rainfall and irrigated production regions of Queensland. The yield potential of peanuts in high input irrigated systems is more than 8 t/ha with some fields returning commercial yields in the 6–7.5 t/ha range. However invariably, many growers are only realizing 4-5 t/ha. Lack of timely and adequate irrigation is a major contributor to this huge yield gap. Irrigating the crop at the right time with the right amount of water, together with the adoption of other important best management practices can help to consistently achieve high yields in the vicinity of 75% of potential. The management of irrigation water is critical to target high yields, better water use efficiency and good farm profits. All peanut production areas can benefit from better decision-making about water management.

To assist with the irrigation scheduling of peanuts, DPI&F are currently trialing a new decision support system called 'AQUAMAN'.

Input:

- Required once for the program is — Nearest climatic station, Soil type, Sowing date, Starting soil water
- Required in-season (actual values) — Daily rainfall (mm), Irrigation (mm) Air temperature (oC), Soil temperature (oC) are optional

Output:

The decision support system will generate a report on request with graphical presentation. The information is stored in the user's online account, which can then be viewed at any time. The report provides updated information on the water balance of the crop and will indicate likely irrigation requirements.

It shows — Accumulated heat units (indication of the crops maturity), total ground cover, stage of crop development.

Record of irrigation, available soilwater in the effective rootzone, rainfall and irrigations

Future irrigation requirements — 'approximate days to next irrigation

Regions:

Queensland

Industries:

Peanut

Users:

Irrigators

Known Community of Users:

Irrigators supporting its development

Where do you get it?

DPI QLD, APSRU, GRDC, Peanut Company of Australia

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

An onlne manual

References:

DPIQLD (2006) Aquaman. Department of Primary Industries, Queensland and APSRU, www.apsim.info/apsim/aquaman/

Contacts:

DPI QLD

Category:

Crop Water Use

AquaSpy™ Viewer

What is it?

AquaSpy is a tool with 2 functions — to store data provided either by telemetry or other means and stored on a PC. The second function is to then analyse the data and present it in a user friendly format. These results assist in the setting of full and refill points. Upgraded versions of the software can be downloaded by customers. The tool is part of purchasing AquaSPY telemetry products.

Input:

Soil water moisture probe data via a PC, mobile or radio node

Output:

- Soil moisture change over time for various soil depths
- Current moisture in relation to refill points

The data is displayed in graphical and tabular views.

Regions:

All region

Industries:

All industries

Users:

All irrigators and advisors

Known Community of Users:

across all industries particularly horticulture

Where do you get it?

Agrilink Holdings Pty Ltd

What does it look like?

Executable file

What is it written in?

Open platform

Is there help available?

Different levels of commercial support are available from online to personal support.

References:

Agrilink (2007) AquaSpy™. Agrilink Holdings Pty Ltd, South Australia. www.agrilink.net

Contacts:

PO Box 2120, Hilton, SA 5033, Australia

Category:

Crop Water Use, Forecasting & Record keeping

Cane-Grower implemented drying — off irrigation scheduling on the Tableland*

What is it?

This project aims to develop simple measurement methods, implementable by cane growers to increase sucrose yields by indicating when to dry off mature cane crops and when to irrigate due to delayed harvesting. The tool is expected to be available on March 2010.

Input:

Proposed inputs will be

- Intuitive cane and soil measurements
- Number of green leaves
- Brix variation along the stem

Output:

Maximum cane yield kg/ ML , for varying soil, cultivar and ratoon types on the Atherton Tablelands

Regions:

Atherton Tablelands

Industries:

Sugar cane

Users:

cane growers

Known Community of Users:

8 trialing cane growers

Where do you get it?

BSES

What is it written in?

BSES

Is there help available?

Likely to be through BSES training and extension services. A manual

References:

(2010) Cane-Grower implemented drying — off irrigation scheduling on the Tableland. BSES, www.bses.org.au

Category:

Crop Water Use

Catcher—see under 'Forecasting & Record keeping'.

Crop Check 500

What is it?

This training package aimed to improve the irrigation scheduling skills of farmers and increase adoption of irrigation scheduling techniques by including it as part of an integrated crop management program. The relationship between crop yield and crop water use for lucerne, canola, faba beans, maize and soy beans was determined and related to the soil and its physical constraints in limiting crop yields in Northern Victoria.

Input:

To calculate crop water usage, class 'A' pan evaporation (the reference crop evapotranspiration) is modified using a multiplier for each different crop. While these crop factors are the subject of on-going investigation, in this study preliminary crop factors were identified as: Faba beans 0.9; Canola 1.0; Maize-variable; lucerne 0.8 from the second irrigation following a cut and 0.95 for subsequent irrigations before the next cut.

Output:

Scatter plots of yield (tonnes per hectare) against total water use (Megalitres) are presented for lucerne, canola, maize, soy beans and faba beans.

Regions:

Northern Victoria

Industries:

Grains

Users:

Growers, Extension

Known Community of Users:

Not known

Where do you get it?

Agrilink

What does it look like?

Website and Executable file

What is it written in?

Crop Check 500: Irrigation Sheduling Component

References:

W. A. Heslop and D. Poulton (1995) Crop Check 500: Irrigation Scheduling Component. Goulburn-Murray Water,

Category:

Crop Water Use

Crop Irrigation Water Requirement Tool—See under 'Forecasting & Record keeping'.

Crop irrigation requirement calculator

What is it?

This program was written as an aid for predicting the irrigation requirements of annual and perennial crops grown in different regions of Western Australia. The program can also be used as a guide for estimating irrigation requirements under different management strategies or for ground water allocation.

Input:

- Irrigation efficiency
- Crop type
- Planting date
- Soil type

Output:

- Irrigation volume by month (kL)
- Irrigation depth (mm)

Regions:

Western Australia

Industries:

Annual and perenial crops

Users:

Irrigators

Where do you get it?

Dept. Agriculture & Food, Western Australia. Free.

What does it look like?

Executable file

What is it written in?

Windows 98, NT 4, ME, 200, XP

References:

N. Lantzke (2003) Crop Irrigation Requirement Calculator. W.A. Dept. Agriculture & Food, http://www.agric.wa.gov.au/content/lwe/water/irrig_calculator_nlantzke.htm

Category:

Crop Water Use

CropMan

What is it?

With this software, crop irrigators will be able to make informed decisions about when and how much to irrigate. CropMan is a simple interface for a simulated database of past crop performance using historical weather records from the last 104 years in Western Australia. This data is used to help predict future crop performance under different conditions and with different management.

Input:

- Location,
- Soil type (Eg. clay, sandy loam, acid sandy loam, sand, duplex),
- Initial soil water (wet, dry), and
- Initial N (low, high)
- Crop type (currently only wheat),
- Cultivar (late or early flowering),
- Sowing date (5 May, 5 June, 5 July or rainfall determined),
- Nitrogen application at sowing (kg N/ha) (0, 30, 60, 90),
- Nitrogen application at 6 weeks (kg N/ha) (0, 30, 60, 90), and
- Nitrogen application at 10 weeks (kg N/ha) (0, 30).
- Southern Oscillation Index information
- Rainfall

Output:

CropMan provides the 104 year averages for the site including annual rainfall, rainfall distribution across the year, grain yield and grain protein and gross margin.

Dollar return for each dollar invested,

- Grain yield,
- Grain protein, and
- Gross returns.
- Average values for deep drainage water loss
- Nitrate leaching below the potential maximum root zone

Regions:

WA

Industries:

Grains

Users:

Irrigators, Consultants

What is it written in?

CropMan: improving crop production in Westerm Australia information sheet

References:

CSIRO Plant Industry (2006) CropMan: improving crop production in Western Australia information sheet. http://www.csiro.au/resources/cropman.html

Category:

Crop Water Use, Forecastion & Record Keeping

Crop Optimiser*

What is it?

CropOptimiser is a decision support tool for optimising cropping strategies for different seasons and climate types. It employs a Linear Programming model (currently under development) to optimise the regional irrigated cropping patterns, and employs interactive GIS tools to display the results. It is being developed as part of the ACIAR project, “Seasonal climate forecasting for better irrigation system management in Lombok”.

Input:

Crop Optimiser requires

- modeled-irrigation-diversion and rainfall time-series data for a range of irrigation catchment areas.
- Irrigation catchment information such as area, location and soil type.
- ENSO-state time-series data is also required.
- Cropping information such as price, potential yield, growing costs are also needed.
- Soil productivity index information is required on a crop and seasonal basis.
- Physical and social cropping constraints are required by the LP model to determine the optimal conditions.

Many inputs are quite subjective, especially relating to the social constraints. Many simplified assumptions are required.

Output:

- Proportion of crops grown for each season, climate-type and irrigation-area.
- Yield, water use and physical properties are also presented on a regional basis. Outputs presented texturally or as an overly on a map.

Regions:

All

Industries:

All industries

Users:

Government Agencies/ strategic planners

What does it look like?

Executable file

What is it written in?

Written in C++, with XML and ASCII data formats. Reports are generated using XSLT templates

Is there help available?

Help documentation is currently being developed

References:

D. McClymont (2008) Crop Optimiser 2.01 (beta). Queensland Climate Change Centre of Excellence,

Contacts:

David McClymont
Senior Research Scientist
Queensland Climate Change Centre of Excellence
Telephone 07 4688 1630 Faxsimile 07 4688 1490
Email David.McClymont@climatechange.qld.gov.au
Mobile 0421 584 587

Category:

Crop Water Use

DailyET

What is it?

Daily evapotranspiration is a key input to enable estimation of water requirements for different crops, and evaporation from water storages.

DailyET is a simple Windows based calculator for estimating daily and monthly reference evapotranspiration (ETo) according to four methods using data collected from either conventional or electronic weather stations.

Input:

The minimum input data required are

- Maximum and minimum air temperature,
- Relative humidity,
- Sunshine duration,
- Wind speed, and the
- Location of the weather station (latitude, height above sea level).

Output:

The outputs are daily or monthly reference evapotranspiration in mm.

Regions:

All locations

Industries:

All industries

Users:

Consultant

Where do you get it?

Freely available from: http://www.silsoe.cranfield.ac.uk/iwe/_private/software/dailyet/download.htm

What does it look like?

Executable file

What is it written in?

DailyET — A simple 'calculator' for estimating daily reference crop evapotranspiration (ETo).- IRRISOFT software descriptions and reviews at Sakia.org.

References:

T. M. Hess and T.-M. Stein (2005) DailyET — A simple 'calculator' for estimating daily reference crop evapotranspiration (ETo).- IRRISOFT software descriptions and reviews at Sakia.org. Sakia.org, http://www.irrisoft.org/irrisoft/sdp/dailyet

Category:

Crop Water Use

HowLeaky?

What is it?

Its main purpose is to explore the effects of different vegetation (including crops, pastures and trees), climates, soil types and management on the water balance: evapotranspiration, runoff, and deep drainage. Erosion, sediment and pesticide movement are estimated. For some, HowLeaky? will provide a pathway to the use or better understanding of other simulation models, such as APSIM, GRASP and PERFECT. As well as its use as an analysis tool, it makes an excellent training aid. The model is responsive to water, temperature and radiation stress, and can represent the dynamics between weather, soils and vegetation in so far as these impact on water use and water and sediment flows. Since crop production is treated simply, these models should not be expected to simulate detailed crop management options such as soil fertility, detailed phenology or population issues.

The model can answer questions such as:

* How much water is lost as run off, and how much erosion will occur?
* Under different lands uses, how much water leaks below the root zone?
* What is the risk of off-farm pesticide loss?

HowLeaky? Version 2.18 (beta), due for release in 2008, represents a rebuilding of the PERFECT V3 model, with an enhanced interface designed to be useful to a range of non-modellers to explore the implications of alternative land-uses on water balance, runoff, erosion, and drainage. This is an experimental approach to explore whether a more user-friendly interface will enable a wider range of users to use daily simulation models as an aid to land use planning. It is a simple, graphical interface to a daily water balance model.

Input:

HowLeaky requires:

- Time-series of rainfall
- Max/min temperature
- Solar radiation, and
- Pan evaporation.
- Also required are soil, vegetation, tillage, planting, irrigation and pesticide/phosphorus parameters.

Field-measured time-series data can also be imported for calibration purposes.

Output:

A range of graphical and textural outputs. This includes:

- Time-series outputs relating to the water-balance, soil properties, vegetation, pesticide, phosphorus, and empirical model parameters.
- Results can be viewed as daily/monthly/yearly time-series, or reported as annual summaries using XSLT reporting facilities.

The outputs are displayed in tables, graphs, and customised reports.

Regions:

All

Industries:

All industries

Users:

consultants, extension and trainers

Known Community of Users:

Queensland Government Scientists, Victorian DPI... several other Australian scientists and consultants

Where do you get it?

Agricultural Production Systems Research Unit, Department of Natural Resources, and Water

What does it look like?

Executable file

What is it written in?

Written in C++, with XML and ASCII data formats. Reports are generated using XSLT templates

HowLeaky (continued)

Is there help available?

Manual is available

References:

D. McClymont, D. M. Freebairn, D. J. Rattray, J. B. Robinson, D. M. Silburn and J. Owens (2008) HowLeaky? Agricultural Production Systems Research Unit, Department of Natural Resources, and Water, www.apsru.gov.au/apsru/

Contacts:

PO Box 318, Toowoomba, Qld 4350.
David.McClymont@climatechange.qld.gov.au

Category:

Crop Water Use

HowMuch?

What is it?

HOWMUCH? uses rainfall records to estimate crop yields from a crop's Water Use Efficiency (WUE) and the soil's Plant Available Water Capacity (PAWC).

Input:

- Daily rainfall data from web (mm)
- Fallow, sowing, crop stage and harvest dates
- Threshold water (mm)
- Plant Available Water capacity of the soil (mm)
- Water use efficiency (kg/ha/mm water)

Output:

- Mean, variability and percentile values for the yield (kg/ha) and
- Rainfall (in each crop stage) between the selected Start and End years.

Industries:

Grains

Users:

Irrigators

Where do you get it?

Freely available on the web at http://www.apsru.gov.au/apsru

What does it look like?

Executable file

What is it written in?

Microsoft Visual Basic Version 4.0

Is there help available?

An online manual is available

References:

D. M. Freebairn and S. Glanville HowMuch? Agricultural Production Systems Research Unit, Queensland Department of Natural Resources, http://www.apsru.gov.au/apsru

Contacts:

c/- Agricultural Production Systems Research Unit
Department of Natural Resources
P.O. Box 318, Toowoomba, Queensland, Australia. 4350
ph 07 4688 1391 fax 074688 1193
freebad@dnr.qld.gov.au

Category:

Crop Water Use

IrriCalc

What is it?

IrriCalc indicates how much irrigation can be applied to a paddock (or series of paddocks) without over-saturation. It provides a full record of the weather conditions, on a day-by-day basis, along with recorded rainfall and irrigation.

It can be configured to a deficit irrigation system that is suited to effluent irrigation. This system leaves a small soil water deficit when the irrigation is complete.

The program provides meteorological-based irrigation scheduling, and uses no soil-water monitoring tools. Experience has shown that this provides a reliable indication of when to irrigate at much less cost and effort than systems that rely on soil sensors.

Input:

- The program is pre-set for each site, using the appropriate soil and evaporation characteristics.
- The only operation for the user is to enter the weather for each day, viz whether it was clear, partly cloudy, overcast, or to enter the amount of rain when it is wet.
- If required, the operator can also enter an indication of the wind strength, and whether a high watertable is present. If the weather or wind conditions are not entered, mean values will be assumed.
- Cloud cover (Clear sky, Partly cloudy, Overcast or Wet)
- Daily rainfall (mm)
- Wind strength (calm, moderate, strong)

Output:

- Estimate the day by day variation in soil water (mm), and it will indicate when an irrigation needs to be scheduled.
- Irrigation can be scheduled separately for different blocks on the same property

Regions:

All. The program has no geographical limitations as each copy is tailored to suit the local climate.

Industries:

Cropping, Grazing, Pasture

Users:

Irrigators

What does it look like?

Executable file

What is it written in?

Windows 95 or better

References:

J. Murtagh (2004) IrriCalc. Agricultural Water Management,

Contacts:

Agricultural Water Management
49 Pebble Beach Drive, Runaway Bay 4216
(Ph) 07 5563 9776
(Fax) 07 5537 8082

Category:

Crop Water Use

IRRIGATE*

What is it?

A web application that presents a water balance-based Decision Support tool to irrigators when they order their water online from their local supply company.

Input:

- Weather information from local weather stations or SILO
- Growers' crop parameters
- Water availability from water supply companies

Output:

- Irrigation scheduling information to the irrigator
- Water orders to the water supply company

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators, Water supply companies

Known Community of Users:

Coleambally Irrigation Pty Ltd

What does it look like?

Website

What is it written in?

.NET Framework (C#.NET, ASP .NET), MySQl, XML Web Services

Is there help available?

Free advice for testing

References:

E. Christen (2007) IRRIGATE. CRC Irrigation Futures,

Contacts:

Evan Christen, evan.christen@csiro.au, CSIRO Griffith, 0269601500

Category:

Crop Water Use, Forecasting & Record keeping

irriGATEWAY Precision Irrigator*

What is it?

A standalone PC based application for investigating spatial variability issues in irrigation systems — water/nitrogen/deep drainage etc and its effects on performance (yield) and associated environmental impacts (deep drainage) using precision farming derived inputs and remote sensed data.

Input:

- Data intensive — Remote sensed data i.e. NDVI + irrigation water, yield maps,
- Soil electromagnetic surveys, weather information, crop parameters

Output:

- Water use efficiency and productivity in a spatial sense
- Spatial deep drainage
- Spatial soil salinity
- Spatial yield
- Spatial nitrogen losses etc

Regions:

All of Australia

Industries:

All industries

Users:

Consultants, Scientists

What does it look like?

Executable file

What is it written in?

.NET Framework (VB.net)

Is there help available?

Free advice for testing

References:

J. Hornbuckle (2007) irriGATEWAY Precision Irrigator. CRC Irrigation Futures, http://www.irrigateway.ne

Contacts:

John Hornbuckle, john.hornbuckle@csiro.au, CSIRO Griffith, 0269601500

Category:

Crop Water Use

irriGATEWAY SMS ETo

What is it?

An SMS broadcast service that sends local ETo measurements to irrigators each day

Input:

ETo from automatic weather stations or SILO

Output:

ETo information via SMS

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators

Known Community of Users:

Test group (10 irrigators)

Where do you get it?

www.irrigateway.net

What does it look like?

SMS message

What is it written in?

.Net Framework (C#NET, ASP .NET), MySQL, XML Web services

Is there help available?

Manual, free advice for testing

References:

N. Car (2007) irriGATEWAY SMS ETo. CRC Irrigation Futures, www.irrigateway.net

Contacts:

Nicholas Car, nicholas.car@csiro.au, CSIRO Griffith, 02 6960 1500

Category:

Crop Water Use

irriGATEWAY SMS Scheduler

What is it?

A simple water balance using local ETo measurements, rainfall and growers' irrigations that communicates with growers using SMS

Input:

ETo from automatic weather stations or SILO, rainfall from either automatic weather stations or growers, irrigations from growers

Output:

irrigation scheduling information via SMS

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators

Where do you get it?

http://www.irrigateway.net

What does it look like?

SMS message and some equipment

What is it written in?

.NET Framework (C#.NET, ASP .NET) My SQL, XML Web services

Is there help available?

Manual, free advice for testing

References:

N. Car (2007) irriGATEWAY SMS Scheduler. CRC Irrigation Futures, http://www.irrigateway.net/

Contacts:

Nicholas Car, nicholas.car@csiro.au, CSIRO Griffith, 02 6960 1500

Category:

Crop Water Use

Irrigation Informatics System(TM)*

What is it?

THe CRCIF is researching tools for the collation, recording and integrated analysis of spatial and temporal data to assist irrigators in irrigation management decisions. Key activities will include:

- SILO climate data for irrigators
- Smart metering
- Spatial drainage assessment
- Farmer heuristics in irrigation decision making

Output:

Expected Outputs

- Decision support tools to improve irrigation decision making for different spatial scales, levels of data availability and user requirements
- Tools to identify the optimum economic irrigation management unit size
- Training of irrigators in system uses and benefits
- Tools for routine spatial sensing of crop production responses or indices of crop water demand
- Integration of real time crop / environmental inputs with crop production models
- Tools and methods to evaluate and improve control of surface irrigation and pressurised systems
- Smart metering tool to automatically record onfarm water distribution
- Irrigation forecasting tools with estimated financial and environmental consequences of action or inaction tailored to farm or field
- Information supply product for irrigators that can also be used by irrigation water distribution companies as input into optimising water supplies at a scheme level.

References:

CRC IF Cooperative Research Centre for Irrigation Futures, http://www.irrigationfutures.org.au/projects.asp?ID=38

Category:

Crop Water Use

Irrigation Performance Benchmarking*

What is it?

NCEA is developing a tool that will allow irrigators to benchmark themselves against others in their district or industry. It will also provide high level statistical data to Queensland Department of Natural Resources and Water (a project funder). The process has begun with 3000 questionnaires being sent out to irrigators in SE Queensland. NCEA are working on achieving a minimum of 10% return. Industries targeted include — dairy, and horticulture. Within horticulture industries priority industries include — nurserys, turf and cutflowers. Once the data is entered irrigators will be able to go online and either retrieve their own results (password protected) or if a new contributor entered their data, receive a benchmarking report on selected attributes.

Input:

Not finalised

Output:

Not finalised

Regions:

Queensland

Industries:

Dairy,Horticulture

Users:

Irrigators

Where do you get it?

NCEA

What does it look like?

Website

What is it written in?

Database

Is there help available?

Likely to be an online support manual

References:

E. Schmidt (2007) Irrigation Performance Benchmarking. ncea.org.au

Category:

Crop Water Use, Controlling water on and off the paddock

Irrigation of Vegetables on Sands in WA

What is it?

This tool is to help growers to achieve best practice in irrigation and nutrient management. The tool has three parts a Good Practice Guide, SMS service to farmers on evaporation data, Crop Irrigation requirement calculator.

Input:

- Best practice information fact sheets
- Automatic weather station data online
- Register for the SMS evaporation data service
- Crop irrigation requirement calculator — type of crop, location, irrigation efficiency, area planted, area irrigated, annual or perennial, planting date,

Output:

- An online BMP manual
- Up to date evaporation data via SMS
- Crop irrigation requirement calculator — Crop name, planting and harvest date growing period — number of days
- Irrigation efficiency, soil factor, depth of water applied (mm) by month
- Volume of water applied by month (KL)

Regions:

Western Australia vegetable growing regions — Albany to the Ord

Industries:

Vegetable

Users:

Vegetable growers and industry officers

Known Community of Users:

vegetable growers around and south of Perth

Where do you get it?

Vegetable WA and Department of Food & Agriculture WA. The tools are available for free. The SMS service may attract a charge

What does it look like?

Website and Spreadsheet

What is it written in?

Efficient Irrigation of Vegetables on Sands

Is there help available?

Industry extension officers, and a manual is incorporated into the crop irrigation requirements spreadsheet

References:

G. Foord, R. Prince and C. Dendy (2007) Efficient Irrigation of Vegetables on Sands. Vegetables WA, http://www.vegetableswa.com.au/irrigation/

Category:

Crop Water Use

Irrisoft BUDGET

What is it?

This model enables prediction of crop water stress and the effects of water stress on plant yields.

BUDGET is a set of subroutines describing the various processes involved in water extraction by plant roots and water movement in the soil profile. The water stored in the root zone is determined in the soil water balance model on a daily basis by keeping track of incoming and outgoing water fluxes at its boundary. Given the simulated soil water content in the root zone, the corresponding crop water stress is determined. During periods of crop water stress the resulting yield depression is estimated by means of yield response factors. By selecting appropriate time and depth criteria irrigation schedules can be generated.

Input:

- ETo, Rain, Crop and Soil Files from the Climate/Crop/Soil Data Base;
- Specify the start of the growing period
- Specify an irrigation option (if any) and the quality of the irrigation water
- Specify the Simulation Period, the Initial Conditions for a run, and the Output Files that need to be created

Output:

- Net irrigation requirement;
- Actual amount of water lost by soil evaporation, crop transpiration, and surface runoff
- Amount of water that has been infiltrated in the soil profile that drains out of the bottom compartment of the soil profile and that is stored between bunds on top of the soil surface
- Expected relative yield at the end of the growing period
- Irrigation events during the simulation period and
- Information on the salt content of the soil water at various depths in the soil profile

Regions:

International

Industries:

All industries

Users:

Consultants

Where do you get it?

Freely available

What does it look like?

Executable file

What is it written in?

BUDGET—A soil water and salt balance model.

Is there help available?

Comprehensive manual is supplied

References:

D. Raes (2004) BUDGET—A soil water and salt balance model. Sakia, http://www.irrisoft.org/irrisoft/sdp/budget
Software from: http://www.iupware.be

Category:

Crop Water Use

MaizeMan

What is it?

MaizeMan is a crop soil water model that has been constructed to allow corn growers to improve the timing of irrigation events, forecast yields and assess the influence of the water table on crop growth.

It is based on a crop and soil simulation model derived from both the CERES-Maize crop growth model and Swagman-Destiny (the water and salt balance models).

MaizeMan can be used to examine crop performance from past seasons and to investigate what the effect of different management strategies might have been, to assist in irrigation scheduling and nitrogen management decisions for the current crop, and to explore other options for growing maize as affected by location (climate), seasonal weather conditions, site conditions (soil type, groundwater) and management.

Input:

Extensive parameterisation is necessary including:

- Daily rainfall and temperature data
- Initial soil characteristics and soil water holding characteristics and salinity down through the soil profile
- Sowing
- Irrigations
- Nitrogen applications
- Genetic co-efficients for the variety of maize being grown.

Output:

- Forecasting water use requirement and yield
- Gross margin analysis
- Irrigation scheduling
- Potential yield

Regions:

Southern NSW

Industries:

Maize

Users:

Consultants

Where do you get it?

http://ispg.csu.edu.au/members/bwhite/MaizeMan/V2Features

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

User Manual

References:

E. Humphreys (2004) MaizeMan. CSIRO Land and Water,

Contacts:

“MaizeMan”
CSIRO Land and Water
PMB 3
Griffith NSW 2680
Australia
Phone 02 6960 1528; internat. phone 61 2 6960 1528
Fax 02 6960 1600; internat. fax 61 2 6960 1600

Category:

Crop Water Use

MMMR systems*

What is it?

This tool is under development and aims to use METRIC analysis to verify/formulate crop coefficient (kC) values appropriate to major irrigation enterprises (dairy, horticulture, vines, cotton) in major irrigation regions (GV, Sunraysia, MIA, northern NSW) in the MDBC. It is also hoped to test the approach for ecosite water management i.e. Can we manage ecosite water requirements using established crop approaches? The approach will use satellite imagery to monitor crop water use (supported by extensive ground truthing). This will then be used to support the development of information tools such as benchmarking.

Input:

Satellite imagery

Output:

Daily crop evapotranspiration (mm)

Regions:

All

Industries:

All industries

Users:

Irrigators, water suppliers and regional planners

Known Community of Users:

Under development

Where do you get it?

DPI Victoria

What is it written in?

Measurement, monitoring and reporting systems for improved managment of regional water resources at farm to national scales in Australia

References:

D. Whitfield and Q. Mcallister (2010) Measurement, monitoring and reporting systems for improved management of regional water resources at farm to national scales in Australia.

Category:

Crop Water Use, Forecasting & Record Keeping

NPRO

What is it?

NPro soil moisture software converts neutron probe data into management options. NPro has been extensively tested in the vineyard regions of the Barossa Valley and is currently used by a large number of growers and large wineries. The NPro support includes "frequently asked questions". The program was developed with extensive consultations with university researchers and practical farmers. It is suitable for irrigators, government advisory bodies and teaching institutions.

It is planned to be used intuitively for the setting up and inputting of data with many of the tasks fully automated. The manual outlines in detail all of the common decisions you are required to make. NPRO can be set up for most irrigated agricultural enterprises. NPro can handle data from Diviners, Echo Probes, neutron probes, gypsum blocks and tensiometers, and can quickly convert these measurements into soil volumetric measurements.

Input:

- Evapotranspiration
- Rainfall
- Irrigators' own irrigation parameters.

Output:

- Historical and actual soilwater content (mm and month)
- Refill requirements (mm)
- NPRO uses graphs and tables to indicate refill points and the requirements for a number of scenarios. It provides graphical representation of actual soil water compared to the refill and full points.

Regions:

All

Industries:

All

Users:

Irrigators, consultants, researcher, training institution

Known Community of Users:

Viticulture industry, SA

Where do you get it?

ICT International Pty Ltd

What does it look like?

Executable file

What is it written in?

Windows based

Is there help available?

Comprehensive illustrated manual and a 24 hour free call help-line

References:

I. Grierson (2007) NPRO. ICT International, www.ictinternational.com.au

Category:

Crop Water Use

PRIDE

What is it?

PRIDE is a crop demand model. PRIDE was developed for estimating irrigation demand by using a combination of climate data, crop culture and knowledge of traditional farming practices. PRIDE is most commonly used to estimate private diverter and irrigation district water demands for use in REALM (REsource ALlocation Model). REALM is a water supply system simulation package. Any water supply system can be configured in REALM as a network of nodes and carriers representing reservoirs, demand centres, waterways, pipes, etc. PRIDE has been included as it may be a useful tool for large properties to better manage their various water resources and there may be potential to work with neighbouring irrigators if water storages and groundwater were managed in partnership to gain better WUE.

Input:

- Crop factors
- Climate data eg Pan evaporation, rainfall
- Channel supply volume
- Channel efficiency
- Soil drainage factor
- Crop area (ha)
- Soilwater threshold

Output:

- Water demand ML/ for a specified time period

Regions:

Victoria

Industries:

All industries in the region

Users:

Water supply companies, or those responsible for extraction on a large property.

Known Community of Users:

SKM, GMW staff

Where do you get it?

Department of Sustainability and Environment, Victoria

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Comprehensive PDF manual

References:

SKM (2007) Pride. Department of Sustainability and Environment, Victoria, Melbourne.

Contacts:

Obtain a copy from — Barry James, Office of Water, Department of Sustainability

Category:

Crop Water Use

Probe for Windows

What is it?

Probe for Windows was originally developed for the CPN 503 neutron probe to run on VAX and other mainframe computers. It now runs on Windows and Macintosh and also

handles data from the TekSmart, Diviner2000, EnviroSCAN, Delta-T Profile Probe, Adcon C-Probe, and similar systems.

Other soil and crop information can be incorporated, such as weather data and crop size. This data can be downloaded from other sources (or entered manually) and growth rates, total water use and irrigation efficiency can then be calculated.

Irrigation Scheduling

Schedules are calculated using three different values of crop water use...

1. Calculated from the soil moisture measurements.
2. A user entered value.
3. From ET0 and crop factors; models; or historical data.

The date and the amount of water required over forthcoming weeks is calculated, ready for valve operators or automatic control systems.

The program is available in English, Chinese, and Spanish, and can easily be translated into any other language.

Input:

Soil moisture is measured at different depths down the soil profile

Output:

- The daily water consumption of the crop
- The efficiency of each irrigation and rainfall
- When the next irrigation is due
- How much needs to be applied
- How far down crop roots extend
- The maximum water holding capacity of the soil
- The soil water content at which the crop becomes stressed and needs water

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators, Consultants

What does it look like?

Executable file

What is it written in?

Probe for Windows

Is there help available?

Manual

References:

T. Finch (2007) Probe for Windows. Research Services New England (RSNE), http://www.rsne.com.au

Contacts:

Research Services New England
8/16 Nicholson Street
Balmain, NSW 2041, Australia
T +61 (2) 9810 3563 F +61 (2) 9810 3323
www.rsne.com.au
support@rsne.com.au

Category:

Crop Water Use

RART

What is it?

RART uses daily evaporation figures from a local weather station and the crop and soil statistics from the property to estimate when and how much irrigation to apply to each specific crop. It has been redeveloped a number of times. Current usage is low.
It has generally been found most growers need some support to get started and the first few times of usage.

Input:

- Crop area
- Irrigation rate applied (mm/hr)
- Evaporation (mm),
- Rainfall (mm)
- Irrigation data (mm),
- Leaching fraction,
- Initial soil water deficit (SWD)
- Maximum SWD,
- Crop factor
- Dry soil co-efficient
- Dry soil limit
- Minimum effective rainfall by month
- Average daily evaporation

Output:

- Previous and future irrigation schedule (mm, hours, ML)
- Previous SWD (mm)
- Effective rain (mm, ML),
- Drainage (mm, ML, %)
- Graph (mm and day)
- Relationship of effective rainfall
- SWD
- Irrigation and drainage to refill points

Regions:

ALL

Industries:

All industries

Users:

All

Known Community of Users:

some Mallee horticulturists

Where do you get it?

G syme

What does it look like?

Spreadsheet

What is it written in?

EXCEL coded in Visual Basic

Is there help available?

Manual and paid consultant support

References:

G. Syme Right amount Right Time. Geoff Syme,

Category:

Crop Water Use, Controlling water on and off the padock

Salinity and Leaching Calculator*

What is it?

This calculator, which is under development, it enables farmers to determine the rootzone salinity depending on their irrigation schedule, soil type, rootzone and evapotranspiration. The software can also calculate whether leaching of the rootzone is required and determines the amount of water required to leach enough salt to reduce the rootzone salinity below a threshhold amount.

Input:

- Soil type
- Crop
- Rootstock
- Evapotranspiration (mm)
- Leaching fraction
- Applied irrigation (mm)
- Applied irrigation water salinity (dS/m)
- Measurements of rootzone salinity

Output:

- Average rootzone salinity (dS/m)

Regions:

All

Industries:

Primarily horticulturists, but sustainable for all irrigated enterprises

Users:

Irrigators, Consultants

Known Community of Users:

CCW Cooperative members

What does it look like?

Executable file

What is it written in?

Windows Visual Basic

Is there help available?

Manual

References:

G. Schrale and T. Biswas (2007) Salinity and Leaching Calculator. SARDI, http://www.sardi.sa.gov.au/pages/water/products_and_services/root_zone_salinity_hazard_assess.htm:sectID=403&tempID=1

Category:

Crop Water Use, Controlling water on and off the padock

SWAGMAN Destiny GIS

What is it?

SWAGMAN Destiny GIS is used to to prepare crop/soil/climate and management scenarios on a spatial and temporal scales with the ability to perform simulations and present results on a spatial and temporal scales using thematic maps and improve presentation and understanding. Work is underway to link the model with daily satellite data to enable real-time use of actual evapotranspiration data.

Thematic maps for current and forecast:

- Yield
- ET
- Recharge (at different horizons including root zone)
- Salinity levels

Maps of Recharge can be used as input to surface/groundwater interactions models.

Input:

- Crop
- Climate
- Soil
- Irrigation
- Water table

Output:

- Crop yield
- Water content
- Water fluxes
- Salt concentrations
- Crop water use and other indicators

Regions:

NSW

Industries:

Grains

Users:

Irrigators, Consultants

Known Community of Users:

Colleambally Regional Investment Business Plan is testing this applications

What does it look like?

Executable file

What is it written in?

SWAGMAN Destiny GIS

References:

Crop Water Use

Category:

S.Khan (2007) SWAGMAN Destiny GIS

SWAGMAN® Farm

What is it?

SWAGMAN® Farm was developed to help determine cost-effective options to achieve farm scale water and salt balance within irrigation areas. The model takes into account distribution of soils within the farm, potential landuses, crop evaporative requirements, current irrigation practices, leaching requirement, annual rainfall, rainfall runoff, leakage to deeper aquifers, depth to watertable, capillary upflow from shallow watertable, salt concentration of irrigation water, groundwater, and rainwater, and the economic returns from potential landuses.

The model can be used to: provide farmers with a method to simulate and assess various farm cropping scenarios in terms of economic return and environmental effects; determine environmentally optimal irrigation intensity and encourage water use efficiency through water and salinity auditing in an integrated model; assist irrigation authorities (public & private) develop policy to achieve improved economic and natural resource sustainability.

Input:

- Irrigation water allocation (ML)
- Irrigation water price ($/ML)
- Groundwater pumping (ML)
- Groundwater pumping cost ($/ML)
- Allowed watertable rise (m)
- Allowed salinity rise (dS/m)
- Crop name
- Crop factor
- Root depth (m)
- Minimum infiltration rate
- Economic data
- Yield (t/ha)
- Price ($/t)
- Cost ($/ha)

Irrigation water data:

- Salinity(dS/m)
- Runoff percentage (%)
- Runoff salinity (dS/m)
- Monthly growth days
- Irrigation water use (ML/ha) by soil type
- Minimum cropping area (ha)
- Maximum cropping area (ha)
- Leaching factor by soil type
- Initial water content by soil type
- Saturated water content by soil type
- Field capacity by soil type
- Wilting point by soil type
- Monthly rainfall (mm)
- Monthly evapotranspiration (mm)
- Depth to watertable (m)
- Deep leakage (ML/ha)
- Salt concentration (dS/m)

Output:

Outputs include:

- The farm's gross margin,
- Area of each crop,
- Amount of groundwater recharge during cropping and non-cropping periods,
- Amount of salt brought in or taken out of the rootzone,
- Changes in water table levels and optionally, the amount of water pumped to maintain water levels.

Regions:

Southern Australia

Industries:

Grains, Pastures

Users:

Irrigators, Consultants

Where do you get it?

http://www.colyirr.com.au/swagmanfarm/allUser/SwagFarm.asp

What does it look like?

Executable file

What is it written in?

C++

References:

CSIRO SWAGMAN® Farm. http://www.colyirr.com.au/swagmanfarm/allUser/SwagFarm.asp

Category:

Crop Water Use

Tools for Irrigation Profitability and Longevity*

What is it?

This project, which is under development, aims to develop tools for:

- Real time sensing of plant water use and stress at a range of scales
- Forecast spatial and temporal crop water use
- Decision support systems that assemble, analyse and project decision options for profitable irrigation management and irrigation water distribution
- Optimisation of irrigation system layouts and management
- Tools for prediction and management of drainage and associated contaminants
- Multi criteria assessment of irrigation management decisions especially to include financial analysis

The key innovation in this project is in bringing together the elements of plant sensing, spatial variability assessment, irrigation system design assessment and decision support systems.

The tools are being designed to standards (and where they do not exist create standards) that will allow the transfer of data over the internet and used on other common platform applications.

Output:

Data will be standardised for easy transfer to other applications

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators, Consultants

What does it look like?

Executable file and spreadsheet

What is it written in?

Various including C++, javascript, visual basic,

References:

E. Christen (2007) Tools for Irrigation Profitability and Longevity. CRC Irrigation Futures, www.irrigationfutures.org.au

Category:

Crop Water Use

VineLOGIC™

What is it?

VineLOGIC™ Virtual Vineyard is a simulation computer model of grapevine growth and development, designed to simulate what might happen to a grape crop under different conditions and management practices. The model allows users to explore the potential changes caused by manipulating the vineyard environment.

New features in VineLOGIC™ Virtual Vineyard as compared to Version 1 include:

- Over 30 years of weather data for each of 44 locations across the main viticultural regions
- Greater choice of varieties, with inclusion of Sultana, Merlot and Colombard.
- Direct choice of rootstock, covering 15 of the more common rootstock varieties, plus own roots for the listed scions
- Greatly enhanced soils options, including typical soils of differing texture, regional Australian vineyard soils and data from the 'Key to Vineyard Soils of Australia'
- Seamless integration across 3 calendar years and covering 2 complete vine growth and development seasons
- Inclusion of vineyard floor management options
- Inclusion of a calendar-based option for scheduling irrigations
- Environmental output screens for water and salinity detailing the fate of applied water (irrigation and rainfall) and dissolved salt.

Input:

- Weather (region, climate)
- Soil type salinity
- Pruning system
- Trellis type
- Variety
- Rootstock
- Irrigation water
- Irrigation schedule
- Water table depth
- Soil salinity.

Output:

- Time of end of dormancy
- Time of budburst
- Time of veraison
- Time of ripening
- Potential yield
- Periods of stress
- Severity of stress
- Weather summary.

Outputs can be seen either as text or as graphs using a viewer that is part of VineLOGIC Virtual Vineyard. This enables users to compare and analyse results from a wide variety of scenarios.

Regions:

All of Australia

Industries:

Viticulture

Users:

Consultants, Trainers

What does it look like?

Executable file

What is it written in?

VineLOGIC™

Is there help available?

Manual, Helpdesk

References:

R. Walker VineLOGIC™. CRC Viticulture, http://www.crcv.com.au/products/vinelogic/

Contacts:

Rob Walker
Telephone: (03) 5051 3100
rob.walker@csiro.au

Category:

Crop Water Use

Water Budget Calculator

What is it?

The water calculator helps the irrigator or adviser calculate the theoretical annual crop water requirement (mm) for a specific crop. It includes in the calculation a total estimate of the volume required to grow the entire crop. The tool is being developed in collaboration with staff from the Department of Agriculture and Food, Waterwise on the Farm program. It is currently under final review and it will require further amendment. It is anticipated the tool will be finalised by the end of October, 2007. The calculator will be available free of charge. It is likely that most irrigators will want support the first time they use it.

Input:

- Average monthly evaporation (mm)
- Average monthly rainfall (mm)
- Average monthly rainfall decile 1 (mm)
- Effective rainfall fraction
- Crop Factor
- Name of crop
- Current crop allocation (kL/ha/yr)
- Crop area or property size (ha)
- System Efficiency

Output:

- Licensed allocation KL
- Theoretical Irrigation requirement for average rainfall year (kL/yr)
- Theoretical irrigation requirnent for Decile 1 rainfall tear (kL/yr)
- Calculated Crop Allocation (DU % allocated) — Average Rainfall year (kL/yr)
- Calculated Crop Allocation (DU % allocated) — Decile 1 Rainfall year (kL/yr)
- Potential Crop allocation (DU% adjusted) — Average rainfall year (ha)
- Potential Crop allocation (DU% adjusted) — Decile 1 rainfall year (ha)

Regions:

Swan Catchment

Industries:

All industries

Users:

irrigators and industry officers

Known Community of Users:

Trial irrigators Swan Catchment

Where do you get it?

Swan Catchment Council

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Manual embedded in the spreadsheet but limited instructions

References:

Swan Catchment Council (2007) Water Budget Calculator. Swan Catchment Council,

Category:

Crop Water Use

Water Quality Calculator

What is it?

This simple web tool can be used to calculate the salinity (EC), Sodium Adsorption Ratio (SAR) and pH when water sources are mixed together to provide irrigation water. The calculated figures are then compared with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and reference information contained in the Cotton CRC WaterPak publication.

Input:

- Water source
- Volume (ML)
- EC (dS/m)
- Sodium Adsorption Ratio (SAR)
- pH

Output:

Estimated yield reduction in cotton crop for the weighted average salinity level of the irrigation water.

Regions:

Queensland, NSW

Industries:

Cotton

Users:

Irrigators

Where do you get it?

http://tools.cotton.crc.org.au/CottonLOGIC/WQC/

What does it look like?

Website

What is it written in?

Water Quality Calculator

References:

CSIRO (2005) Water Quality Calculator. Cotton Catchment Communities CRC, http://tools.cotton.crc.org.au/CottonLOGIC/WQC/index.aspx

Category:

Crop Water Use

WATERTRACK OPTIMISER™

What is it?

WATERTRACK OPTIMISER™ provides a comprehensive daily whole farm water balance with a full break down of losses and the ability to predict water use and losses forward to optimise production per megalitre. It calculates essential irrigation performance indicators for any farm which provide a starting point in establishing the water use efficiency of a farming operation.

WATERTRACK tracks water through every operation on an irrigation farm including:

- supply channels,
- storages,
- headditches
- field application
- tailwater return
- wetting up soil (channel, storages, fields & drains)
- evaporation from water surface of each element and from the soil surface
- seepage and deep drainage

Input:

- Farm map
- Water allocations
- Basic dimensions of the irrigation system
- Channel and drain lengths, top water widths and depth
- Storage volumes and surface areas to depth relationships
- Field sizes and soil types
- Pumping capacities
- Crop types and planting dates
- Weather data for the location
- Field irrigated
- Irrigation duration
- Siphon numbers and size
- Average siphon head or measured siphon flow.

Output:

- Growing the crop,
- Seepage and evaporation in all channels, drains & storages, and
- Deep drainage below the root zone.

Regions:

All

Industries:

All industries

Users:

Irrigators

Where do you get it?

Aquatech Consulting and supplier network

What does it look like?

Executable file

What is it written in?

WATERTRACK OPTIMISER™

Is there help available?

User support can be purchased on an annual basis

References:

J. Purcell (2005) WATERTRACK OPTIMISER™. Aquatech Consulting Pty Ltd,, http://www.watertrack.com.au/

Contacts:

WaterTrackTM Agent
Ph: 1800 886 536
www.watertrack.com.au
Fax: 1800 899 768

Category:

Crop Water Use, Controlling water on & off the paddocks

Water Usage Stewardship protocol

What is it?

This protocol comprises different components such as software programs, hardware and many years of in-house horticultural experience to apply best practice in the efficient and effective utilization of water.

Input:

- Phytech stem Dendrometers
- Soil solution extractors
- Soil solution monitoring spreadsheet
- EnviroScan and software
- Drought Water Budgeting Tool and Plan
- Training

Output:

- Indications of tree stress
- Growth rates.
- Soil EC at different depths in the soil
- Calculation of the economical optimum percent of normal irrigation to apply

These outputs assist with water forecasting, prioritisation of blocks based on the marginal profit per ML of water for each block. For drought management the calculation of the economical optimum percent of normal irrigation to apply to each priority class, so that, at the end of the season, all water is used.

Regions:

All

Industries:

Grazing Horticulture Cotton Dairy Sugar

Users:

Irrigators, commercial extension services, water consultants to growers, engineers, designers, trainers

Known Community of Users:

Mainly the horticulture industry

Where do you get it?

AgriExchange

What does it look like?

Worksheet

What is it written in?

Multiply

Is there help available?

Via commercial adviser

References:

AgriExchange (2007) Water Usage Stewardship protocol. AgriExchange, http://www.yandillapark.com.au/Growers/enviroscan_main.htm

Category:

Crop Water Use

WaterSense

What is it?

WaterSense delivers paddock-by-paddock irrigation advice which enables growers to schedule the season's irrigation and make the most of limited water. WaterSense is a computer program accessed via the Internet which simulates the growth of the crop and predicts when it should be irrigated to avoid a defined level of water stress. It is powered by the APSIM crop growth simulator. Scenario analysis to improve irrigation schedule can be undertaken. This takes into account the growth of the crop (as modelled by APSIM), and factors such as whether trash has been left on the ground.

Input:

- Name of closest automated weather station
- Soil water deficit (mm), soil type, and irrigation (mm)
- Rainfall (mm) (Added automatically from weather station)
- Crop cover (%)
- Date of irrigations (dd/mm/yyyy) and planned irrigations (dd/mm/yyyy)
- Harvest date
- Planting or ratoon date (dd/mm/yyyy)

Output:

- Growth of cane crop (t/ha)
- Total irrigation (ML/ha)
- Total rainfall (ML/ha)
- Crop evapotranspiration (mm)
- Crop cover (%)
- Crop water needs met (% — indicates the crop's ability to meet daily water requirements.
- Scenario analysis to improve irrigation schedule

Regions:

Queensland, Western Australia (Ord)

Industries:

Sugar

Users:

Irrigators, Consultants

Known Community of Users:

Bundaberg, Ord and Sarina sugar growers

What does it look like?

Website

What is it written in?

WaterSense

References:

G. Inman-Bamber, S. Attard, C. Baillie, D. Lawson and L. Simpson (2005) WaterSense. CSIRO, Sugar Research & Development Corporation, www.clw.csiro.au/watersense/pages/main.aspx

Category:

Crop Water Use

WeatherFare*

What is it?

This tool is designed to link to other meteorological data websites and enable calculation of evapotranspiration, so that weather-based scheduling of irrigation can be undertaken, avoiding over-watering when rain is imminent.

The tool is still in the development stage and uses the full FAO 56 methodology to calculate ETo and ETc (ie. adjusts kc for wetting frequency etc — inclusion of all the elements of this full methodology is not complete).

Input:

- Crop type
- Planting date
- Crop coefficients, specified by growth stages
- Rooting depth

From Bureau of meteorology: Daily or monthly average:

- rainfall
- temperature
- windspeed
- evaporation

Output:

Daily forecast and actual crop water use

Regions:

NSW

Industries:

Broadacre and Horticulture

Users:

Consultant

What does it look like?

Spreadsheet

What is it written in?

EXCEL

References:

H. Fairweather WeatherFare. http://www.irrigationfutures.org.au//imagesDB/messageboard/WeatherFare.xls

Category:

Crop Water Use

Yield Prophet®

What is it?

Yield Prophet® is an on-line crop production model designed to provide grain growers with real-time information about the crop during growth. This enables them to better match fertiliser and water applications to the stage of the growth of the crop. Yield Prophet® uses the computer simulation model APSIM together with paddock specific soil, crop and climate data to generate information about the likely outcomes of farming decisions.

Input:

- Sowing date (dd/mm/yy)
- Crop and variety
- Date and rate of nitrogen fertiliser application (kg/ha)
- Rainfall (mm)
- Irrigation applications (mm) and efficiency (%)
- Stubble quantity (kg/ha)
- Maximum rooting depth of crop (cm)
- Soil pH
- Organic carbon (%)
- EC of soil (dS/m)

Output:

- Projected yields of grain (t/ha) by probability
- Projected yields of hay (t/ha) by probability
- Probability of frost
- Probability of heat shock
- Availability of soil water (mm) to the growing roots
- Availability of nitrogen (kg/ha) to the growing roots

Regions:

Australia

Industries:

Grains

Users:

Irrigators, Consultants

Known Community of Users:

Birchip Cropping Group

What does it look like?

Website

What is it written in?

JAVA

Is there help available?

Fully supported

References:

J. Hunt (2007) Yield Prophet®. CSIRO, http://www.yieldprophet.com.au

Contacts:

James Hunt
Phone: 03 9354 1654
Mobile: 0429 922 787
E-mail: james.hunt@aanet.com.au

Category:

Crop Water Use

CATEGORY 3:
FORECASTING & RECORD KEEPING

Almond Daily Water Budgeting Spreadsheet

What is it?

The spreadsheet is reportedly useful for a range of management levels and can be used throughout the grower season. It is purely designed for the almond industry.

Input:

NA

Output:

NA

Regions:

Not known

Industries:

Almond industry

Users:

Irrigators

Known Community of Users:

Not known

Where do you get it?

Almond Board of Australia

What does it look like?

Spreadsheet

What is it written in?

Excel

Is there help available?

Not known

References:

Almond Board of Australia (2007) Almond Daily Water Budgeting Spreadsheet. Almond Board Australia, Berri. www.aussiealmonds.com/html/s01_home/home.asp?dsb=9

Category:

Forecasting & Record keeping

AquaSpy™ Viewer—see under "Crop Water Use"

Catcher

What is it?

Catcher is a “Back of the Envelope” calculator for analyzing catchment water balances — how much rain falls (RAIN), how much water evaporates and is used by crops (Et), how much runs off (RUNOFF), and how much disappears into the sub-soil (DEEP FLOW). It uses monthly point-value estimates of Et, RUNOFF and DEEP FLOW from the AgET program, adds them up for a given catchment, and allows users to see how much effect different crop plantings in different areas of a catchment can have on the catchment water balance.

Input:

- Monthly point-value estimates of Et,
- RUNOFF and
- DEEP FLOW from the AgET program
- The percentage area of each of the types of land used in the AgET program is then entered

Output:

- Graphs provide information on individual and total components of the water balance.
- The Report screen gives annual average values of the whole water balance for the catchment.

Regions:

Western Australia

Industries:

All industries

Users:

Consultant

What does it look like?

Executable file

What is it written in?

Catcher

References:

R. Colliver and R. Argent (1999) Catcher. Department of Agriculture and Food, Western Australia, http://www.agric.wa.gov.au/content/lwe/water/Zcatch.ZIP

Category:

Forecasting & Record keeping, Crop Water Use

Consumption Tracker

What is it?

This spreadsheet allows users to plot their weekly water usage and compare it with their allocation for the year to ensure that they do not go above their allocation. It provides comparisons against the previous 2 seasons' usage. The speadsheet also contains links to other tools on irrigation e.g. http://www.pir.sa.gov.au/pirsa/drought/irrigation__and__water_management/water_budgeting_and_water_trade_decision_tools

Input:

- Weekly Meter reading (KL)
- Annual allocation (ML)
- % of allocation that is available

Output:

Graphical analysis of usage compared to maximum allowed usage.

Regions:

South Australia

Industries:

All irrigators

Users:

South Australia irrigators

Where do you get it?

Freely available on the web

What does it look like?

Spreadsheet

What is it written in?

EXCEL and Visual Basis

Is there help available?

Help desk is available from Drought Response Team on 08 8582 4477

References:

SAMDBNRM (2007) Consumption Tracker Spreadsheets. South Australian Murray Darling Basin Natural Resources Management Board, http://www.samdbnrm.sa.gov.au/BoardProjects/IrrigationManagement/ConsumptionTracker.aspx

Category:

Forecasting & Record keeping

Continuous Sharing

What is it?

The Continuous Sharing initiative involves upgrading the existing announced allocation system of water sharing with "Continuous Sharing" (CS). CS is an important change in that it provides customers with the means to self-manage their allocations and plan the management of their water accounts over a period greater than a single water year.

This information, combined with the irrigator calculating expected dam inflows, provides powerful planning information on when and how much to plant or alternatively whether to sell water. Sunwater have the responsibility to have the tool upgrade the irrigators' continuous share. The information is available online, but access is limited to customers and each irrigator's information is password protected.

Input:

not known

Output:

Irrigators current share of the dam's capacity (ML)

Regions:

St George Irrigators. Shortly to be expanded to MacIntyre Brook

Industries:

All

Users:

Irrigators

Known Community of Users:

St George Irrigators

Where do you get it?

SunWater

What does it look like?

Online

What is it written in?

web browser

Is there help available?

There is user support in the form of online help files as well as a manned SunWaterOnline 1800 helpline for customers.

References:

SunWater (2007) Continuous Sharing of the dam's capacity. SunWater, www.sunwater.com.au/#

Contacts:

SunWater
Level 9, 120 Edward Street
PO Box 15536
City East
Queensland 4002
Australia

Category:

Forecasting & Record keeping

Costing an irrigation system (net margin calculator)

What is it?

This calculator is designed to allow the user to enter the costs for two different irrigation systems to compare the viability of purchasing or upgrading an irrigation system.

Input:

- Area to be irrigated (ha)
- Yearly labour (hr)
- Labour cost ($/hr)
- Yearly repair costs ($)
- Capital cost ($)
- Years of working life (yr)
- Resale value of irrigator ($)
- Gross margin ($ income/ha)

Output:

- Annual $ returns from the irrigation system

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators

What does it look like?

Website

What is it written in?

Costing an irrigations system (net margin calculator)

Is there help available?

None

References:

L. Davies and A. Richards (2002) Costing an irrigation system (net margin calculator). NSW Department of Primary Industries, http://www.agric.nsw.gov.au/reader/budgets-and-costs/irrig-costing-systems.htm

Category:

Forecasting & Record keeping

Crop Irrigation Water Requirement Tool

What is it?

This tool has been developed to support irrigators to better understand their crop water requirements and to also link in with the Northern Territories Water Planning process. The tool has been initially designed for mangoes and this season there have been workshops with growers on its use. During the wet season DPIFM staff will follow up with growers on its accuracy. The tool is expected to be expanded to other crops.

Input:

- Rainfall—average, decile date, median (mm)
- Crop characteristics
- Crop factors
- Mean evaporation (mm)

Output:

- Minimum and maximum water requirements — ML/ha/mth
- Predicted irrigation requirements per month for 1–9 deciles of rainfall — mm/mth
- Predicted annual irrigation requirements ML/ha

Regions:

Katherine, N.T.

Industries:

Mango — this is likely to expand

Users:

Irrigators, DPIFM staff

Known Community of Users:

Katherine irrigators and Katherine DPIFM staff

Where do you get it?

DPIFM

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Personal support from Department agency staff

References:

DPIFM. (2007) Crop Water Requirements. Department Primary Industries Fisheries and Mines Northern Territory (DPIFM),, Darwin

Category:

Forecasting & Record keeping, Crop Water Use

CropMan

What is it?

With this software, crop irrigators will be able to make informed decisions about when and how much to irrigate. CropMan is a simple interface for a simulated database of past crop performance using historical weather records from the last 104 years in Western Australia. This data is used to help predict future crop performance under different conditions and with different management.

Input:

- Location
- Soil type (Eg. clay, sandy loam, acid sandy loam, sand, duplex)
- Initial soil water (wet, dry)
- Initial N (low, high)
- Crop type (currently only wheat)
- Cultivar (late or early flowering)
- Sowing date (5 May, 5 June, 5 July or rainfall determined)
- Nitrogen application at sowing (kg N/ha) (0, 30, 60, 90)
- Nitrogen application at 6 weeks (kg N/ha) (0, 30, 60, 90)
- Nitrogen application at 10 weeks (kg N/ha) (0, 30)
- Southern Oscillation Index information
- Rainfall

Output:

CropMan provides the 104 year averages for the site including annual rainfall, rainfall distribution across the year, grain yield and grain protein and gross margin.

- Dollar return for each dollar invested
- Grain yield
- Grain protein
- Gross returns
- Average values for deep drainage water loss
- Nitrate leaching below the potential maximum root zone

Regions:

WA

Industries:

Grains

Users:

Irrigators, Consultants

What is it written in?

CropMan: improving crop production in Western Australia information sheet

References:

CSIRO Plant Industry (2006) CropMan: improving crop production in Western Australia information sheet. http://www.csiro.au/resources/cropman.html

Category:

Crop Water Use, Forecasting & Record keeping

Daily soil moisture records analyser

What is it?

This tool, developed in the R Statistical System (2006), helps summarise daily soil moisture and rainfall events.

Input:

Data from the CR200 data logger

Output:

Graphical display of:

- Soil moisture percentage for various soil depths
- Rainfall events (mm)
- Cumulative amount of rainfall (mm)

It operates on a daily time step.

Regions:

WA

Industries:

Horticulture

Users:

Irrigators and industry officers

Known Community of Users:

Dept of Agriculture and Food WA staff

Where do you get it?

Dept of Agriculture and Food WA

What does it look like?

Executable file

What is it written in?

Software developed in R Statistical System (2006)

Is there help available?

There is a support manual with contact details for the Ag WA biometrician team and a link to the R statistical program http://www.r-project.org

References:

M. D'Antuono and R. Prince (2006) Rlogger- Analysis of daily soil moisture records using the R©: A language and environment for statistical computing. Department of Agriculture and Food Western Australia, http://www.agric.wa.gov/Rlogger , www.agric.wa.gov.au/biometrics

Contacts:

Mario D'Antuono
Phone: (08) 9368 3848
Fax: (08) 9368 2958
Email: mdantuono@agric.wa.gov.au
Senior Biometrician, BSc (Hons in statistics)

Category:

Forecasting & Record keeping

Farm Enterprise Budgets

What is it?

A series of template budgets have been developed with typical costs and prices for the enterprise, and adjacent space for farmers to add in their own estimated or measured prices and yields. The farm budgets for irrigated crops assist in prioritising water applications in relation to other crop inputs.

The budgets that are available that are relevant to irrigators are listed below:

Irrigated Murray summer crop gross margins 2006/07
Flood irrigated maize gross margin budget, Murray area, 2006/07
Flood irrigated rice: long grain, aerial sown, Murray area, 2006/07
Flood irrigated rice: medium grain, aerial sown, Murray area 2006/07
Flood irrigated soybeans: Murray area, 2006/07
Flood irrigated soybeans: rows/beds, Murray area 2006/057
Water costs — Murray 2006/07

Irrigated Murray winter crop gross margins 2007
Barley 2007
Canola 2007
Oaten hay 2007
Oats: grain only 2007
Wheat: ASW/AH1, border check, direct drill 2007
Wheat: ASW/AH1, rice fallow, flood irrigation layout, direct drill, 2007

Irrigated Murrumbidgee summer crop gross margins 2006/07
Cotton — Bollgard II 2006/07
Cotton — conventional 2006/07
Cotton — narrow row 2006/07
Flood irrigated lucerne establishment: border check,Murray and Murrumbidgee areas, 2006/07
Flood irrigated lucerne maintenance: border check, Murray and Murrumbidgee areas, 2006/07
Flood irrigated maize: Murrimbidgee area, 2005/06
Flood irrigated rice: long grain, aerial sown, Murrumbidgee area 2006/07
Flood irrigated rice: medium grain, aerial sown, Murrumbidgee area 2006/07
Flood irrigated rice: medium grain, sod sown, Murrumbidgee area 2006/07
Flood irrigated soybeans (permanent beds): Murrumbidgee area 2006/07
Flood irrigated soybeans: rows/beds, Murrumbidgee area 2006/07
Water Costs 2006/07 for Murrumbidgee area
Water costs for Colleambally area 2006/07

Irrigated Murrumbidgee winter crop gross margins 2007
All Murrumbidgee Irrigated Winter Crop budgets 2007 [22 pages)
Barley 2007
Canola 2007
Faba beans 2007
Lucerne establishment 2007
Lucerne maintenance 2007
Summer perennial pasture 2007
Wheat: ASW/APW/AH, contour bay 2007
Wheat: biscuit, beds 2007
Wheat: biscuit, border check, conventional sown 2007
Wheat: biscuit, contour bay, sod sown 2007
Winter annual pasture establishment 2007
Winter annual pasture maintenance 2007
Irrigated central summer crop gross margins
Azuki beans 2006–07
Irrigated central winter crop gross margins 2007

All Central NSW Irrigated winter Crop Budgets (2007 — 10 pages)
Flood irrigated canola 2007
Flood irrigated lucerne establishment 2007
Flood irrigated lucerne maintenance 2007
Flood irrigated wheat 2007
Spray irrigated lucerne maintenance 2007
Irrigated northern summer crop gross margins
Irrigated cotton (Bollgard II) 2005–06
Irrigated cotton (conventional) 2005–06
Irrigated maize 2005–06
Irrigated mungbeans 2005–06
Irrigated navy beans 2005–06
Irrigated refuge crop (pigeon peas) for Bollgard II cotton, 2005–06
Irrigated sorghum 2005–06

Irrigated soybeans 2005–06
Irrigated summer crops, northern NSW 2005–06
Irrigated sunflowers 2005–06
Spray irrigated lucerne for hay 2005–06
Surface irrigated lucerne for hay 2005–06
Irrigated northern winter crop gross margins

All Northern Irrigated Winter Crop Budgets 2007 (13 pages)
Bread Wheat 2007 (spray irrigated)
Bread Wheat 2007 (surface irrigated)
Chickpeas 2007 (surface irrigated)
Durum Wheat 2007 (spray irrigated)
Durum Wheat 2007 (surface irrigated)
Lucerne Establishment 2007
Sheep gross margins July 2007
1st Cross ewes — terminal meat rams 2007
Dorper ewes — Dorper rams 2007
Merino ewe (21 micron) — 75% to Merino rams, 25% to terminal meat rams 2007
Merino ewe (21 micron) — maternal meat ram 2007
Merino ewe (21 micron) — terminal meat rams 2007
Merino ewe—(19 micron) — Merino rams 2007
Merino ewe—(21 micron) — Merino rams—2007
Merino ewe—(23 micron) — Merino rams 2007
Merino ewes (21 micron):— Merino rams, wether lambs sold as trade lambs 2007
Merino wethers—19 micron 2007
Merino wethers—21 micron 2007
Merino wethers—23 micron 2007

Summer crop gross margins
Introduction to the Budgets
Vegetable gross margins
Asparagus Establishment Gross Margin Budget
Asparagus Fresh Gross Margin Budget
Asparagus Processing Gross Margin Budget
Beetroot Gross Margin Budget
Broccoli Gross Margin Budget
Burdock Gross Margin Budget
Cabbage Gross Margin Budget
Capsicum Gross Margin Budget
Carrots Fresh Gross Margin Budget
Carrots Processing Gross Margin Budget
Cauliflower Gross Margin Budget
Eggplants Gross Margin Budget
Garlic Gross Margin Budget
Lettuce Gross Margin Budget
Onions Hand Harvest Gross Margin Budget
Onions Mechanical Harvest Gross Margin Budget
Parsnips Gross Margin Budget
Potato Summer Fresh Gross Margin Budget
Potato Summer Processing Gross Margin Budget
Potato Winter Fresh Gross Margin Budget
Pumpkin Butternut Gross Margin Budget
Pumpkin Jarradale Gross Margin Budget
Rockmelon 1st Yr Drip Gross Margin Budget
Rockmelon 2nd Yr Drip Gross Margin Budget
Rockmelon Furrow Gross Margin Budget
Swedes Gross Margin Budget
Sweet Corn Fresh Gross Margin Budget
Sweet Corn Processing Gross Margin Budget
Tomato Fresh Gross Margin Budget
Tomato Processing Drip Gross Margin Budget
Tomato Processing Furrow Gross Margin Budget
Watermelon Gross Margin Budget
Zucchini Gross Margin Budget
Winter crop gross margins

Farm Enterprise Budgets (continued)

Input:

Costs and prices for the enterprise's various proposed crops

Output:

Comparison of enterprise's variable costs against typical industry costs

Regions:

NSW, but readily adapted for other areas

Industries:

Grazing, Grains, Horticulture

Users:

Irrigators, Consultants

Where do you get it?

http://www.agric.nsw.gov.au/reader/budget-related/budget-list.htm

What does it look like?

Website

What is it written in?

Farm Enterprise Budgets

References:

NSW Department of Primary Industries (2007) Farm Enterprise Budgets. http://www.agric.nsw.gov.au/reader/budget-related/budget-list.htm

Category:

Forecasting & Record keeping

FARMWEATHER

What is it?

FARMWEATHER helps to make better informed decisions regarding such operations as planting, short-term irrigation, spraying and harvesting.

FARMWEATHER includes expert commentaries, synoptic charts, satellite images and four day forecasts of maximum and minimum temperatures, rainfall, rainfall probability and wind speed and direction.

Output:

Forecasts of rainfall, rainfall probability, maximum and minimum temperatures, wind speed and wind direction.

Regions:

All of Australia

Industries:

All rural industries

Users:

Irrigators

What does it look like?

Fax

What is it written in?

FARMWEATHER

References:

Bureau of Meteorology FARMWEATHER. http://ssu1.bom.gov.au/pub/consulting/farmweather.html

Category:

Forecasting & Record keeping

FlowCast

What is it?

FlowCast is a seasonal climate forecasting decision support tool with spatial and point-based analyses. It is capable of analysing any time-series data such as rainfall, crop production and streamflow. Consultants and irrigators can predict the water available from various sources (including allocations) to determine crop type and planted area.

FlowCast is comprised of a data management interface, a data analysis interface, and a forecast analysis interface, linked together by unique and powerful graphical controls for manipulating and designing the analyses. Non-parametric and comparative testing techniques are employed by FlowCast to identify and quantify "forecasting potential".

The package can also be used as an analysis tool for browsing and comparing time series data, providing data conversion functions, statistical analysis, data transformations, regression analysis and data manipulation. FLOWCAST was first developed for the MDBC it has since been undergoing redevelopment and it is likely to be released on the requirement that training is undertaken first.

Input:

Predictor data — montly time-series data such as SOI (Southern Oscillation Index Data) or SSTa (Sea Surface Temperature Anomalies) data.

Predictand data—that which we wish to predict such as rainfall, max/min temperatures, evaporation, streamflow, storage levels, storage inflows, irrigation allocations, pumping days, etc.

Predictand data must be daily or monthly of at least 30 years length.

Output:

A range of graphical and textural outputs. Forecasts are presented as pie charts (2 or 3 cateogry) or probably distributions. These are accompanied by a rage of graphical representations of skill to assess the reliability of the forecasts. Outputs can be spatially represented on a map

Regions:

All

Industries:

All industries

Users:

Users trained in the basics of climate science. Potentially this includes climate researchers, water agencies, policy makers, consultants and corporate irrigators. It would not be suitable at the farm level given the dangers inherent in forecast generation.

Known Community of Users:

Queensland Government climate scientists, and Indonesian Government Meteorological Office. Earlier versions of the software were released to select users, but support was not maintained for the now redundant version.

Where do you get it?

Contact David McClymont for more information. There will be no cost for the software, but there will likely be restrictions on who can use it. This is currently under review, pending finalization of the software.

What does it look like?

Executable file

What is it written in?

Written in C++, with XML and ASCII data formats

Is there help available?

No support is available for the older versions. Help document is currently being developed for Version 4.12 (due to be released in 2008).

References:

D. McClymont (2003) FlowCast v.4.12. Department of Natural Resources & Mines, Queensland,

Contacts:

David McClymont
Senior Research Scientist
Queensland Climate Change Centre of Excellence
Telephone 07 4688 1630 Faxsimile 07 4688 1490
Email David.McClymont@climatechange.qld.gov.au
Mobile 0421 584 587

Category:

Forecasting & Record keeping

Forecasting System*

What is it?

A new information tool under development and planned for release in late 2007. This tool will offer SunWater customers the ability to project the probabilities of future water storage water levels in SunWater dams over a 12 month horizon. The tool will allow users to select the basis upon which the wish to project inflows (based on historical data, current ENSO indicators like SOI, or other options) as well as the level of demands over the next 12 months that they would like to test.

Input:

- Projected inflows,
- Levels of demand

Output:

Allows SunWater customers to project future water storage levels.

Regions:

Sunwater districts in Queensland

Industries:

All industries

Users:

Irrigators

Known Community of Users:

under development

Where do you get it?

SunWater

What does it look like?

Website

What is it written in?

web browser software

Is there help available?

not known

References:

SunWater (2007) Forecasting Systems. Sun Water,

Category:

Forecasting & Record keeping

HARTT Hyrdograph Analysis—Rainfall and Time Trend

What is it?

HARTT enables better understanding and use of groundwater, by statistically estimating trends in groundwater levels. The approach separates the effect of atypical rainfall events from underlying time trends and the lag between rainfall and its impact on groundwater is explicitly represented. The method improves the estimation of time trends and allows for better interpretation of treatment effects on groundwater levels.

HARTT software was developed to aid hydrologists with the analysis of groundwater hydrographs. The software is easy to use and eliminates cumbersome data operations. It is a useful tool in hydrological studies.

Input:

- Historic daily or monthly rainfall figures (at least 10 years)
- Historic bore levels measuring rainfall by date measured

Output:

Graphical analysis of the:

- Rainfall and
- Bore water levels

Where do you get it?

Lote-Tree Software at support@lotetree.com.au

What does it look like?

Spreadsheet

What is it written in?

File size: 2.9MB (a further file of 2.9MB may required for older systems)
Minimum hardware required: Pentium III compatible computer with 128MB RAM
Operating systems: Windows 98, NT 4, ME, 2000, XP
Additional software: Microsoft Excel 97, Microsoft Excel 2000 and XP

Is there help available?

Technical and software support advertised on-line as available by telephone and email. The HARTT-XLS help files include:
Ferdowsian et al. (2001).pdf
HARTT Manual.pdf
Data input example.xls
Data input template.xls

References:

R. Ferdowsian, C. McCarron and R. Majidi (2001) HARTT— Hydrograph Analysis — Rainfall and Time Trend.
http://www.agric.wa.gov.au/content/lwe/water/harrt.htm#import

Contacts:

Ferdowsian R. Pannell D.J. McCarron C. Ryder A.T. and Crossing L. (2001: “Explaining Groundwater Hydrographs: Separating Atypical Rainfall Events from Time Trends”, AJSR vol. 39, 4. 861-875

Ferdowsian R. Majidi R. McCarron C. (2002). “HARTT: User-friendly software for hydrograph analysis to separate rainfall and time trend”, 27th Hydrology and Water Resources Symposium Proceedings, Melbourne, 20–23 May 2002. CD-Rom produced by Amlink.

Ferdowsian R. Pannell D. J. (2001). “Explaining trends in groundwater depths: distinguishing between atypical rainfall events, time trends, and the impacts of treatments”, MODSIM 2001 Congress Proceedings, Canberra, 10–13 December 2001. PP. 549-554 (Modelling and Simulation Society of Australia and New Zealand INC).

Category:

Forecasting & Record keeping

HowOften?

What is it?

HowOften? explores long-term rainfall records to determine the frequency of rainfall events. The general question asked is: 'How often does x mm of rain fall in y days occur between date 1 and date 2?'

With HOWOFTEN? you can find:

* When planting opportunities occur,
* When flooding rains are most likely,
* If more rain did fall in the 50's

The program assists the user to download a rainfall file from the web and interpret it by graphing the results.

Input:

Location and a file of rainfall for that location, downloadable from the web

Output:

Customised graphs of :

- The amount of rainfall falling in a period that the user specifies, and
- A comparison with other years in the data set.

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators

Where do you get it?

http://www.apsru.gov.au/apsru/

What does it look like?

Executable file

What is it written in?

Open platform

References:

R. Hudson and A. Doherty (2006) HowOften? Queensland Government, Natural Resources and Water, http://www.apsru.gov.au/apsru/

Category:

Forecasting & Record keeping

IPART*

What is it?

This tool, which is still under development, will be used by irrigation industry development officers to store/analyse and report on irrigation system performance.

Users:

Consultant, Trainer

What is it written in?

Irrigation Performance Audit Report Tool

References:

(2007) Irrigation Performance Audit Report Tool. www.ncea.org.au

Category:

Storage & Delivery

IRES™

What is it?

IRES software is an Irrigation Recording and Evaluation System that allows irrigators to keep comprehensive irrigation records, analyze the records and evaluate water use efficiency down to the irrigation valve unit level. Records at the irrigation valve unit level can be compiled to produce comprehensive irrigation reports in table and graph formats, for specific crop types, varieties or rootstocks.

IRES enables irrigators to record irrigation management on an event basis, evaluate water use efficiency and review irrigation management with production indices. Detailed crop and irrigation system information is entered for each planting patch and irrigation valve unit. Irrigation dates, irrigation hours and valve units included in each irrigation shift are also entered. Water meter readings are desirable but are optional. The prototype software allows irrigators to track the distribution and volume of irrigation water applied across the property on an event and annual basis. IRES calculates irrigation depth (mm) and kilolitres applied for each irrigation valve unit, planting patch and crop type on an annual basis or for specified time periods. Irrigation volumes calculated from irrigation hours can be reconciled with water meter readings.

IRES allow users to calculate reference crop (ETo) and crop evapotranspiration (ETc) from daily weather data according to FAO 56. Crop evapotranspiration, rainfall and irrigation records are combined to simulate changes in daily soil water content within crop root zones for all irrigation valves and planting patches. Soil water monitoring data can be imported into IRES to validate simulated soil water traces and refine crop coefficients. Ratios of irrigation depths applied relative to ETo can be generated for any irrigation valve and date range for easy comparison with standard crop coefficients.

Annual water budgets may be specified for each planting patch and irrigation applications progressively monitored against budgets throughout the season at a patch and property level.

IRES enables:

- Comprehensive irrigation record analysis and reporting
- Planning irrigation hours and valve unit combinations for desired flow rates, shift areas, irrigation depths, volumes and litres per plant
- Monitoring patch water budgets
- Generating daily ETo and ETc from weather data
- Calculating ratios of irrigation applied to ETo
- Comparing simulated daily changes in root zone soil water content with soil water monitoring data
- Developing property specific crop coefficients
- Forecast crop water use and changes in root zone soil water content
- Review history to identify periods of optimal sub-optimal irrigation management
- Generating annual irrigation reports
- Calculating a suite of water use efficiency indices

Input:

- Detailed crop and irrigation system information is entered for each planting block and irrigation valve unit.
- Data from each irrigation shift is added including -Irrigation dates, irrigation hours and valve units. Water meter readings are desirable but are optional
- Rainfall and evapotranspiration can be separately downloaded from applicable weather stations and added.

The prototype software allows irrigators to track the distribution and volume of irrigation water applied across the property on an event and annual basis.

Output:

- Comprehensive irrigation record analysis and reporting
- Planning irrigation hours and valve unit combinations for desired flow rates, shift areas, irrigation depths, volumes and litres per plant
- Generating daily ETo and ETc from weather data
- Simulated daily changes in rootzone soil water content
- Forecast crop water use and changes in rootzone soil water content
- Review history to identify periods of optimal or sub-optimal irrigation management

Regions:

South Australia

Industries:

Horticulture

Users:

Intended for use by growers on irrigated horticultural properties with pressurized irrigation systems. It has the potential to be a tool that supports initiatives and targets implemented by irrigation district or community based water management committees and agencies.

Known Community of Users:

Irrigators in the Central Irrigation Trust districts

IRES™ (continued)

Where do you get it?

PIRSA — Commercial

What does it look like?

Worksheet or spreadsheet

What is it written in?

EXCEL

Is there help available?

Farm visits, training workshops

References:

T. Adams (2006) Irrigation Recording and Evaluation System (IRESTM). Irrigated Crop Management Service (ICMS) of Rural Solutions SA,, www.ruralsolutions.sa.gov.au

Contacts:

Tony Adams
Program Manager: Irrigated Crop Management Services (ICMS)
Rural Solutions SA,
PIRSA Loxton Centre
Box 411
Loxton SA 5333
Phone: 08 8595 9142
Email: adams.tony@saugov.sa.gov.au

Category:

Forecasting & Record keeping

IRRIGATE* — see under 'Crop Water Use'

Irrigation Risk Management Toolkit

What is it?

This worksheet and report assists commercial businesses to assess their needs with regard to the mix of permanent water and temporary water that they will need, and the costs associated with different choices.

Input:

The kit works through 6 questions:

Q1. How often will I be short of water?

Q2. Over the long term, how much will it cost me to use temporary water trade to avoid being short of water?

Q3. Over the long-term, am I better off trading permanent or temporarywater?

Q4. How much can I afford to pay for temporary water over the long term?

Q5. How do the options compare in an extreme year?

Q6. How do the options compare in the event of rationing?

Output:

Better information on the risks and opportunities to trade water

Regions:

All of Australia

Industries:

Horticulture, Dairy, Rice

Users:

Irrigators

What does it look like?

Worksheet or spreadsheet

What is it written in?

Irrigation Risk Managment Permanent Horticulture Kit: Tailoring water entitlement to suit your business

Is there help available?

Manual

References:

Rendell McGuckian (2002) Irrigation Risk Management Permanent Horticulture Kit: Tailoring water entitlement to suit your business. Rendell McGuckian, www.npsi.gov.au
http://downloads.lwa2.com/downloads/publications_pdf/ER020352.pdf
http://products.lwa.gov.au/downloads/publications_pdf/ER020353.pdf

Category:

Forecasting & Record keeping

IrriMAX™ 7—see under 'Controlling water on and off the paddock'

Magpie

What is it?

Magpie is a software package to receive, store and display information from soil moisture sensors or weather stations. Collation of this information enables irrigators to make better decisions for water use and crop growth.

Magpie offers a variety of graph customisations to generate a graph view most appropriate for the application. These customised graphs can be saved as favourites for fast recall at a later date. Magpie's tabular data display is useful to track down specific times or values. Tables can be easily navigated to find data of interest. Data can be selected and exported for further processing in third party applications. For telemetry based systems, Magpie provides a manual dial/hang-up facility which lets you call a site, unload the data and even check the current sensor readings. Calls can be automated using the Windows Scheduler. Magpie supports multi-user access.

Input:

- Sensor ID
- Rainfall (mm)
- Irrigation (mm)

Output:

Customised display

Regions:

All

Industries:

All industries

Users:

Irrigators, Consultants

Known Community of Users:

Central Irrigation Trust

Where do you get it?

MEA has a range of accredited sales agents Australia wide.

What does it look like?

Executable file

What is it written in?

Windows

Is there help available?

Manual

References:

D. Peacock Magpie. Measurement Engineering Australia (MEA), www.mea.com.au/magpie/index.htm

Contacts:

MEA
41 Vine St, Magill, SA, 5072
PO Box 476, Magill, SA, 5072
Ph: 61 8 8332 9044

Category:

Forecasting & Record keeping

MMMR systems*

What is it?

This tool is under development and aims to use METRIC analysis to verify/formulate crop coefficient (kC) values appropriate to major irrigation enterprises (dairy, horticulture, vines, cotton) in major irrigation regions (GV, Sunraysia, MIA, northern NSW) in the MDBC. It is also hoped to test the approach for ecosite water management i.e. Can we manage ecosite water requirements using established crop approaches? The approach will use satellite imagery to monitor crop water use (supported by extensive ground truthing). This will then be used to support the development of information tools such as benchmarking.

Input:

Satellite imagery

Output:

Daily crop evapotranspiration (mm)

Regions:

All

Industries:

All industries

Users:

Irrigators, eater suppliers and regional planners

Known Community of Users:

Under development

Where do you get it?

DPI Victoria

What is it written in?

Measurement, monitoring and reporting systems for improved management of regional water resources at farm to national scales in Australia

References:

D. Whitfield and Q. Mcallister (2010) Measurement, monitoring and reporting systems for improved management of regional water resources at farm to national scales in Australia.

Category:

Crop Water Use, Forecasting & Record Keeping

Multi-Log

What is it?

Multi-Log helps irrigators to improve on-farm water use efficiency by collating results from a variety of different data loggers, and providing a more sophisticated graphical display of results.

Multi-Log can graph data from a wide range of data loggers from different manufacturers — Campbell, MEA, CIMIS, EIT, Delta-T, Diviner, Enviromanager and many more. The data can be graphed separately, or overlaid on the same graph. Data from different loggers, recorded at different times, can be plotted on the same graph or map.

A wizard assists the user to create new loggers and sensors. They can be created from scratch, copied from an existing logger, or copied from a supplied template.

The actual data values can be viewed, edited, and exported as comma-delimited text files.

Input:

- Soil moisture data
- Meteorological data

Output:

Graphical display of variables such as:

- Calculated total water content from individual soil moisture sensors
- Calculated growing degree days from temperature
- Smoothed data to give a daily average.
- Calculated daily water use from continuous soil moisture data (Figure 2).
- Calculated the effective gain from an irrigation (the net rise in water content)

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators, Consultant

What does it look like?

Executable file

What is it written in?

Windows

References:

T. Finch Multi-Log. Research Services New England (RSNE), http://www.rsne.com.au

Category:

Forecasting & Record keeping

Patch tool for vines

What is it?

A spreadsheet to support growers in deciding on the use of water resources at the patch scale, particularly assisting in the prioritisation of water between patches and over the whole season when water is limited. This spreadsheet has been designed using the average monthly pan evaporation data for the Riverland area.

Input:

Total water allocation (ML)
Water restriction (%)
Additional water purchased (ML)
Meter number
Meter reading (kL)
Patch name
Patch area (ha)
Crop type
Application rate (mm/hr)
Irrigation system
Rationed amount (ML/ha/season)
Estimated % of rationed amount of water to be used per month (based on historical pan evaporation figures for the area)
Desired irrigation frequency (days)

Output:

Duration of irrigation (hours/month)
Seasonal surplus or deficit for a given irrigation season (ML)

Regions:

Mallee SA (RIverland)

Industries:

Viticulture, Citrus, Stonefruit, Other

Users:

Grape growers

Known Community of Users:

CCW cooperative members

Where do you get it?

CCW Cooperative

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

via CCW extension staff training

References:

CCW Cooperative (2007) Patch Water Rationing Budget.CCW Cooperative. www.ccwcoop.com.au/
http://new.webtemplate.com.au/bridgehead/CCW/media/files/1040.xls

Category:

Forecasting & Record keeping

Property Rationing Tool CCW

What is it?

A spreadsheet to support growers in deciding on the use of water resources on the property. The spreadsheet allows growers to look at scenarios of allocating limited water around their farm.

Input:

Patch name
Grape variety
Area (ha)
Predicted return ($/t)
Total allocation (ML)
Annual available allocation (%)
Price of water ($/ML)
% of purchased water available (%)
Ideal water application (ML/ha/patch)
Predicted harvest per patch (t/patch)
Running costs ($/ha/yr)
Minimum water requirement (ML/ha/patch)
Predicted harvest per patch under minimum water conditions (t/patch)

Output:

Surplus/Deficit of available water (ML)
Gross returns ($)
Net returns ($)

Regions:

Mallee SA

Industries:

Primarily viticulture

Users:

Growers

Known Community of Users:

CCW cooperative members

Where do you get it?

CCW Cooperative

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

via CCW extension staff

References:

CCW Cooperative (2007) Variety and Water Priority Tool. CCW Cooperative Berri. www.ccwcoop.com.au/
http://new.webtemplate.com.au/bridgehead/CCW/media/files/1037.xls

Category:

Forecasting & Record keeping

Pump Efficiency Cost Calculator

What is it?

This tool allows the efficiency of an electric or diesel pump to be determined. The results need to be compared with the manufacturer's pump curve to determine its efficiency. The tool also provides an overview of the various costs such as c/kWhr/ML pumped.

Input:

Example for an electric motor driven pump:

Irrigation:

- Date (enter as dd-mm-yy)
- Time (enter as hh:mm)

Pump and Motor:

- Flow meter (ML)
- Operating pressure:(kpa)
- Suction lift: (m)
- Rated motor output: kw
- Drive Type

Electricity Meters:

- No 1 — High rate dial (kw)
- No 1 — Low rate dial (kw)
- No 2 — High rate dial (kw)
- No 2 — Low rate dial (kw)
- No 3 — High rate dial (kw)
- No 3 — Low rate dial (kw)
- Multiplier

Electricity Tariff:

- Tariff — Off-peak Rate (c/kwhr)
- Tariff — Comparison Rate (c/kwhr)
- Tariff — Peak Rate (c/kwhr)

Output:

Example for an electric motor driven pump

- Volume pumped (ML)
- Time monitored (hours)
- Flow rate (L/second)
- Electrical power drawn (kW/hr)
- Electrical power per ML (kWh/ML)
- Motor Efficiency (%)
- Pump Efficiency (%)
- Electrical Cost ($/kW hour)
- Off-peak rate (/ML)
- Comparison rate (c/kWh/ML)
- Peak rate (/ML)

Regions:

All

Industries:

All industries

Users:

Irrigators and advisors

Where do you get it?

Dairy Australia

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Some users tips in the tips in the spreadsheet cells

References:

G. Harris (2002) Pump Efficiency Cost Calculator. QLD DPI, www.dairyinfo.biz/index.cfm?MenuID=104

Category:

Forecasting & Record keeping

Rainfall Reliability Wizard*

What is it?

The Wizard is a software tool to assist in analysing Australia's long-term monthly rainfall record. It is not a predictive tool. It is intended to provide users with map-based indicators of rainfall means, variability and reliability. The Wizard can perform queries for specific events (e.g. a given month or months) as well as for the historical record.

This product is an experimental prototype and should be used cautiously. Its main intended use is to estimate the likelihood of sequences of rainfall, like exceeding 150mm in Winter or 25mm in each month of May to October.

Output:

A color-coded map-based result from the query

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators

Where do you get it?

Freely available on the web.

What does it look like?

Website

What is it written in?

Rainfall Reliability Wizard

Is there help available?

Brief online help is available

References:

G. Laughlin Rainfall Reliability Wizard. http://www.brs.gov.au/rainfall/

Contacts:

Dr Gregory Laughlin
Principal Scientist
Integrated Spatial Projects
Phone: 0417 710 244
Fax: 02 6272 4687
E-mail: gregory.laughlin@brs.gov.au

Category:

Forecasting & Record keeping

Rainfall to Pasture Growth Outlook tool

What is it?

By providing a summary of records for the seasonal and yearly variation in rainfall and pasture growth, as well as an outlook for rainfall and pasture growth over the next three months, this tool can assist beef producers to make better management decisions.

Trends of rainfall in the past are used to predict the short-term rainfall for the future (three months into the future). Years with the same sea surface temperature as the current year are listed. These years are considered to be the best indicators of future rainfall. Soil moisture for the site is given, assuming a sandy loam soil. The estimate of soil moisture can be adjusted for different soil types.

Input:

Selection of weather station(s)

Output:

- Annual patterns of rainfall
- Annual patterns of soil moisture
- Annual patterns of pasture growth
- Number of frost days

Regions:

All of Australia

Industries:

Grazing

Users:

Irrigators

Known Community of Users:

Beef producers who are members of Meat & Livestock Australia

Where do you get it?

MLA

What does it look like?

Website

What is it written in?

Rainfall to Pasture Growth Outlook tool

Is there help available?

On-line Manual

References:

(2007) Rainfall to Pasture Growth Outlook tool. Meat and Livestock Australia (MLA), Bureau of Resource Sciences (BRS), http://www.mla.com.au/growthoutlooktool/

Category:

Forecasting & Record keeping

RAINMAN

What is it?

Rainman is a tool for analysing historical climate data to see whether there are patterns that are reliable enough to alter your decisions. Rainman Streamflow version 4.3 is the current version of the Australian Rainman software.

Rainman Streamflow contains historical monthly and daily rainfall for 3800 locations some dating back as far as 1832 and monthly rainfall and daily streamflow for nearly 400 locations. Users can add in their own rainfall records.

The software can be used to:

- analyse these records for individual locations for seasonal, monthly and daily patterns;
- forecast seasonal rainfall based on the Southern Oscillation Index (SOI) and Sea Surface Temperature (SST);
- group locations for spatial analysis;
- import monthly and daily rainfall and streamflow data;
- print results as tables, graphs or maps.

The advanced features in Rainman can answer typical questions of livestock or crop producers, for example:

1. What are my chances of getting 200 mm of rain over the next season?
2. How reliable is this forecast?
3. What is the latest SOI and what SOI Phase are we in now?
4. In which months is seasonal forecasting likely to be useful to me?
5. How can I update monthly rainfall data?
6. When was the driest 12-month period here and how did last year compare?
7. How bad have the last 'n' months been at your location compared to history?
8. Were the last 12 or 24 months in the driest 10% of years (EC) in this region?
9. When am I likely to get planting rains of 50 mm over a week?
10. It's June and I have just mustered my breeders for a second round. Should I cull more heavily this year?
11. How much flow could I expect in the local river this year?

There are 3 editions of this product that are customised for different groups of users:

- Standard, for farmers and business
- Educational, for use in universities, colleges and schools
- Professional, for use by agricultural advisers, consultants, water managers, government planners and researchers

Input:

Rainfall records

Output:

- Analysis of seasonal, monthly or daily patterns,
- Predictions of Southern Oscillation Index (SOI)

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators, Consultants, Scientists

Where do you get it?

Bureau of Meterology http://www2.dpi.qld.gov.au/rainman/

What does it look like?

CD-ROM based software package

What is it written in?

RAINMAN STREAMFLOW version 4.3

References:

Australian Bureau of Meteorology RAINMAN STREAMFLOW version 4.3. http://ssu1.bom.gov.au/pub/consulting/rainman.html

Contacts:

Bureau of Meteorology (03) 9669 4994 (phone) (03) 9669 4670 (fax).

Category:

Forecasting & Record keeping

Red Sky Farm Performance Analysis

What is it?

This spreadsheet software develops annual budgets and business plans for farm businesses and benchmarks animal and pasture production from year to year.

Input:

Farm description
Stock data
Fodder
Financial data

Output:

Return on assets
Debt to equity ratio
Equity growth
Feed costs

Regions:

All of Australia

Industries:

Dairy, Beef, Sheep and Cropping

Users:

Farmers, Consultants

What does it look like?

E. file

What is it written in?

Red Sky Farm Performance Analysis

References:

Red Sky Agricultural Pty Ltd (2007) Red Sky Farm Performance Analysis.www.redskyagri.com

Category:

Storage & Delivery

SCOPIC

What is it?

SCOPIC is decision support software providing seasonal climate outlooks and drought monitoring capabilities for climate-sensitive industries in Pacific Island Countries. The software contains forecasting tools and analyses for producing outlooks and assessing the reliability of the forecasts.

Version 2 has seen the introduction of a drought analysis component using drought indices (percentile and SPI) that can quantitatively compare current conditions with previously experienced droughts. It can also be used to predict the likelihood of future droughts based upon climate predictors such the Southern Oscillation Index and Sea Surface Temperature anomalies.

Input:

- Predictor data — monthly time-series data such as SOI (Southern Oscillation Index Data) or SSTa (Sea Surface Temperature Anomalies) data.
- Data that we wish to predict such as rainfall, max/min temperatures, evaporation, streamflow, storage levels, storage inflows, irrigation allocations, pumping days, etc.

Output:

A range of graphical and textural outputs. Forecasts are presented as pie charts (2 or 3 category) and are accompanied by a range of graphical representations of skill to assess the reliability of the forecasts. Outputs can be overlaid graphically onto a map.

Regions:

This software has specifically been designed for the Pacific Island Countries, but could be used anywhere in the world. It has been used in many case studies in Australia.

Industries:

Any climate sensitive industries with measurable monthly time-series data.

Users:

Users trained in the basics of climate science. Potentially this includes climate researchers, water agencies, policy makers, consultants and corporate irrigators. It would not be suitable at the farm level given the dangers inherent in forecast generation.

Known Community of Users:

Queensland Government climate scientists, Australian Bureau of Meteorology climate scientists, meteorological agencies in Cook Islands, Fiji, Kiribati, New Caledonia, Niue, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

Where do you get it?

Contact Janita Pahalad for more information. There will be no cost for the software, but there are restrictions on who can use it.

What does it look like?

Executable file

What is it written in?

Written in C++, with XML and ASCII data formats. Reports are generate using XSLT templates

Is there help available?

Help documentation is included with several step by step tutorials. A comprehensive set of interactive multimedia tutorials is currently being developed through an independent E-Learning Company. The project requires that training be provided with the software. Many training workshops have previously been conducted in the target countries.

References:

D. McClymont (2006) SCOPIC v2.02. Australian Bureau of Meteorology, http://www.bom.gov.au/climate/pi-cpp/ (Exe file is 8.5Mb)
http://www.bom.gov.au/climate/pi-cpp/SCOPIC-brochure.pdf (5.4Mb)

Contacts:

Janita Pahalad
Project Team Leader
Pacific Islands — Climate Prediction Project (PI-CPP)
National Climate Centre
Australian Bureau of Meteorology
GPO Box 1289
Melbourne, Victoria, 3001
Australia
Tel: 613 9669 4781; Fax: 613 9669 4678
mobile: 0417 315 609; email: j.pahalad@bom.gov.au

David McClymont
Senior Research Scientist
Queensland Climate Change Centre of Excellence
Telephone 07 4688 1630 Faxsimile 07 4688 1490
Email: David.McClymont@climatechange.qld.gov.au
Mobile 0421 584 587

Category:

Forecasting & Record keeping

SILO

What is it?

The NRW SILO website provides meteorological data for biophysical and landscape modelling. The up-to-date, Australia-wide data provided is continuous (no missing data) and is also:

- point and spatial
- historical length
- daily time-step

The Patched Point Dataset (PPD) uses original Bureau of Meteorology measurements for a particular meteorological station, but with interpolated data used to fill ("patch") any gaps in the observation record.

The Data Drill accesses grids of data derived by interpolating the Bureau of Meteorology's station records. Interpolations are calculated by splining and kriging techniques. The data in the Data Drill are all synthetic; there are no original meteorological station data left in the calculated grid fields. However, the Data Drill does have the advantage of being available for any set of coordinates in Australia.

The PPD would typically be used when an analysis or simulation is needed quite close to a meteorological station. However, if an analysis is required for a location which has no meteorological station nearby, then the Data Drill is the more relevant product.

Data is also available on the Southern Oscillation Index.

Output:

- Daily maximum and minimum temperature,
- Solar radiation and vapour pressure surfaces for the period 1889 –1956

These were computed using an anomaly-interpolation spline algorithm. Consistent daily Class A pan evaporation data were not available before 1970, and hence no interpolations of evaporation were performed.

Regions:

All of Australia

Industries:

All industries

Users:

Growers, Consultants, Engineers/Surveyors, Trainers

Where do you get it?

http://www.nrw.qld.gov.au/silo/

http://www.nrw.qld.gov.au/climatechange/info/rural.html

http://www.bom.gov.au/silo/

What does it look like?

Website

What is it written in?

SILO

References:

(2007) SILO. Queensland Department of Natural Resources and Water, Small samples are freely available from:

http://www.nrw.qld.gov.au/silo/
http://www.nrw.qld.gov.au/climatechange/info/rural.html
http://www.bom.gov.au/silo/

Category:

Forecasting & Record keeping

terraGIS

What is it?

terraGIS is a web-based Geographic information System (GIS) that allows cotton growers, farm managers, consultants, extension staff, researchers, state and federal government agency personnel and policy analysts access to digital biophysical data (e.g. soil, water and hydrological properties) collected and generated as part of a series of Cotton Research and Development Corporation projects entitled "Understanding the salinity threat in the irrigated cotton growing areas of Australia".

Biophysical data is available in seven irrigated cotton growing areas (i.e. Toobeah, Ashley, Wee Waa and Gunnedah, Trangie and Warren & Bourke) located in five catchments (Macintyre, Gwydir, Namoi, Macquarie & Darling).

Input:

- Cadastral (i.e. water storage reservoirs, irrigation fields, roads and water courses),
- Ancillary (i.e. EM38, EM34, gamma ray spectrometry, DEM — elevation),
- Soil properties (i.e. soil texture, exchangeable cations, CEC, pH, ECe, ESP, Ca/Mg)
- Water properties (i.e. permanent wilting point, field capacity, available water content), and
- Hydrological properties (i.e. deep drainage, hydraulic conductivity, groundwater recharge).

Output:

Property maps with overlays of critical information for the design or redesign of irrigation properties. — i.e. from irrigation storage to the irrigation system for controlling water on and off the paddock

Regions:

Cotton growing regions in NSW

Industries:

Cotton and grains

Users:

Consultants, irrigators, government

Known Community of Users:

Cotton industry

Where do you get it?

University of NSW

What does it look like?

Website

What is it written in?

GIS

Is there help available?

UNSW

References:

J. Triantafilis (2007) terraGIS. University of NSW,, http://www.terragis.bees.unsw.edu.au/

Contacts:

Dr John Triantafilis
Senior Lecturer
School of Biological, Earth and Environmental Sciences
Phone: 02 9385 8087

Category:

Forecasting & Record keeping

Water Benchmarking Tool

What is it?

This tool was developed to help the user to:

* Evaluate what inputs are required for measuring water use efficiency.
* Calculate and benchmark their current water use efficiency indices (within limitations described below).
* Encourage further, in-depth investigation into measuring and monitoring on-farm water use so that water use efficiency can be measured with even greater accuracy.

Effective rainfall is estimated, and as with all estimations there will be a bound of error associated with it.

'Used Soil Moisture' can be estimated using probes or other methods such as Evapotraspiration (ET) calculations. Note that most soil probes are not calibrated and the values returned are estimates only. If soil moisture is estimated, then there will be a bound of error associated with it.

The accuracy of water inflows will depend on pump metering systems being accurate or present. Estimates will effect the accuracy of the calculation.

Input:

Production Details:

(A) Enter Area Grown (ha)

(B) Enter total cotton production (bales)

(C) Average Yield (bales/ha)

Water supply:

(D) Enter total water from bores and other sources such as Irrigation Schemes (ML)

(E) Enter total water from river (ML)

(F) Total water from metering systems (ML)

(G) Enter volume of water in on-farm storage at planting (ML)

(H) Enter volume of water in on-farm storage at harvest (ML)

(I) Used from farm storage (ML)

(J) Enter volume of on-farm water harvested in-season (ML)

(K) Enter volume of water used on other crops (ML)

(L) Total irrigation applied on cotton (ML)

Rainfall:

(M) Enter total in-season rainfall (mm)
(O) Effective rainfall estimate (mm)
(P) Rainfall efficiency (%)
(Q) Estimated effective rainfall for farm (ML)

Soil Water:

(R) Enter used soil water reserve (average of all fields) (mm)
(S) Used Soil reserve (ML)
(T) Total seasonal water usage (ML)

Output:

Water Use Summary:

- ML/ha Pumped
- ML/ha effective rainfall
- ML/ha harvested
- ML/ha used soil reserve
- ML/ha total water usage

Water Use Indices:

- Irrigation WUI (farm)
- Gross production WUI (total) (farm)
- Gross production WUI (effective) (farm)

Regions:

NSW, Queensland

Industries:

Cotton

Water Benchmarking Tool (continued)

Users:

Irrigators

Where do you get it?

http://www.morganruraltech.com.au/cottonbmp/

What does it look like?

Website

What is it written in?

Water Benchmarking Tool

References:

D. Hickey (2007) Water Benchmarking Tool. © Cotton Research & Development Corporation, http://www.morganruraltech.com.au/cottonbmp/

Category:

Forecasting & Record keeping

Water Budget Tool

What is it?

This tool helps the irrigator plan their water use, including the positive or negative balance of water available on a monthly basis. It calculates the water use efficiency of the plan based on the last year's irrigation schedule which provides some guidance to this year's plan.

The irrigator completes various EXCEL worksheets on water availability, expected water use for the area to be irrigated and completes the irrigation schedule options.

Input:

- Detail of all farm water resources (ML)
- Estimate of water to be used (ML/ha/irrigation)
- Area to be watered (ha)
- Number of cows
- Number of irrigations per month

Output:

- Total amount of water available ML
- Monthly water balance
- Water purchase requirements
- Summary of water requirements for annual and perennial pastures, and number of waterings per month

Regions:

Northern Victoria But it could be adapted for other regions

Industries:

Dairy

Users:

Irrigators and consultants

Known Community of Users:

Dairy farmers and extension staff around Echuca

Where do you get it?

DPI Vic Echuca

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Dairy extension staff whilst funded

References:

V. DPI (1998) Planning Water Use. Department of Primary Industries, Victoria, Echuca

Category:

Forecasting & Record keeping

Water Budgeting Tool—Monthly

What is it?

The tool uses long term average weekly reference crop evapotranspiration from the Loxton Research Station. It provides the grower with a suggested water budget and the ability to track against actual usage. If too much or too little water is applied during a particular week the tool recalculates the application rate to use the total budgeted water by the end of the season. It is not designed to be a scheduling tool.

Input:

- Crop details including area (ha) and yield loss (%)
- Watering rate
- Rootzone refill value
- End of irrigation season date
- Usable allocation available (kL)
- Actual volume used per week (kL)
- Depth of application (mm) and hours of application (hrs)

Output:

- Suggested weekly water budget for the remaining irrigation season based on the available allocation(mm/wk & kL/wk)
- Summary table of suggested allocations by month (mm/mth, kL/mth, % of total water available, hours of irrigation (hrs/mth),
- Balance of water remaining (kL, mm)
- Graph showing actual cumulative kL applied versus suggested cumulative kL to be applied.

Regions:

SA Mallee

Industries:

Horticulture

Users:

Irrigators and advisors

Known Community of Users:

Mallee irrigators

Where do you get it?

Rural Solutions SA

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

The spreadsheet contains a manual and fill in cells have instructions. The may be phone support available from PIRSA

References:

Rural Solutions SA (2006) Water Budgeting Tool — Monthly. Rural Solutions SA, Loxton. www.pir.sa.gov.au/drought

Contacts:

Rural Solutions Loxton — 0885959100

Category:

Forecasting & Record keeping

Water Budgeting Tool—Seasonal

What is it?

The tool allows the farm's water budget to be built up by each patch of crop. The irrigator can nominate the potential yield required which helps in scenario planning of managing a limited water supply. The tool is free but requires registration and is copyright protected.

Input:

- Property and patch details,
- Potential yield required,
- Details of entitlement and allocation

Output:

- Suggested irrigation rate (kL/ha)
- Suggested volume for the patch (kL)
- Committed allocation and allocation balance (kL)
- Useable allocation (kL)

Regions:

Mallee SA

Industries:

horticulture

Users:

irrigators and advisors

Known Community of Users:

irrigators and advisors

Where do you get it?

Rural Solutions — Loxton

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

The spreadsheet contains prompts and there is an extensive range of guidelines on the topic. Some phone help may be available from PIRSA

References:

Rural Solutions SA (2006) Water Budgeting Tool — Seasonal. Rural Solutions SA, Loxton. www.pir.sa.gov.au/drought

Contacts:

RuralSolutions Loxton — 0885959100

Category:

Forecasting & Record keeping

Water Trade Decision Tool

What is it?

This 7-step spreadsheet tool can assist with water trade decisions in the current irrigation year. The tool is based on water allocation, restrictions, source of trade water, yield & income.

Information is entered into the white cells. Calculations occur in red cells automatically. Water purchase should be considered if income loss from the water restriction on yield (D), is greater than the purchased water value (A), or where the difference (D-A) is positive. The spreadsheet is available from the internet and on CD.

Input:

- Details of license
- Entitlement and allocations
- Water purchase details
- Type of crop
- Yield, and
- Value under various water availability scenarios

Output:

- Summary costs of water purchased
- Income under various scenarios
- The income difference, and result after the cost of water purchased

Regions:

SA Murray irrigators

Industries:

known horticulture crops on the Murray.

Users:

Irrigators and advisors

Known Community of Users:

Mallee irrigators

Where do you get it?

Rural Solutions — Loxton

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

The spreadsheet contains prompts and there is an extensive range of guidelines on the topic. Some phone help may be available from PIRSA

References:

Rural Solutions SA (2006) Water Trade Decision Tool Version 2. Rural Solutions SA (copyright),, www.pir.sa.gov.au/drought

Contacts:

Rural Solutions Loxton — 0885959100

Category:

Forecasting & Record keeping

Water Use Benchmarking

What is it?

This tool allows the dairy farmer to benchmark with other dairy farmers participating in their district. It compares water use with pasture production, cow stocking rates and aspects of milk production. It is used as a training aid in the irrigation course.

Input:

- Milk
- Water
- Pasture area and
- Stocking rate information

Output:

Water-Use Efficiency (WUE) (Adjusted* kg milk fat + protein per ML) (Adjusted* litres per ML)

1. Minimise runoff
   - % of farm captured by re-use
   - Water applied per hectare (MLper ha)
   - Application Efficiency
   - Water applied per cow (ML per cow)
2. Growing Pasture
   - Adjusted* kg 'fat + protein' per ha# (from pasture)
   - Phosphorus Fertiliser (kg P per ha perennial pasture)
   - Nitrogen Fertiliser(kg N per ha of perennial pasture)
3. Using Pasture
   - Pasture consumed (tonnes dry matter per ha)
   - Pasture consumed (tonnes dry matter per ML)
   - Stocking Rate (cows** per hectare)
4. Using Supplements Well
   - % of energy from brought in feed
   - Total kg 'fat + protein' per cow
5. Getting More Energy Into Milk
   - % total energy as milk
   - % energy into non-milking stock
   - % energy for maintaining milkers
   - Ratio of Energy to Milk : Energy for Maintaining milkers

Regions:

Dairt regions in Victoria

Industries:

Dairy

Users:

Irrigators and trainers

Known Community of Users:

Echuca Dairy Extension staff

Where do you get it?

DPI Vic Echuca

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Dairy Extension staff Echuca, Part of a irrigation training course

References:

D. Armstrong and J. Knee (1998) Water Use Benchmarking Program. DPI, Vic, Kyabram.

Category:

Forecasting & Record keeping

Waterworks

What is it?

The model, which is under development, is designed to maximize return from agricultural production through limited water supplies by using existing or alternative irrigation technologies. This model builds on the findings of a range of existing efforts such as the SWAGMAN series of models as well as the DPI MIA economic model to include and be useful to the other valleys given the range of different irrigation systems, water availability and major enterprises. The model is being developed to include a range of business indicators and returns to capital.

This tool will assist in the development of appropriate rotation mixes at a whole farm level rather than individual enterprises and will provide a decision support tool for optimisation (using mathematical programming techniques) of irrigation water for any given allocation level.

Input:

- Crop yields
- Production costs
- Irrigation costs

Output:

The model's objective function maximizes aggregate gross margin (total revenue less variable costs) from crop production.

Regions:

All

Industries:

Grains

Users:

Consultants

What does it look like?

Executable file

What is it written in?

.NET Framework

References:

S.Khan (2007) Waterworks.

Category:

Forecasting & Record keeping

WISDAM

What is it?

WISDAM is essentially a discounted cash flow model used to assess the financial viability of various irrigation scenarios on a dairy farm. WISDAM models a period of twenty years, with year one being the year of initial investment. The model assesses the financial viability of investment in irrigation by generating a range of measures including a net present value, a benefit:cost ratio, a pay-back period and a peak debt level. For the purposes of assessing productivity improvement the four irrigation systems have been split into two groups: travelling irrigator/Van den Bosch and fixed sprinkler/centre pivot.

Input:

- The area to be irrigated and the anticipated improvement in productivity of this area.
- The user can specify productivity improvements as increased production per head, increased cow numbers or reduced supplements fed. Changes in any one or more of these variables can be recorded for each farm.

Output:

The model outputs show the

- Net present value (NPV)
- Benefit cost ratio (B: C ratio)
- Pay back period
- Peak debt level
- Maximum cows milked
- Average butterfat production per cow, and
- Average protein production per cow for each irrigation system examined

Regions:

West Victoria

Industries:

Dairy

Users:

Dairy irrigators and advisors

Known Community of Users:

Western Victoria dairy farmers and industry officers

Where do you get it?

West Vic Dairy

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

A comprehensive manual and possible some industry officer advice

References:

D. Victoria (2006) WestVic Dairy Irrigation Scenario Decision Assistance Model (WISDAM). DPI Victoria, Warrnambool. www.westvicdairy.com.au/

Contacts:

78 Henna Street Warrnambool, Victoria 3280

Category:

Forecasting & Record keeping

CATEGORY 4:
STORAGE & DELIVERY

Channel Seepage Decision Support Tool: Cost_Calculator_V08_June2004.xls

What is it?

The Channel Seepage Decision Support Tool helps users to calculate the costs of channel seepage remediation and undertake a cost-benefit analysis of alternative techniques to understand the economic consequences of each.

A cost-benefit analysis may not be sufficient to select the best technique for a particular site or to assess the priority for several sites where remediation is proposed. Multi-criteria analysis assists with the prioritisation of techniques and sites according to additional non-economic criteria.

The tool was originally designed for water authorities but large irrigators with on-farm storages and extensive decision systems have expressed an interest in a tool. The manual and tables within the spreadsheet provide comprehensive instructions but some technical knowledge is still required.

Input:

Site characteristics and cost benefit parameters of the channel and surrounds including landuse.

Output:

- Capital and operating costs for all the remediation options
- Cost benefit analysis results and
- Multi criteria analysis

Regions:

Originally regions serviced by water supply authorities.

Industries:

All industries

Users:

Likely to be large irrigation farm advisors where the farm has its own extraction and storage facilities

Known Community of Users:

Some regional water supple authorities/companies

Where do you get it?

ANCID

What does it look like?

Spreadsheet

What is it written in?

EXCEL

Is there help available?

Comprehensive manual, and guidelines for channel remediation

References:

SKM (2004) Evaluation Tools for Channel remediation. Australian National Committee on Irrigation and Drainage (ANCID), Murray Darling Basin Commission (MDBC), www.ancid.org.au/seepage/downloads/

Category:

Storage & Delivery

DAIRYBAL

What is it?

DAIRYBAL is a dairy waste management spreadsheet model designed to help producers sustainably manage their waste to ensure maximum dollar returns while protecting the natural resources upon which their livelihoods depend.

DAIRYBAL may be used to estimate the nutrients in dairy farm waste and to apportion the nutrients across the farm. Consequently, it is a useful tool for managing the reuse of effluent and manure as an organic fertiliser and for assessing the sustainability of grazing practices.

This information can then be used to estimate inorganic fertiliser requirements to supplement effluent/manure applications. This could potentially result in significant fertiliser cost savings while protecting the environment.

DAIRYBAL can also be used to estimate the size of the effluent ponds required to treat the inflow from milking sheds and yards, and to store effluent, pending irrigation onto crop or pasture. Where feedpads are used, the spreadsheet can also estimate the required size for retention ponds to catch contaminated runoff.

Input:

- Size of farm
- Number of cows

Output:

Volume of effluent

Regions:

Queensland

Industries:

Dairy

Users:

Irrigators

Where do you get it?

Dairying Better n' Better CD, https://www.publications.qld.gov.au/

What does it look like?

Spreadsheet

What is it written in?

Excel

References:

A. Skerman (2004) DAIRYBAL — a whole of farm nutrient and water mass balance spreadsheet. Department of Primary Industries and Fisheries, Queensland,

Contacts:

Alan Skerman
Senior Environmental Engineer
Department of Primary Industries and Fisheries
Phone: +61 7 4688 1247
Email: alan.skerman@dpi.qld.gov.au

Category:

Storage & Delivery

DamEa$y

What is it?

The objective of DamEa$y is to model sugar cane crop growth and farm economics in a way that enables analysis of the likely costs and benefits of various scenarios involving investments in farm dams.

While the principal role of Dam Ea$y is to investigate OFWS investment options, it is also possible to consider rainfed systems and other irrigated systems based on the settings you use for allocated and out of allocation irrigation sources.

DamEa$y incorporates a database of pre-run output from APSIM and an economic model. The database greatly simplifies the operation of Dam Ea$y and allows rapid, simultaneous evaluation of a range of possible farm designs. This makes it possible to conduct sensitivity and 'what if' analyses. The database covers a large range of farm systems relevant to sugarcane production in the Bundaberg region.

Input:

- Soil type
- Water allocation (ML/ha)
- Access to additional allocations
- Available catchment area for dam (ha)
- Available irrigated area (ha)
- Irrigation efficiency (%)
- Irrigation refill point (fraction of available soil water, 0 to 1)
- Sucrose content
- Sugar price ($)
- Inflation rate for input costs (%)
- Inflation rate for cane receipts (%)
- Number of partners
- Investment interest rate (%)
- Allocation wter price ($/ML)
- Out of allocation water price ($/ML)
- Storage pumping cost ($/ML)
- Overheads ($)
- Harvesting and levies ($/t)
- Capital costs for pump system, dam construction and reticulation

Output:

- Net present value (NPV) of captial invested
- Annual net cash flow over the life of the investment

Regions:

Queensland

Industries:

Sugar

Users:

Irrigators, Consultants

Known Community of Users:

Bundaberg sugar farmers

What does it look like?

Executable file

What is it written in?

C++

Is there help available?

No user support

References:

S. Lisson, L. Brennan, K. L. Bristow, B. Keating and D. Hughes DamEa$y. CRC Sugar,

Category:

Storage & Delivery

Evaporation Ready Reckoner

What is it?

This spreadsheet will assist irrigation managers in making a decision about when to use evaporation mitigation technologies (EMT).

An EXCEL spreadsheet program has been developed, which allows the user to enter the dimensions of various types of dams (tanks), the pan evaporation data (linked from another site), the seasonal variation in the capacity of the dam, and the costs of any evaporation mitigation technologies. The spreadsheet then calculates the amount of amount of water saved (to the nearest 100 000 litres), and the cost of doing so.

Input:

- Dimensions of dams (m)
- Latitude (degrees)
- Longitude (degrees)
- Pan evaporation data (mm/year)
- Seasonal variation in the capacity of the dam
- Costs of evaporation mitigation technologies

Output:

- Estimated volume of water saved (ML/yr)
- Cost to save this water ($/ML/yr)
- Storage volume (ML)
- Surface area at full supply level (ha)
- Total cost of installation ($)
- Annual operating and maintenance cost ($/yr)

Regions:

Australia-wide

Industries:

All industries

Users:

Growers, Consultants, Engineers, Surveyors

Known Community of Users:

Northern NSW & Southern QLD grain and cotton growers

Where do you get it?

National Program for Sustainable Irrigation, www.npsi.gov.au, free software

What does it look like?

Spreadsheet

What is it written in?

EXCEL (coded in MS Visual Basic)

Is there help available?

A detailed manual, including case studies from around Australia, provides a helpful reference document so that users can check that their own data entries are within plausible orders of magnitude. There is no helpdesk

References:

N. Heinrich and E. Schmidt (2006) Economic Ready Reckoner for Evaporation Mitigation Systems. Cooperative Research Centre for Irrigation Futures, NCEA, FSA Consulting, Toowoomba, Qld. www.npsi.gov.au

Contacts:

Mr Erik Schmidt
schmidte@usq.edu.au
07 4631 1347

Category:

Storage & Delivery

PIMS*— Storage Dam Evaporation Mitigation*

What is it?

The project, which is still under development, it is developing instrumentation and procedures to quantify seepage and evaporation losses and products and systems to mitigate evaporation losses.

This project will place scientific rigor into the use of monolayer evaporation retardants and develop sensing, application and control technologies to optimise their performance.

Input:

- Penman — Monteith evapotranspiration (mm)
- Correction factor algothrims
- Morton dam factor
- Pressure Sensitive Inducer data
- Comparison potential evaporation
- Automatic weather station or SILO data
- Dam Characteristic — Surface area

Output:

Key outputs for a dam are:

- Dam seepage (mm/day)
- Evaporation (mm/day)

For the web based tool there will be an error checking tool incorporated.

Overall the project aims to produce the following technology-based outputs:

- Toolkits to quantify evaporation and seepage from storage dams
- Improved depth sensing technologies for seepage and evaporation measurement
- Recommended analysis procedures for seepage / evaporation determination from storages
- Micro-meteorological based assessment of evaporation losses and spatial distribution of evaporation with and without chemical monolayers.
- Instrumentation and software to map spatial distribution of monolayers
- Performance assessment of alternative monolayer formulations
- Assessment of factors affecting spreading and performance of monolayers
- Assessment of degradation rates and influencing factors
- Recommendation on Optimum dosage rates and strategies
- Assessment of impact of water quality on distribution, performance and degradation
- Assessment of seasonal and weather related changes in product performance
- Recommendations of best management practices and likely performance
- Recommendations on application and control methods
- Economic assessment of likely performance and national cost benefit
- New monolayer product formulation.
- Theoretical assessment of alternative monolayer formulations
- Prototype application and control systems and performance assessment
- Software linking application strategies with weather conditions and forecasts
- Economic calculator for cost— benefit decisions of application
- Sensors , application and control systems for monolayer optimisation.
- Commercial arrangements for delivery of monolayer evaporation control systems.

Regions:

All of Australia

Industries:

All industries

Users:

Irrigators

What does it look like?

Equipment and Executable file

What is it written in?

There will be a stand alone spreadsheet and online tool produced

Is there help available?

There is expected to be a user manual and prompts at the input cells

References:

E. Schmidt (2007) Storage Dam Evaporation Mitigation. CRC for Irrigation Futures, www.irrigationfutures.org.au

Category:

Storage & Delivery

Terramodel Engineering and Surveying software

What is it?

An earthworks software package with irrigation and drainage features that includes the capability of calculating earthwork quantities for storages, channels, drains and landforming

Input:

Land survey, GPS, satellite information, design requirements

Output:

All drawings and design for the setout instruments and machine control Cut and fill (m3)

Regions:

All region

Industries:

Industries using channels and landformed irrigation areas — generally surface

Users:

Irrigators designers

Known Community of Users:

Gouburn Valley Designers

Where do you get it?

Geocomp Systems Pty Ltd

What does it look like?

Executable file

What is it written in?

Written in C++ for a Windows environment

Is there help available?

By phone and email

References:

Geocomp Systems Pty Ltd (2007) Terramodel Engineering and Surveying Software. Geocomp Systems Pty Ltd, www.geocomp.com.au

Contacts:

2-6 Albert Street Blackburn Vic 3130. Australia

Category:

Storage & Delivery

WATERTRACK RAPID™ — see under 'Controlling water on and off the paddock'

WaterSupply

What is it?

WaterSupply simulates the design and management of irrigation systems.All possible irrigation sources (including combinations) can be represented including bore, river, recycled and on farm water storage (OFWS).

Storage architecture (eg gully vs ring) is modified through the selection of different depth and surface area combinations. Different lining characteristics can also be set to reflect actual permeability and seepage attributes of the OFWS (Inman-Bamber & Attard, 2005).

Input:

- Scheme allocations (bore and river)
- Overland flow into OFWS
- Direct rainfall capture by the OFWS
- Recycled tailwater diverted into OFWS

Output:

- OFWS evaporative losses (mm)
- Irrigation
- OFWS seepage.

The model also allows for the presence or absence of scheme carryover and the transfer of water between sources. Linkages to other modules of APSIM (i.e. Crop, Manager and Irrigate), enable simulation of the full array of irrigation management options such as the timing and amount of irrigation in response to crop demand and delivery efficiency.

Regions:

All of Australia

Industries:

All industries

Users:

Consultants

What is it written in?

Open platform

References:

D. Gaydon and S. Lisson WaterSupply. http://www.apsim.info/apsim/

Category:

Storage & Delivery

Winflume

What is it?

This software assists consultants to design the most efficient structures (flumes) for measuring water flow, which can improve the delivery of water onto the paddock.

WinFlume is a stand-alone Windows-based computer program providing the capability to design and calibrate long-throated flumes and broad-crested weirs. These structures provide a practical, low-cost, flexible means of measuring open-channel flows in new and existing irrigation systems, with distinct advantages over other flume and weir devices. These include the lowest head loss requirement of any critical flow device, and custom design and calibration via the computer program, which is based on well-established hydraulic theory. This allows the design of structures that meet unique operational and site requirements, eliminates the need for laboratory calibration, and allows post-construction calibration of structures using as-built dimensions.

Input:

Inputs to the program consist of a geometric description of the flume or weir site with upstream and downstream canal dimensions, hydraulic properties of the site (tailwater conditions, flume and channel roughness characteristics, discharge ranges to be measured), design constraints (freeboard requirements and flow measurement accuracy objectives), and information about methods to be used for measuring the upstream head to allow computation of discharge.

Output:

Output from the program consists of text reports, flume drawings, rating tables and curves, simplified rating equations determined by curve-fitting, and wall gages that indicate discharge directly.

Regions:

Australia

Industries:

Channels irrigation systems

Users:

Engineer/Surveyor

Where do you get it?

Freely available from: http://www.usbr.gov/pmts/hydraulics_lab/winflume/index.html

What does it look like?

Executable file

What is it written in?

Windows 95 or higher prgram coded in Visual Basic

Is there help available?

Installation support, example files, printable users manual

References:

H. T. Wahl (2005) WinFlume — Software for design and calibration of long-throated flumes and broad-crested weirs. Sakia.org, http://www.irrisoft.org/irrisoft/sdp/winflume

Category:

Storage & Delivery