

Whole farm water balance

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One of the keys to better water management



A successful and profitable irrigation enterprise is one that manages precious water at both the crop root zone level (soil moisture monitoring and irrigation scheduling) and at the whole farm level – How much water do I have? What are my losses? and, Therefore how much do I have left for crop production?

This section discusses the whole farm water management area. The tools for whole farm water balance have progressed greatly in the past 10 years. The use of commercial tools and water management consulting services has steadily grown as irrigators strive to improve their profitability with less water.

Below is a step by step process to better manage water at the whole farm level. In summary:

Phase 1

- Measure and record the basics.
- Complete a simple seasonal whole farm water balance.
- Review the results.
- Fix the easy stuff.
- Repeat until happy

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- Not only does water need to be managed in the crop root zone but also at the whole farm level.
- Key measurement is needed to complete any water balance.
- Water losses can best be identified and then reduced by completing a whole farm water balance.
- Measuring equipment and easy to use software packages are now commercially available to complete seasonal and even daily whole farm water balances.
- Water balance and improved water use efficiency can be done in stages starting with the very easy and work through at your own pace.
- Do not chase accuracy for accuracy's sake. A good estimate is better than nothing.

Phase 2

- Stop at Phase 1 if you are happy with your WUE or move to daily water balance. Daily water balance allows prediction forward of water requirements before and during the season.

Phase 1 – Seasonal whole farm water balance

Step 1 – Measurement

Measurement is essential for any good management and water management is no different. To achieve good measurement start with the following:

- Ensure all water meters are installed correctly and measuring accurately. Check them with another meter.
- Survey all storages to establish accurate depth to volume to surface area characteristics. Ensure all tailwater and buffer storages are included. Storage surveys can now be done with water in the storages!
- Fit storage meters in all storages. Gauge Boards are a start but don't really do enough. It is very difficult to measure the volume of a stormwater harvesting event with gauge boards unless the gauge boards are read just before and just after each event and recorded. Irrimate™ Storage Meters have been developed over the past 5–6 years. They read and log water level, storage volume and water surface area at any required interval (normally 30 minutes but can be changed). This not only allows water volume to be accurately monitored in real time but also provides flow rates into or out of the storage. A storage meter also records the water surface area which allows the calculation of water volume loss from seepage and evaporation. Telemetry is now optional with information available by internet (read your storage volume, depth and surface area while on a holiday overseas!).
- Take strategic measurements of soil seepage characteristics and storage and channel evaporation characteristics. This allows calculation of the seepage and evaporation losses in each storage, channel and drain. Irrimate™ Seepage and Evaporation Meters can be hired from Aquatech Consulting or any Irrimate™ Agent. These meters measure both seepage and evaporation characteristics. It is not necessary to measure every storage or every channel and drain to get meaningful results.

Step 2 – Record keeping

The next step is basic record keeping. The aim is to provide enough information to be able to complete a seasonal water balance. Enough basic information is required to calculate accurately how much water the crop actually needed during the particular season and how much water was made available to grow that crop.

In simple terms, the total measured available water, less the calculated actual crop water requirements for the season, equals the water lost to production. It should always be remembered that it is impossible to produce an irrigated crop without some losses. The real question is "How much lost water can be saved and used to increase production and profit?"

To establish this, it is necessary to be able to split up the total water lost to production into components:

- Storages losses (wet-up, seepage and evaporation).
- Channel system losses.
- Drainage system losses.
- In-field losses.
- Operational losses (stuff-ups resulting in water lost out of the system).

The records needed for a seasonal whole farm water balance include:

- Meter readings from all inflows – (river, scheme channel and/or bores).
- Storage volumes at the start of the season.
- Storage volumes at the end of the season.
- Harvested water volumes (land surface diversions) measured using the Irrimate™ storage meters or similar.
- Rainfall on fields.
- Field number or name and area.
- Crop yield.
- Reference Evapotranspiration for each day during season (automatically provided in WaterTrack™).
- Field soil type (menus provided).
- Field soil moisture deficits (mm) at the start of the season and end of season (estimated or from soil probes if available).
- Crop emergence date and end date (when crop stops transpiring e.g. cotton defoliation).
- Dates of each field irrigation.

Step 3 – Seasonal water balance

The whole point of completing a whole farm water balance is to find out where water is being lost, whether those losses are ok and what is required to reduce the losses and increase production.

The Seepage and Evaporation Assessment with an Irrimate™ Meter allows the calculation of soil seepage losses from storages, channels and drains. Similarly, the measured evaporation characteristics from the same measurement allow calculation of evaporation from storages, channels and drains. If a farm has two different soil types, then it 'may' be necessary to complete a second Seepage and Evaporation Assessment in each soil type.

Calculation of actual crop water requirements is based on daily Reference Evapotranspiration (Eto) values for the particular farm and season and crop factors. Eto can be sourced from a weather station on the farm or normally from the Bureau of Meteorology SILO database. If WaterTrack™ is used for the whole farm water balance, the program automatically obtains and updates daily Eto from the Bureau of Meteorology. All that is required is to provide the farm Latitude and Longitude from Google Earth.

Step 4 – Review the results

All irrigation farms will lose water; it is inevitable. The question is "Where are the losses and are they OK?"

WaterTrack Divider™ will complete a simple seasonal water balance and provide Water Use Efficiency Indices

required for myBMP and Water Management Plans.

Irrigation consultants can advise whether the losses are typical, good or bad and can advise on the type of works and cost to reduce losses. WaterTrack Divider™ even provides a basic economic calculator. This can determine if the proposed capital works are economic and how long the pay back period is from the extra production.

There is a network of commercial consultants from Emerald, Queensland to Keith in South Australia who can provide the equipment, software and consulting support to their clients in Water Management and is significantly increasing profit for farmers.

Step 5 – Repeat seasonal water balance next season and so on, until happy with reduced losses and water use efficiency performance

For more detailed accuracy and predictions undertake Phase 2.

Phase 2 – Daily whole farm water balance

Step 6 – Comprehensive daily whole farm water balance

Rather than waiting until the end of the season to check how water management went, it is also possible to set up the daily water balance model, WaterTrack Optimiser™.

WaterTrack Optimiser™ models each element of an irrigation farm in sections and in individual fields daily. The computer model replicates each action taken by the irrigator in his/her daily routine and calculates the losses in each segment of channel and drain, each storage and each field daily.

The results are much more comprehensive than those achieved by completing a seasonal water balance but more effort is required with data collection and data entry. Essentially, every action done with water on the farm is also done on the computer.

The value of the extra effort is the ability to manage water at each irrigation rather than next season. WaterTrack Optimiser™ also allows forward prediction at any time to check whether there is enough water available (including losses) to completely irrigate those fields in production.

Typically, prediction is done:

- Before planting.
- Mid November or early December to decide which fields shall remain irrigated.
- As many times as required in February to determine which fields shall be finished.

The effort required to complete this modelling can result in very significant profit increases by maximising the yield potential of the remaining water. Most irrigators use commercial consultants to complete this modelling. The consultant is then able to work with the irrigator on alternative strategies.

For more information contact: Aquatech Consulting 02 6792 1265, www.irrimate.com.au or www.watertrack.com.au