



# CATCHMENT WATER YIELD ESTIMATION TOOL (CWYET) ■

The Catchment Water Yield Estimation Tool (CWYET) aims to provide a common modelling framework for estimating catchment water yield and daily runoff characteristics across Australia. It will also predict how catchment water yield is affected by influences such as climate variation and land use change, which includes afforestation and the building of farm dams.

CWYET will support managers to explore the following types of questions:

- 1) What is the long-term catchment yield and runoff characteristics from a catchment?
- 2) What is the impact of climate change on catchment water yield and runoff characteristics?
- 3) What is the impact of land use change on catchment water yield and runoff characteristics?

The catchment processes modelled by the CWYET tools are illustrated below and include:

- Spatial and temporal variability in rainfall
- Spatial and temporal variability in potential evaporation
- Impact of plantations on water
- Impact of groundwater processes on surface runoff (linkages with GSWIT). #1

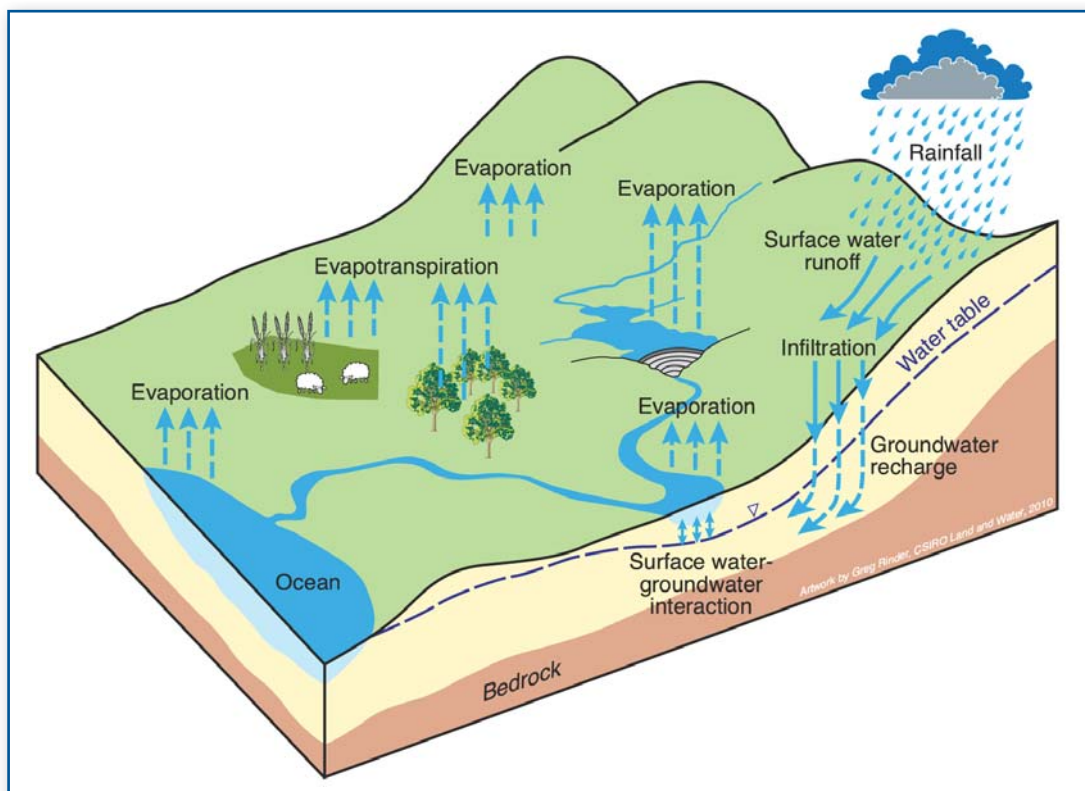


Figure 1: Schematic diagram of partitioning of the water balance components

## Why is it needed?

Existing hydrological modelling tools have many limitations and do not have all the functionalities to answer the range of questions asked of them. Water resources agencies will continue to fund projects to improve modelling for specific objectives as they arise. This approach produces discrete models that address specific purposes, but are rarely used beyond that agency, even for a very similar problem. The result is: considerable duplication, poor use of resources and expertise, and the lack of a common and defensible approach for water accounting across jurisdictions.

State and federal agencies, as well as the National Water Commission recognise the need for a consistent and robust approach to estimating water availability and the impacts of various influences. As a result, they are active partners in the Source Rivers Project and are working with eWater CRC and industry partners to develop integrated tools for planning, operating and managing rivers and their catchments. These tools and methods will overcome the main limitations of existing models, and offer a new framework that

can be consistently used in various water resource applications across Australia.

The science and software behind CWYET builds on existing knowledge and modelling capabilities. It is being developed with the flexibility to allow new scientific knowledge, modelling methods and data types to be easily incorporated into the model.

## When or where would you use it?

The CWYET can be applied by water consultants, managers and researchers, and used in conjunction with other tools to guide water resource management in river basins across Australia. CWYET can also be used by state and federal agencies for estimating daily runoff from gauged as well as ungauged catchments for input to the Source Rivers tool.

## How does it work?

CWYET is a modelling framework for estimating daily catchment water yield and runoff characteristics in regulated and unregulated catchments. The CWYET framework will be integrated into the Source Rivers and Source Catchments models. CWYET will generate a daily time series of stream flow at a catchment outlet, which can be used as an input to a Source Rivers “inflow node” (Figure 2).

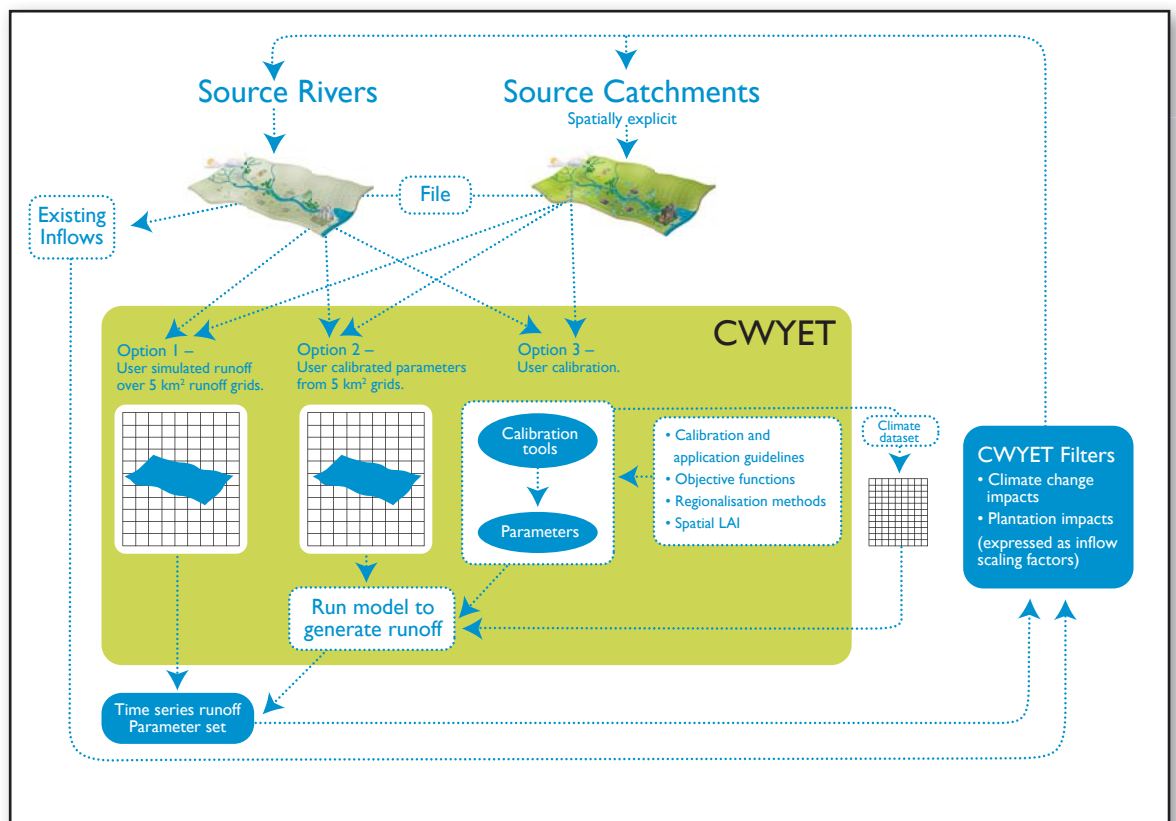


Figure 2. CWYET linkage with Source Rivers and Source Catchments

There are three components within the framework, which when used with appropriate climate data, can estimate daily runoff series for catchments. This can be used for catchment planning or as inflow information for the river models. These components are:

### 1. Rainfall-runoff algorithms - models for estimating catchment water yield and runoff

The CWYET framework includes six daily rainfall-runoff models, all of which have been applied in numerous studies both within Australia and internationally. All the models have been used in regionalisation, landuse and climate change impacts on runoff studies.

The rainfall-runoff models are:

- 1) Sacramento
- 2) SIMHYD
- 3) SMARG
- 4) GR4J
- 5) IHACRES and
- 6) AWBM.

These models will be configured to allow the user to either: run a 5 km<sup>2</sup> grid across the catchment, thus making the inputs and outputs of rainfall, evapotranspiration and generated runoff spatially explicit; or run the rainfall-runoff models at a lumped catchment scale.

### 2. Calibration Tools

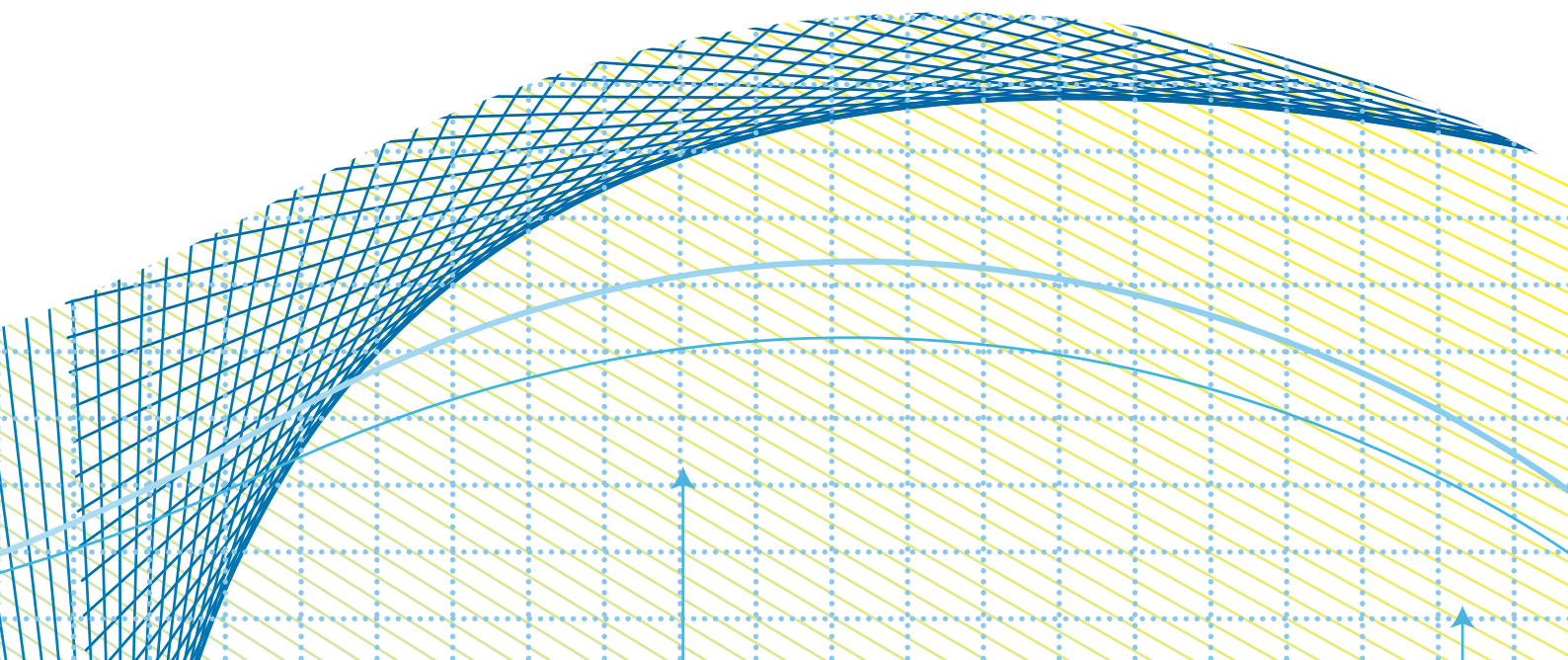
The CWYET framework will include a state of the art optimisation toolset. Stakeholders have requested a high level of flexibility in expressing objectives for calibration purposes and multi-objective optimization capabilities. The high-level optimization features include:

- Availability of SCE-UA, MOCOM-UA, Rosenbrock and other optimisation algorithms.
- Availability of a list of predefined objective functions.
- Definition of custom optimization problems such as regional calibration.
- User defined custom objective functions, through a scripting environment.

### 3. Guidelines to support implementation of algorithms

Guidelines are being developed to support consistent implementation of the CWYET framework as a stand-alone tool or within the Source Catchments / Source Rivers applications. The guidelines will provide information on:

- Applicability of the CWYET tools for stream flow simulation.
- Selecting the appropriate CWYET option for simulating runoff.
- Selecting an optimisation method(s) and choice of different objective functions.
- Selecting appropriate regionalisation method for predicting runoff in ungauged areas.
- Impact assessment for climate change, plantations and farm dams.



## *Trial applications and real-world testing*

CWYET has been tested using streamflow data from more than 300 catchments across eastern Australia. The testing has identified best methods (optimisation algorithms, objective functions, nested and regional calibration, regionalisation for predictions in ungauged areas) for different applications. The CWYET framework will also be applied to several large river basins to test the CWYET, Groundwater-Surface Water Interactions Tool (GSWIT) and Source Rivers.

## Who is involved in building it?

The Catchment Water Yield Estimation Tool (CWYET) is part of eWater's Source Rivers project. It is funded by the National Water Commission and developed in collaboration with all the eWater partners. The project team includes: Jai Vaze, Jean-Michel Perraud, Jin Teng, Francis Chiew, Bill Wang and Zhen Yang.

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