Australia's science-to-policy modelling platform

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Deputy CEO

eWater Ltd
Not-for-profit Australian Government-Owned

Australian Government
Department of the Environment

MURRAY–DARLING BASIN AUTHORITY ← MOU with MRC

Government of South Australia
Department of Environment, Water and Natural Resources

State Government Victoria
Department of Environment and Primary Industries

Queensland Government
Natural Resources and Mines

NSW GOVERNMENT
Department of Primary Industries
Office of Water

We provide software development, capacity building and adoption services.

~30 people engineers, scientists, software developers and admin.

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MOU with Murray Darling Basin Authority

eWater tools and technology are made available under the MOU between the MDBA and MRC via an exchange of letters in 2014:

> *It is agreed by MDBA and MRC that eWater is an important member of the MDBA partner network in IWRM River Basin Modelling Technology and Capacity Building as defined under the MOU. It is agreed that where eWater activities support the Scope and Outcomes (Sections 12 and 13) objectives and the specific subject areas mentioned in Annex 2, MRC and eWater are authorised to share data, technology and knowledge under the auspices of the MRC/MDBA MOU subject to the Intellectual Property Provisions defined in Clause 22 of the MOU.*

The MOU was agreed to be modified as such by an exchange of letters between MRC CEO Hans Guttman and MDBA CEO Rhondda Dickson in September 2014.

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A new modelling capability for Australia

A realisation that earlier generation tools (IQQM, REALM & BIGMOD) would struggle to handle 21Century water management complexity

- Increased Water Policy and Governance Expectations
- Focus on water use efficiency (eg. tradeable rights, environ. water)
- Ecological outcomes and Climate uncertainty
- Generational Change in Software Development

Released in 2012, eWater Source is a nationally consistent forecasting and planning capability, integrating:

- Balancing human and environmental needs
- Conjunctive surface and groundwater use
- Rural and urban supply
- Water use and reuse
- Planning and operational requirements
- Managing Water Accounting and Sharing

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Guiding Principles for Modelling

Adaptive Complexity.

Matching models, data and outcomes (e.g. as study becomes more complex, use more complex models)

Flexibility – foster research and address uncertainty

No one right solution – multiple options (e.g. all models are approximations)

Openness and Community

Collaborative approach to development and access (e.g. free, open development platform)

Defensible

Good/Best Practice - Tools and Applications (Good Practice Guidelines)

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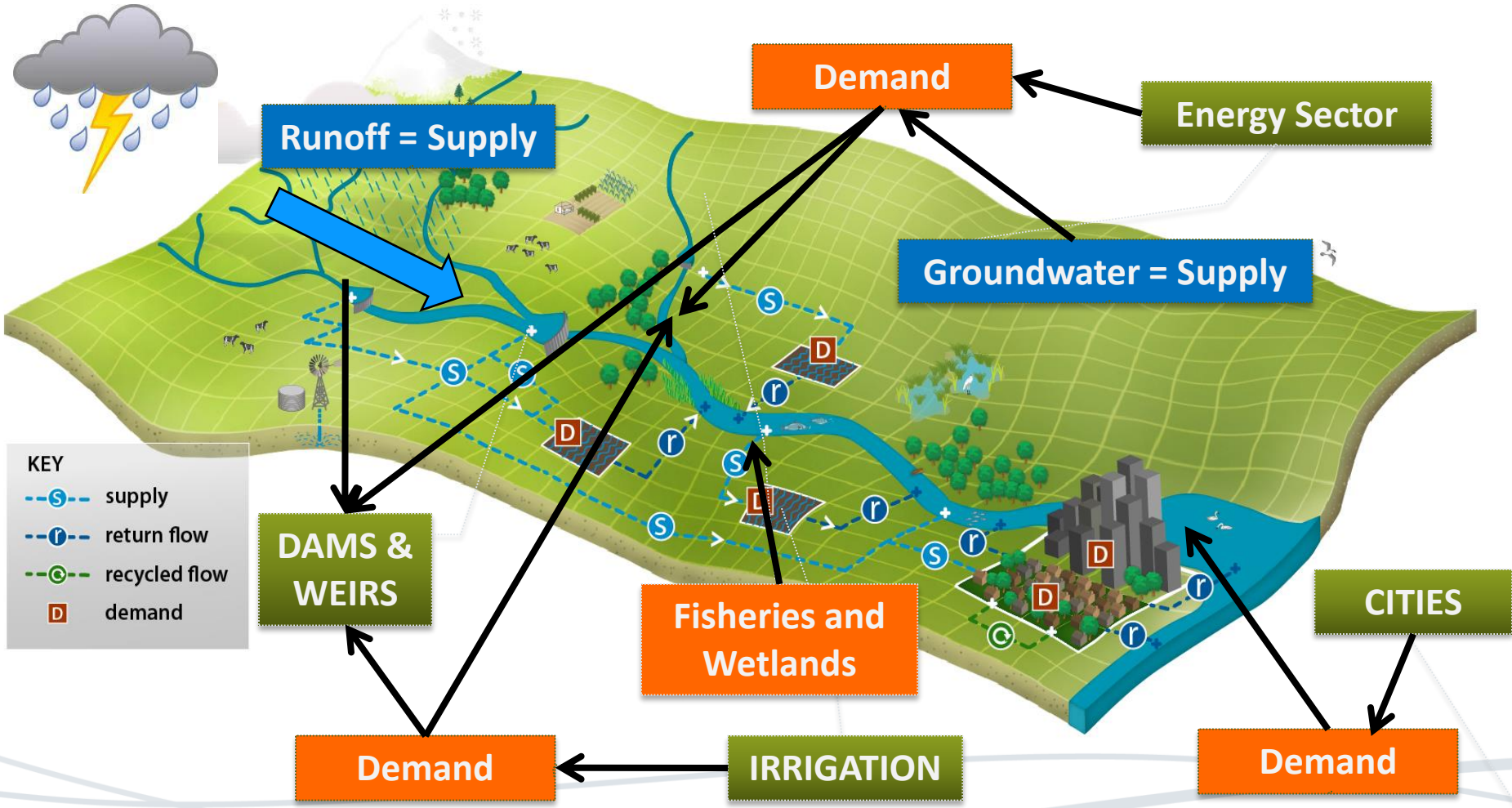
eWater Source – integrated supply and demand of water quantity and quality - local to basin scale



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Major Features Comparison with IQQM

1. Water Quality - Multiple Species with Filtering & Decay (upgraded from IQQM)
2. Multiple Crop and Urban models for demand estimation
3. Incorporation of Environmental Demands (informed by outside process i.e. DRIFT)
4. Surface/Groundwater interaction incl. groundwater head and floodplain recharge
5. NETLP for Multi-Reservoir Operation
6. Genetic Algorithm Optimisation Tools for Tradeoff Analysis
7. River Cross-Sections, Flood Damage and Rating Curves
8. Operational Capability – forecasting of flows in short/medium/long term
9. Multiple Rainfall runoff models - Regionalisation methods (for ungauged catchments and different land use types) Stochastic procedures (for rainfall inflows)
10. Object Code C#/.NET and Cloud Enabled
11. Plugins, FEWS Adapter/Interface
12. Auto Calibration Tool
13. TIME Library integration
14. Input/output data standards (compliant with WDTF, Hydsys, SQL, Oracle, etc.)
15. Documentation
    - Up to date user guide with context-sensitive help (on-line version)
    - Up to date technical reference manual
    - Training Videos
    - Best Practice Guidelines
    - Community of Practice, Knowledge Forums and FAQ

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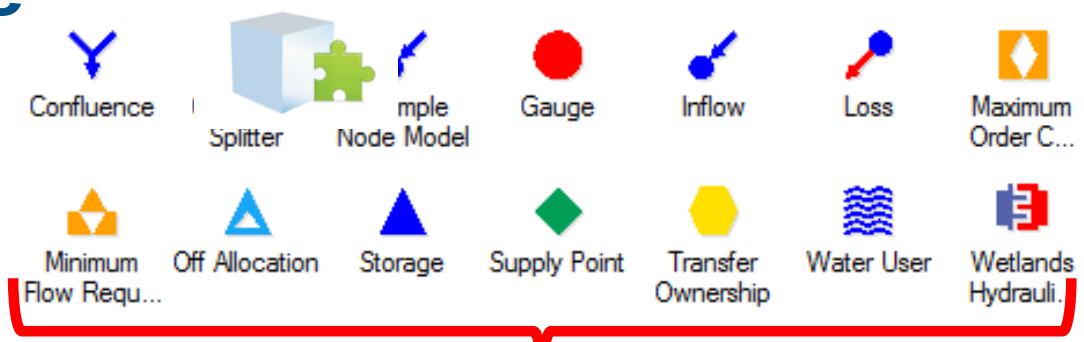
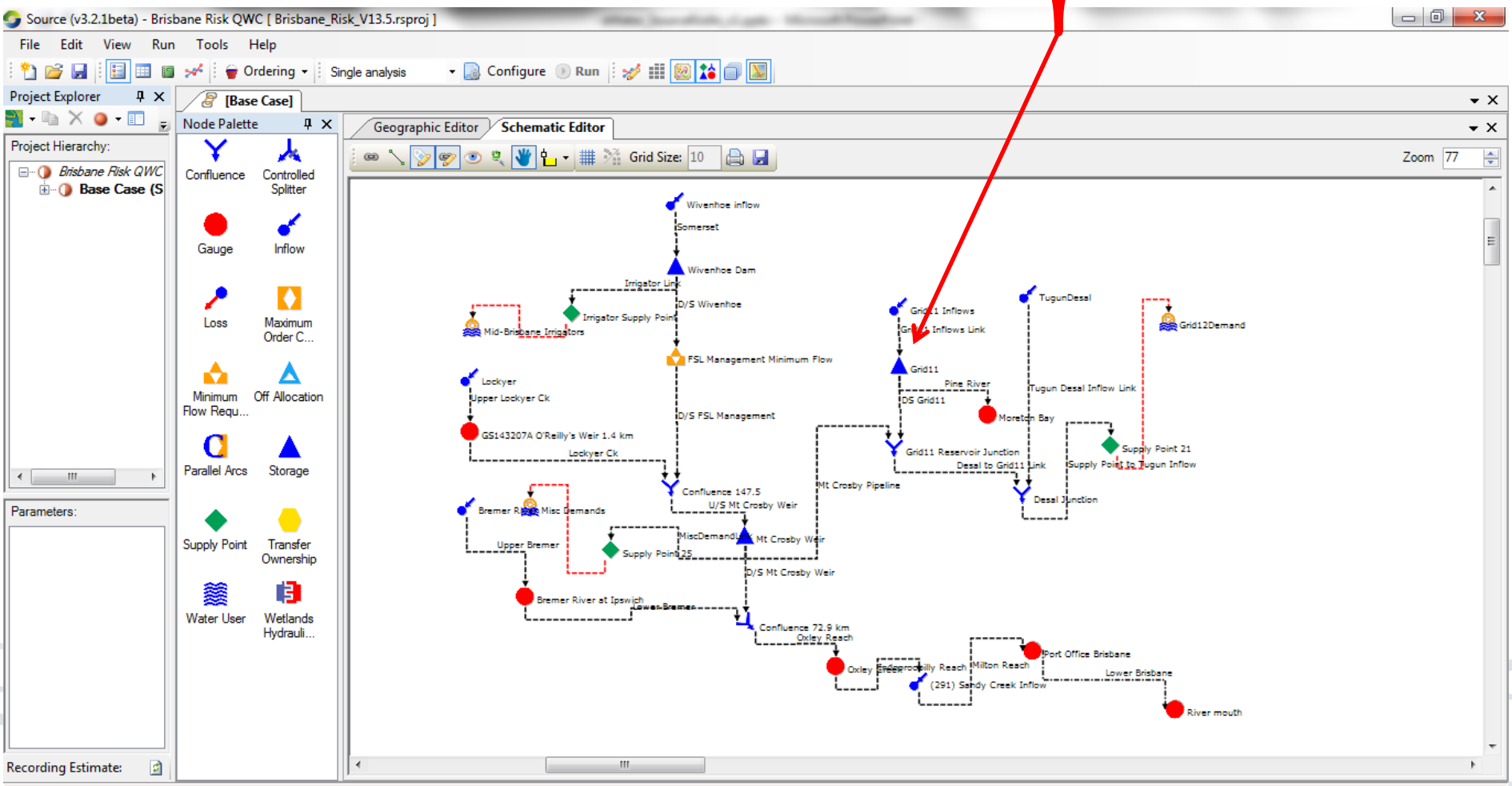
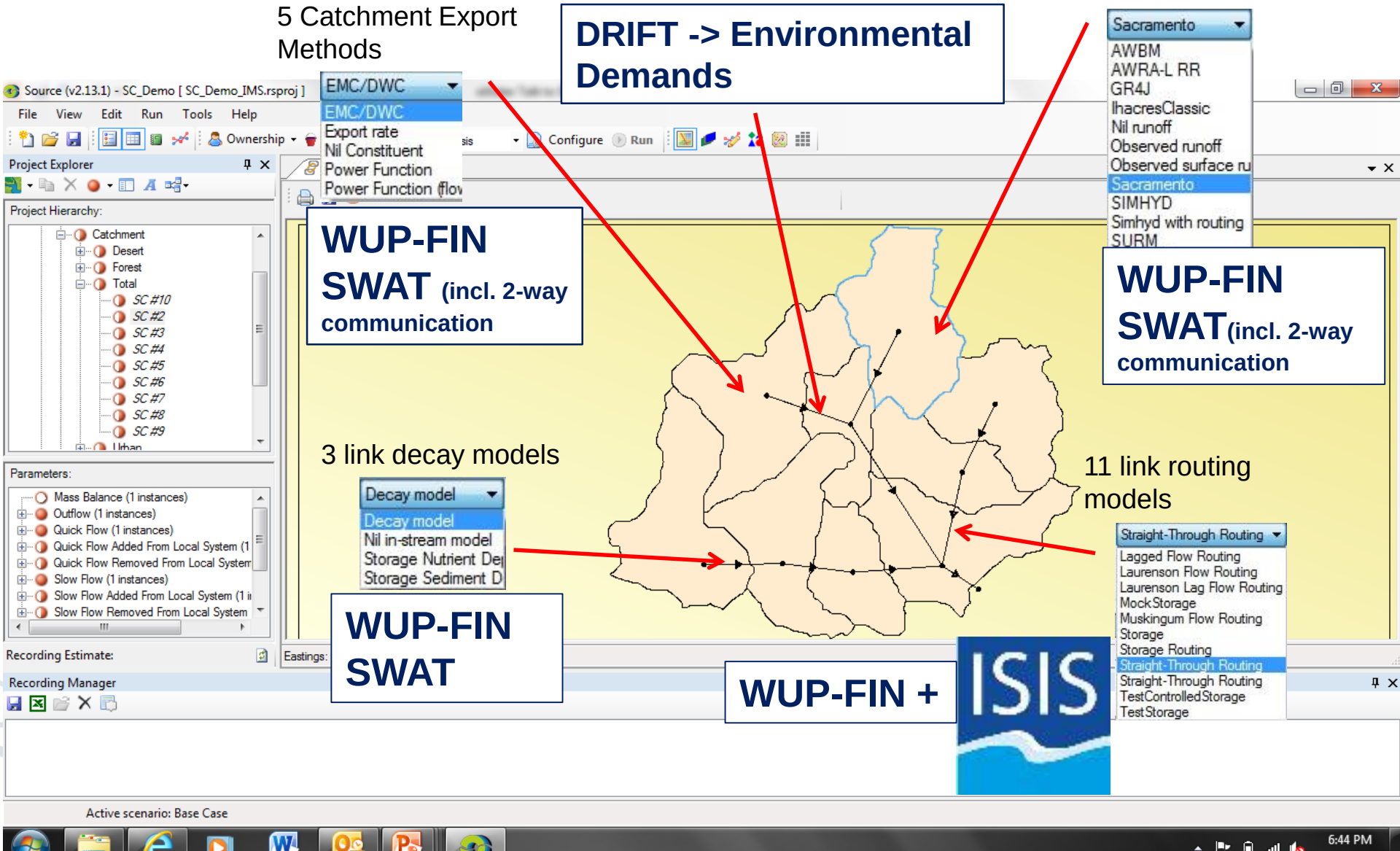
River Manager Mode

Nodes representing points of interest, physical and management characteristics

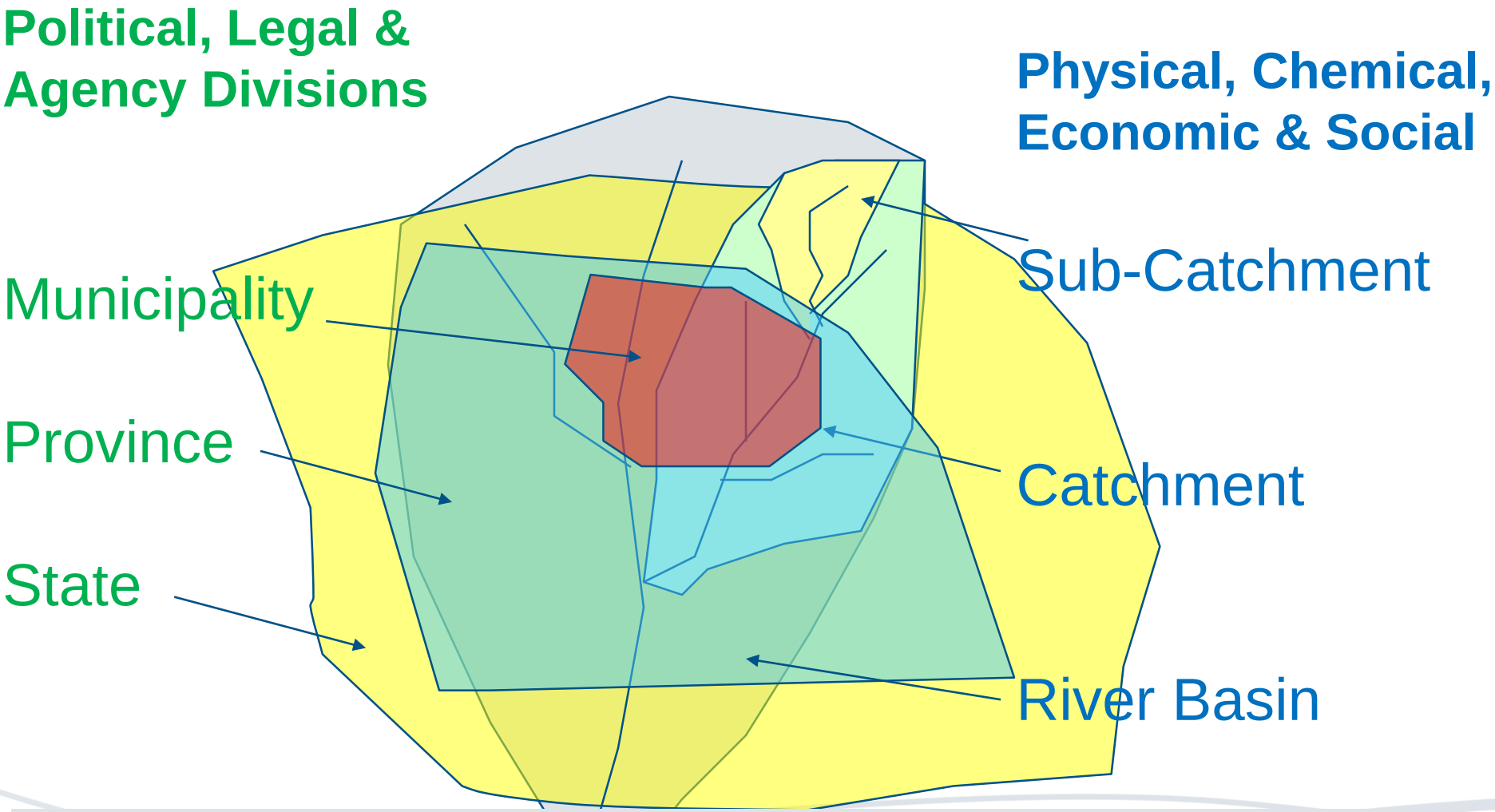




Source as Integration Framework Enhances DSF Capability



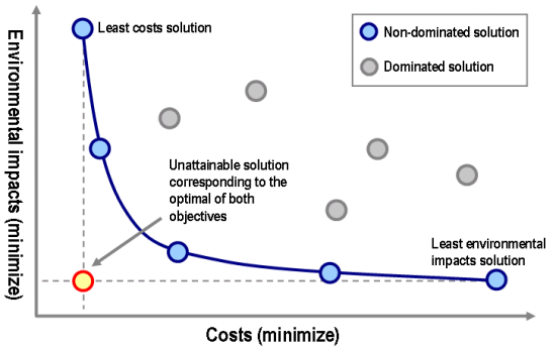
Transboundary IWRM



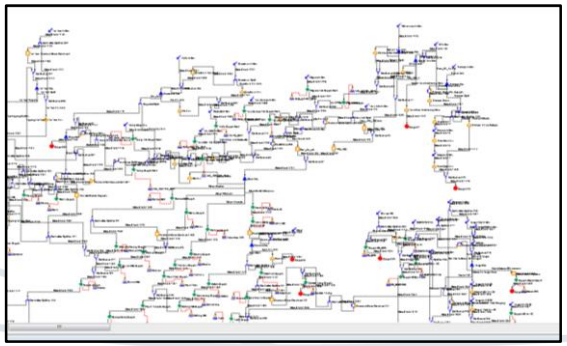
Sources: Surface, Groundwater, Desal, Recycled etc…
Sectors: Hydropower, Irrigation, Urban, Environmental, etc…

Scenario Comparison
Multiple Operational or Planning Horizon Configurations

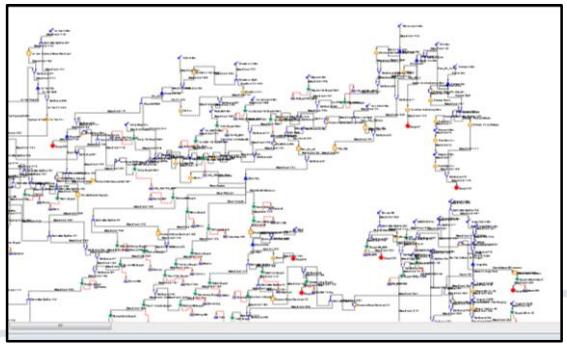
e.g. Strategy to provide 95% reliability of supply over forecast period



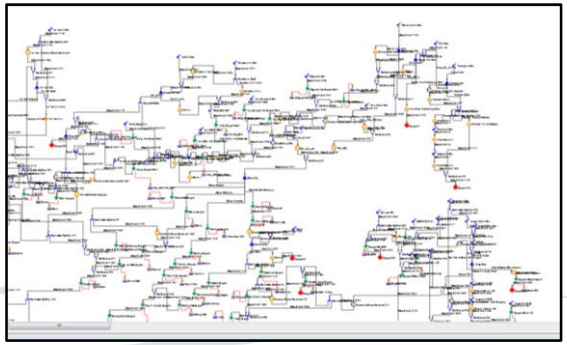
High Demand Wet Weather Operations - 30% Probability



High Demand Normal Operations – 20% Probability

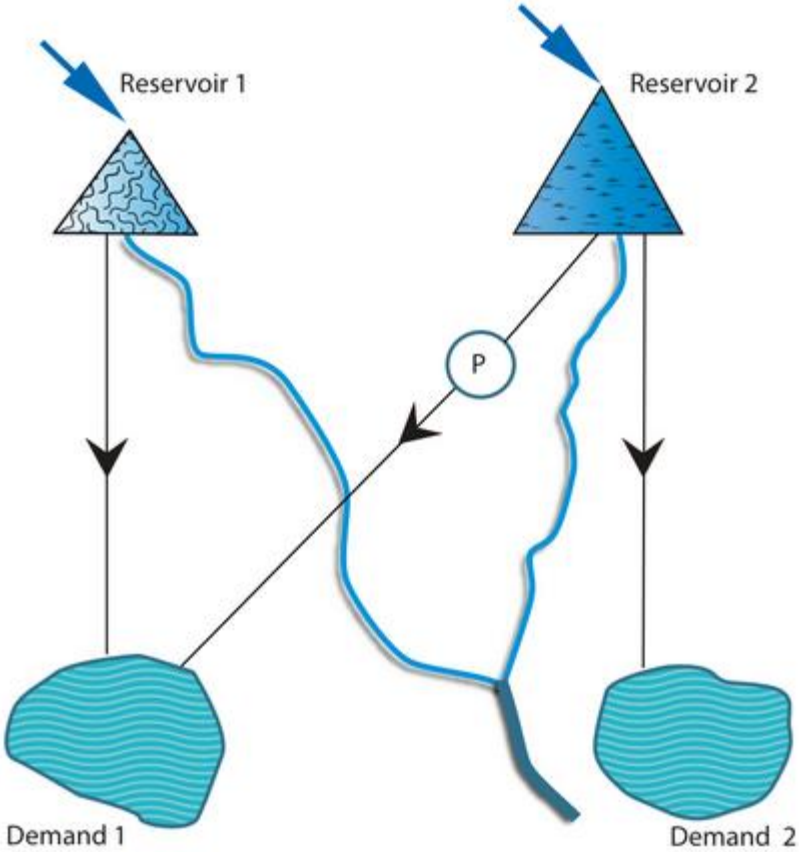


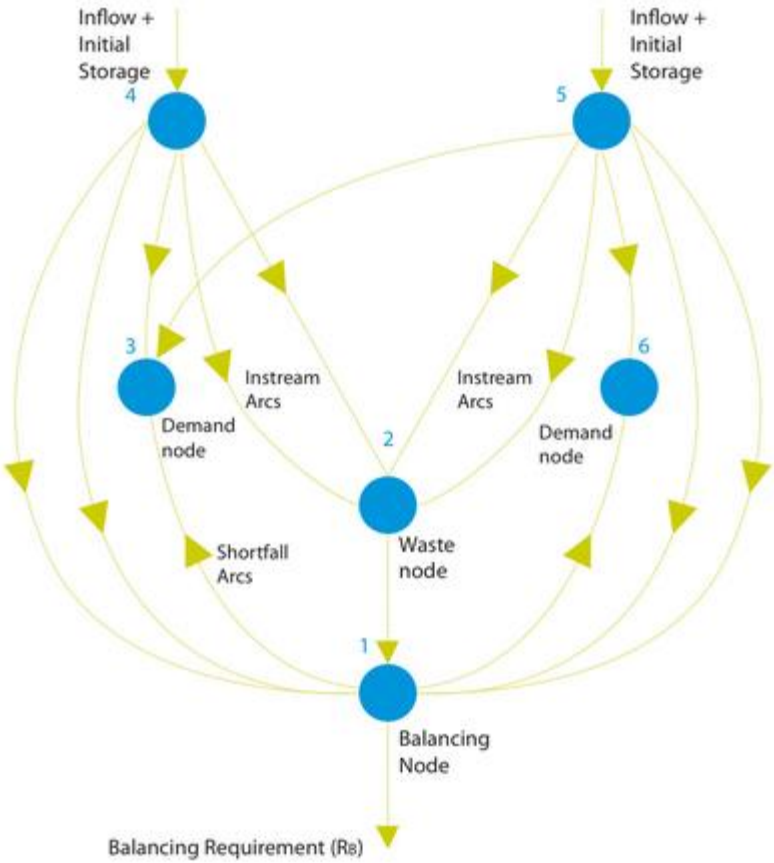
High Demand Maintenance of Tanks – 50% Probability



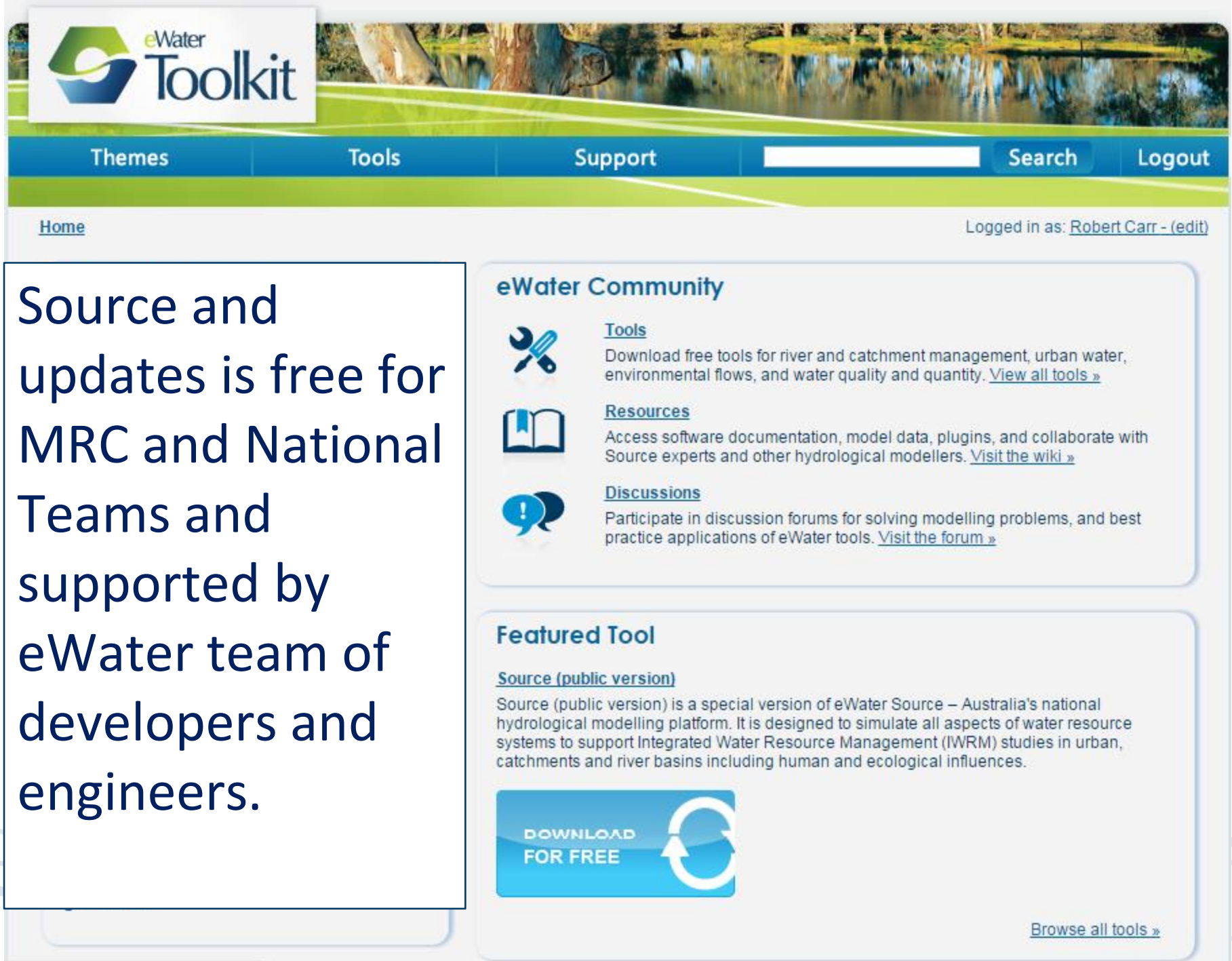
Melbourne Water

Optimisation of Complex and Cascading Reservoirs





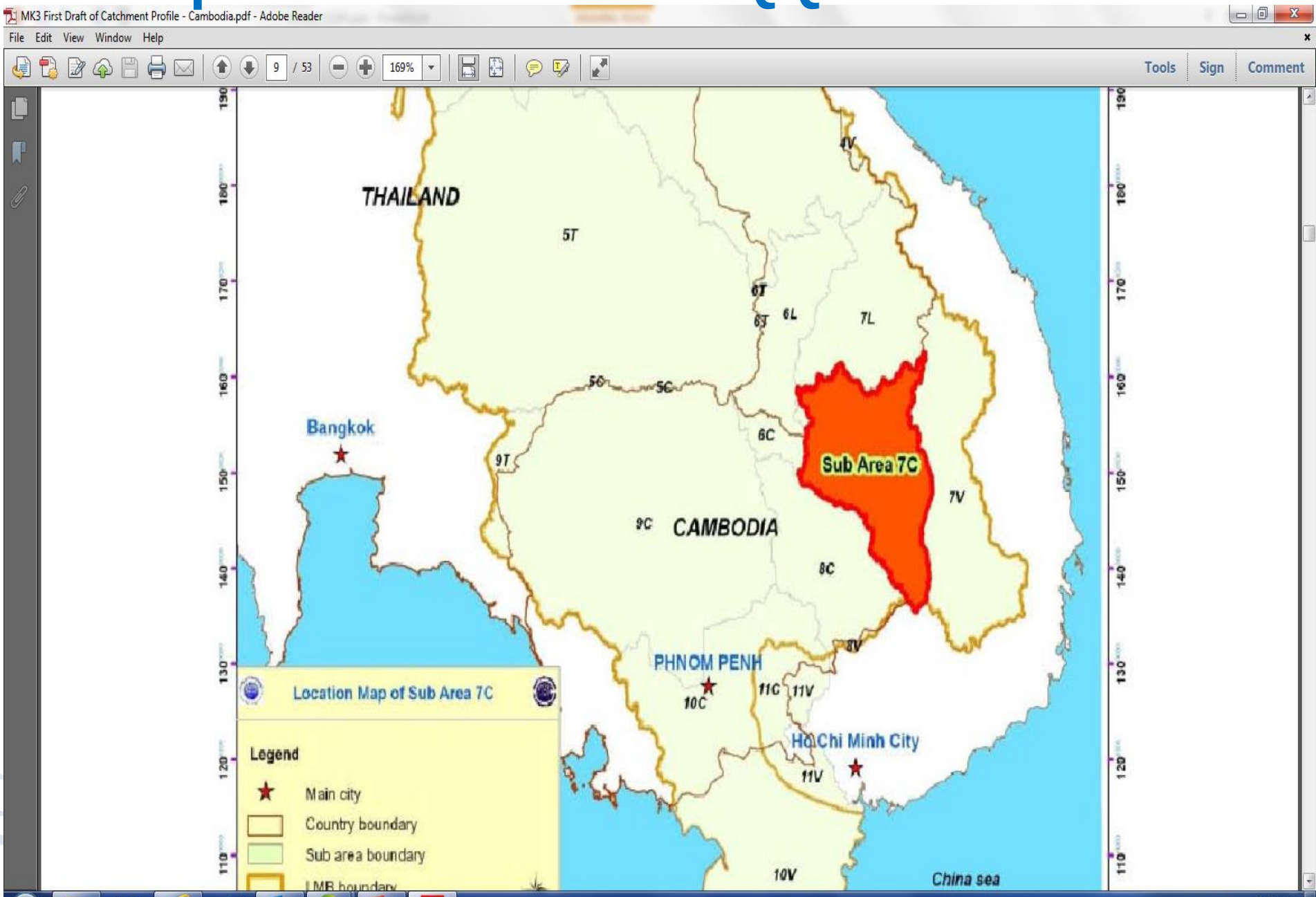
Source and updates is free for MRC and National Teams and supported by eWater team of developers and engineers.



eWater Tools to Support MRC Programs

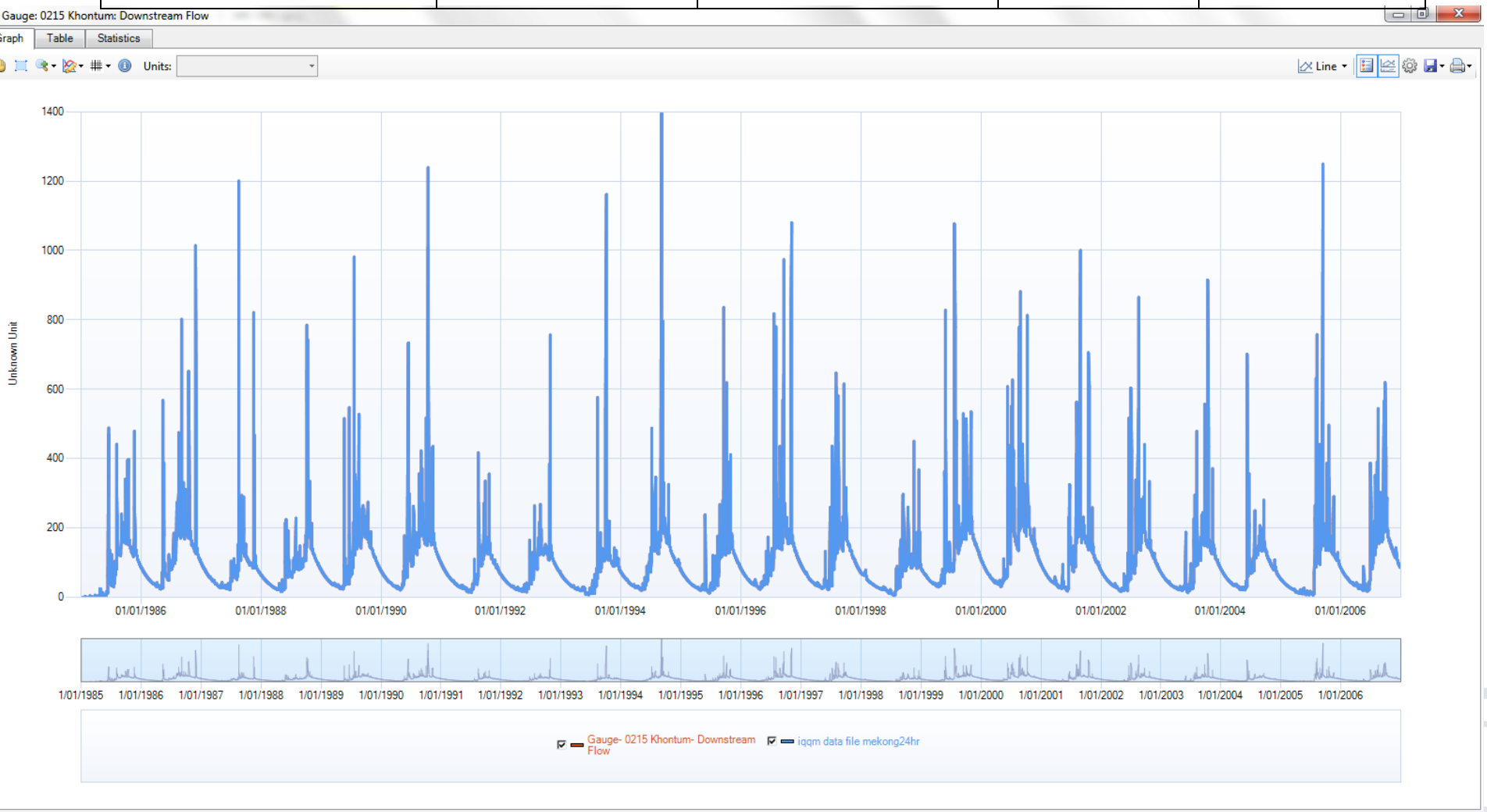
- 2013 Pilot to demonstrate same as IQQM
- Support for PWUM
- Support for Hydrology Component
- Support for Council Study

Comparison Source and IQQM - 3S Pilot



Comparison at Khortum

Model period 1/1/1985 to 31/12/2006	Minimum Flow (m^3/s)	Maximum Flow(m^3/s)	Mean Flow (m^3/s)	Volume (m3)
eWater Source	0	1396	99.2	797368
IQQM	0	1396	99.2	797368



PWUM - eWater Source

On 24th October 2013, the Regional Consultative Meeting on Implementation of PWUM held at Vientiane, Lao PDR a number of recommendations were made related to modelling tools to support PWUM.

1. As a complementary tool to DSF, eWater Source was proposed to estimate water use in the proposed pilot area.
2. The detailed information of using eWater Source for water use estimation should be provided.
3. The training facility and timeframe for eWater Source should be considered.
4. A comparison study on water use estimation using DSF and eWater Source should be conducted.
5. It is highly recommended that IKMP TACT is the most appropriate forum for a discussion on the proposed tool.

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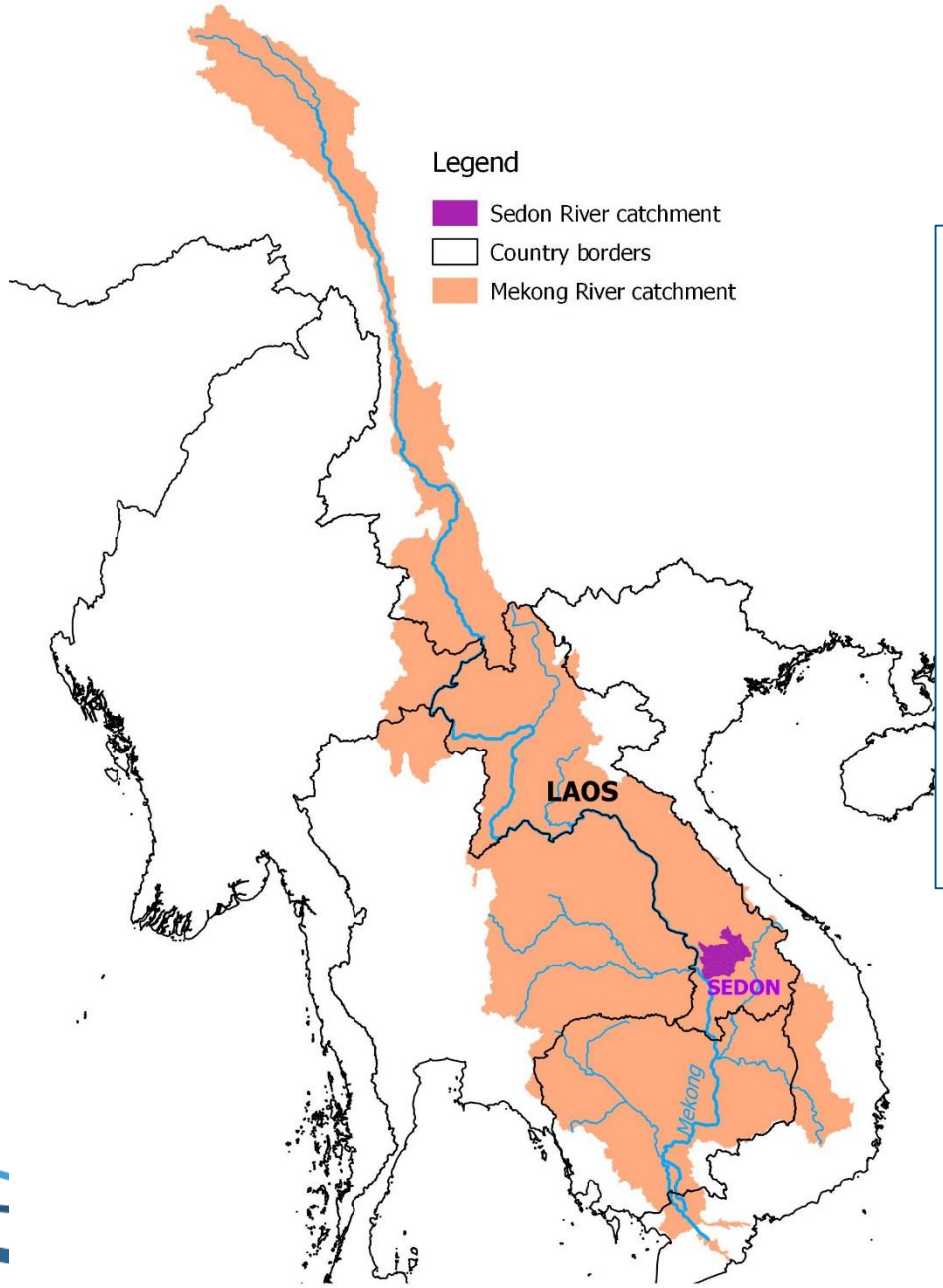
eWater and LNMC – Modelling of SeDon Catchment



SeDon set up in parallel (work is close to finalisation)

1. SWAT/IQQM - LNMC
2. eWater Source – eWater/LNMC

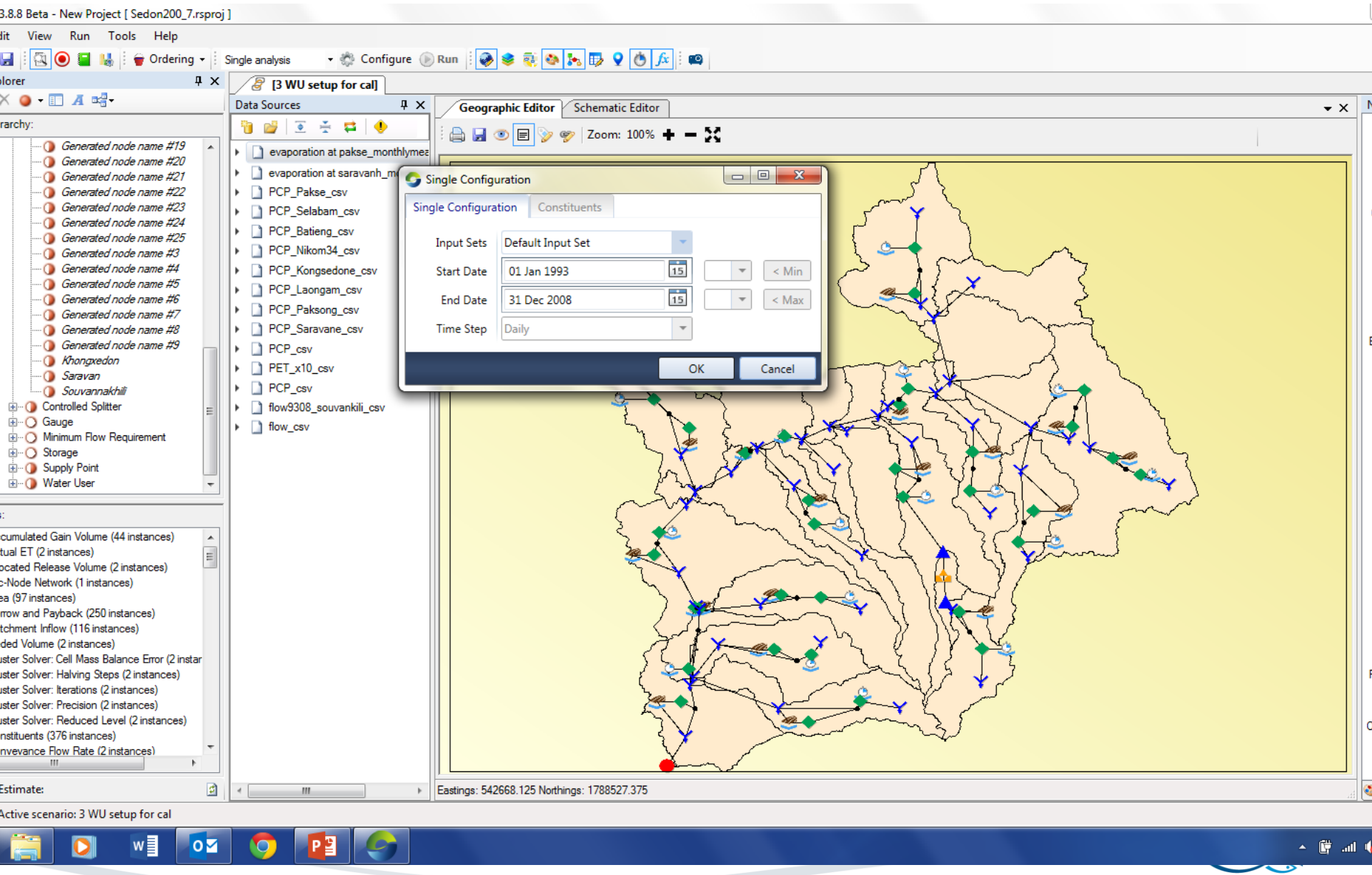
- Comparison of Results
- Experience of Modelling Team in the Process
- Way Forwards

Basic Data Sets and Capacity Building

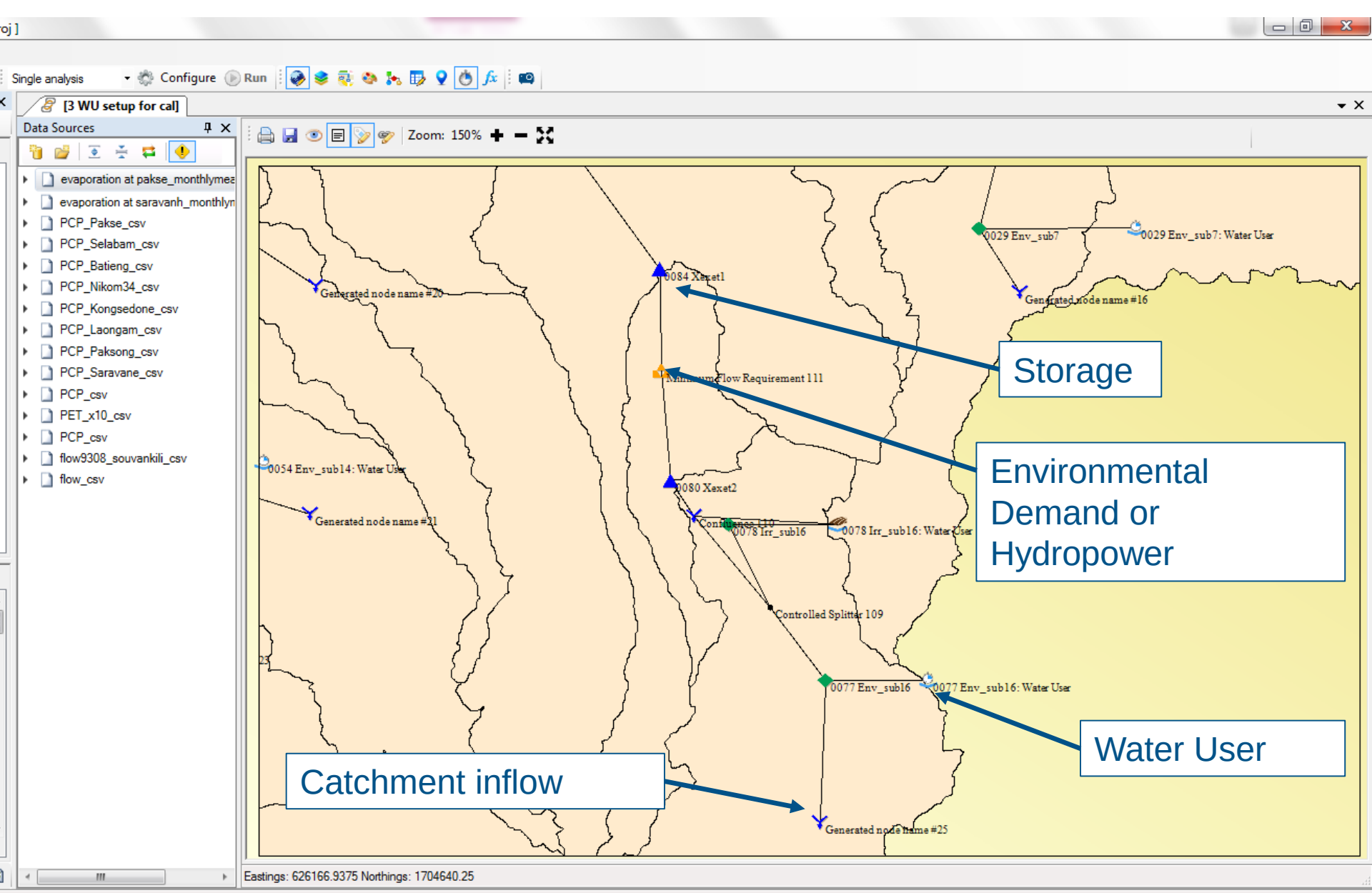
- Digital Elevation Model (create catchments)
- Land Use Data (5 land uses)
- Rainfall Stations (8), Evaporation (2)
- Stream Gauging (3)
- Reservoir Dimensions and Rule Curve (2)
- 34 Water Users - Crop Patterns (from IQQM)
- 2 training sessions (1 week each in 2014) more planned for 2015

eWater

Source Catchments Setup

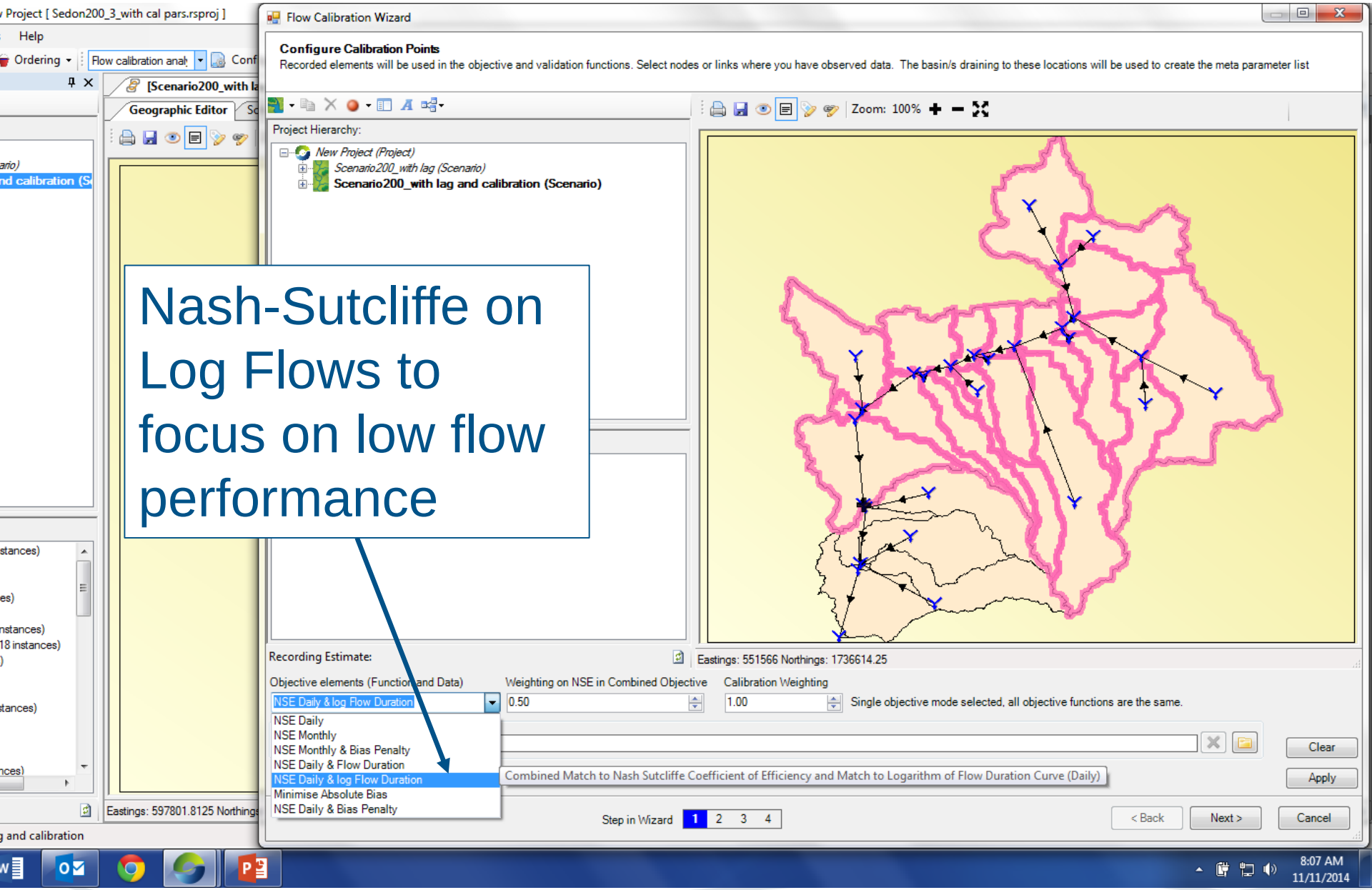


eWater


Single analysis
Configure
Run
[3 WU setup for cal]
Data Sources
evaporation at pakse_monthlymea
evaporation at saravanh_monthlyn
PCP_Pakse_csv
PCP_Selabam_csv
PCP_Batieng_csv
PCP_Nikom34_csv
PCP_Kongsedone_csv
PCP_Laongam_csv
PCP_Paksong_csv
PCP_Saravane_csv
PCP_csv
PET_x10_csv
PCP_csv
flow9308_souvankili_csv
flow_csv
Zoom: 150%
0029 Env_sub7
0029 Env_sub7: Water User
Generated node name #16
0084 Xeset1
Generated node name #20
Minimum Flow Requirement 111
0054 Env_sub14: Water User
0080 Xeset2
Generated node name #21
Confluence 110
0078 Irr_sub16
0078 Irr_sub16: Water User
Controlled Splitter 109
0077 Env_sub16
0077 Env_sub16: Water User
Generated node name #25
Storage
Environmental Demand or Hydropower
Water User
Catchment inflow
Eastings: 626166.9375 Northings: 1704640.25
3:32 PM
25/01/2015

eWater

Nash-Sutcliffe on Log Flows to focus on low flow performance



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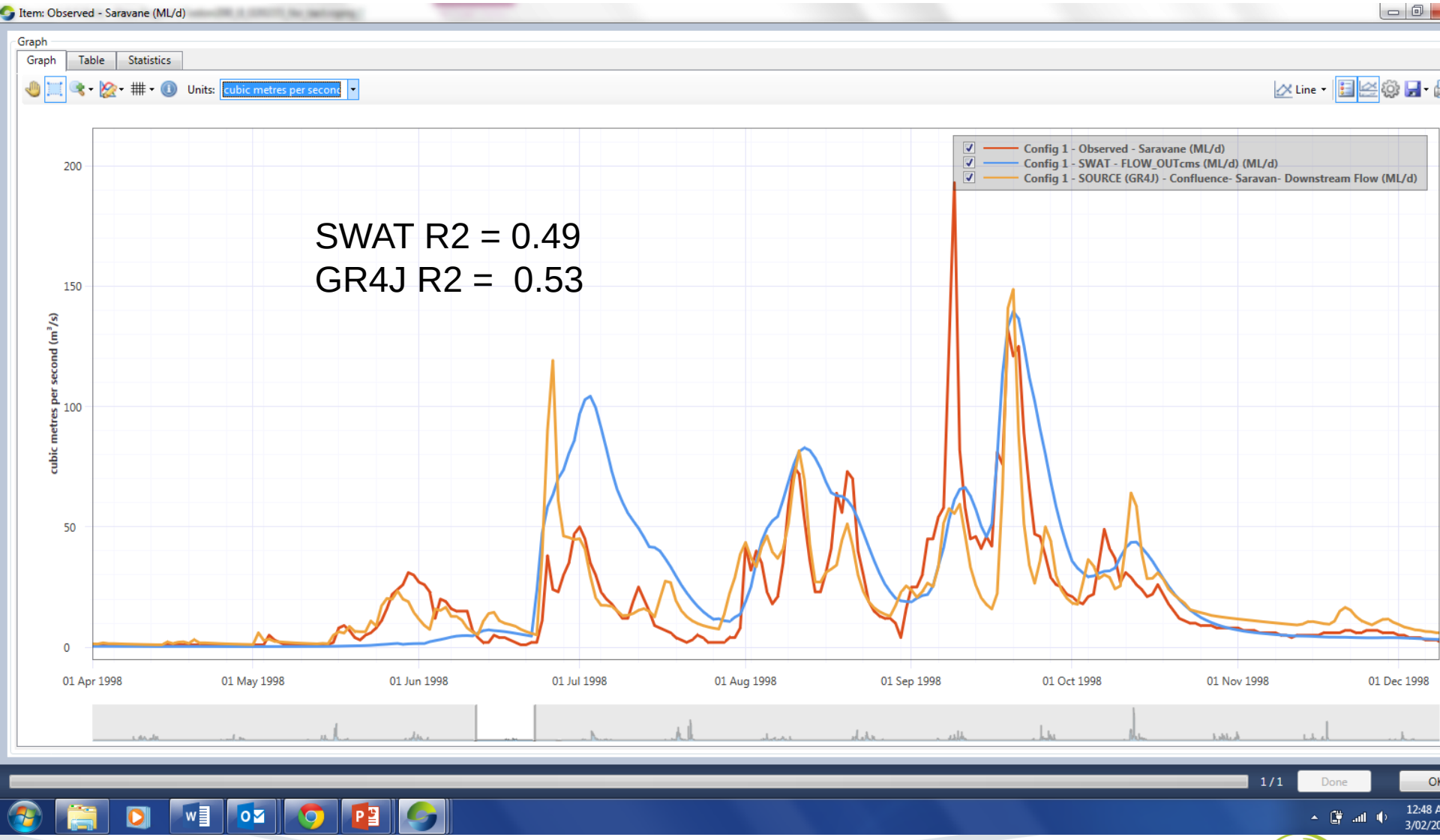
Calibration at Saravane – High Flows



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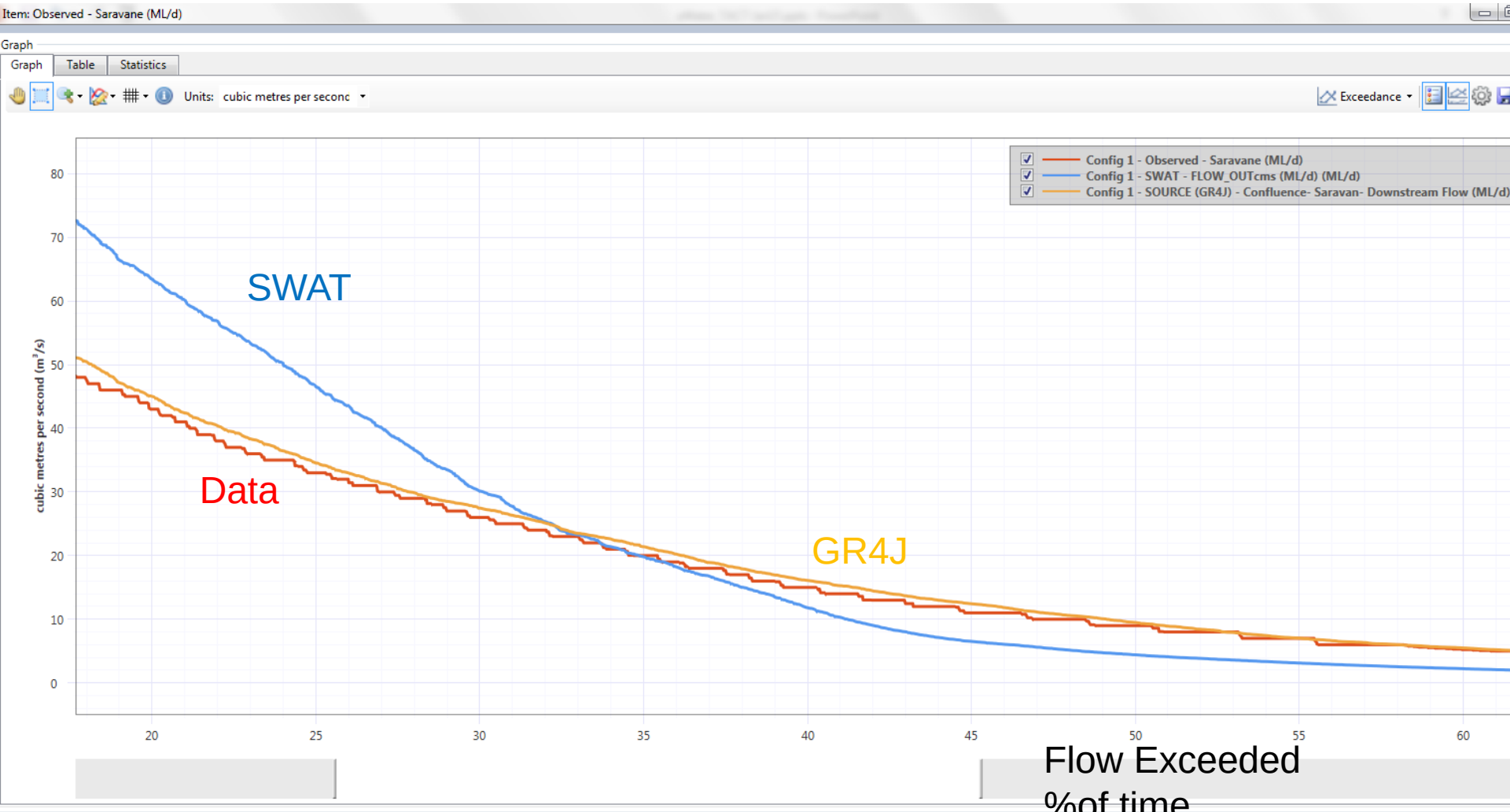
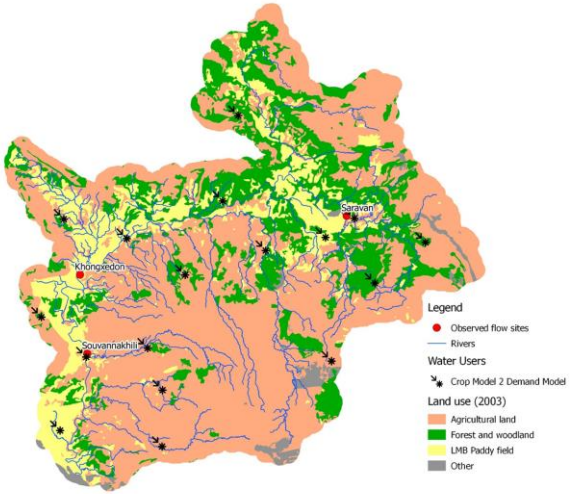
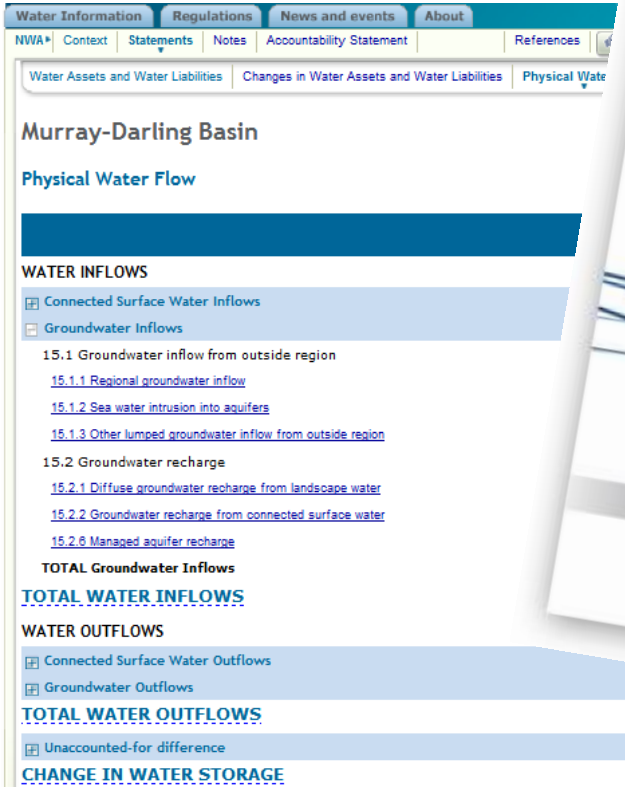
Low Flow Analysis at Saravane – Important for PWUM

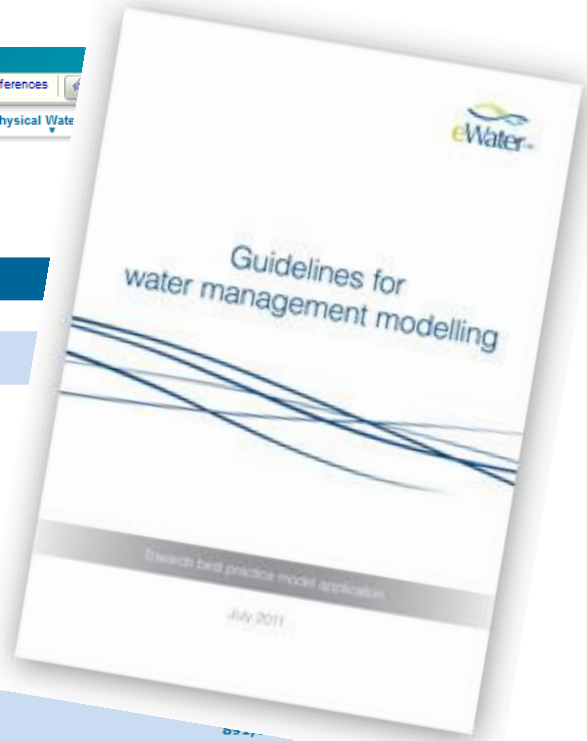


Next Steps

Develop PWUM Water Account Similar to MDBA Good Practice Guidelines Modelling and Data



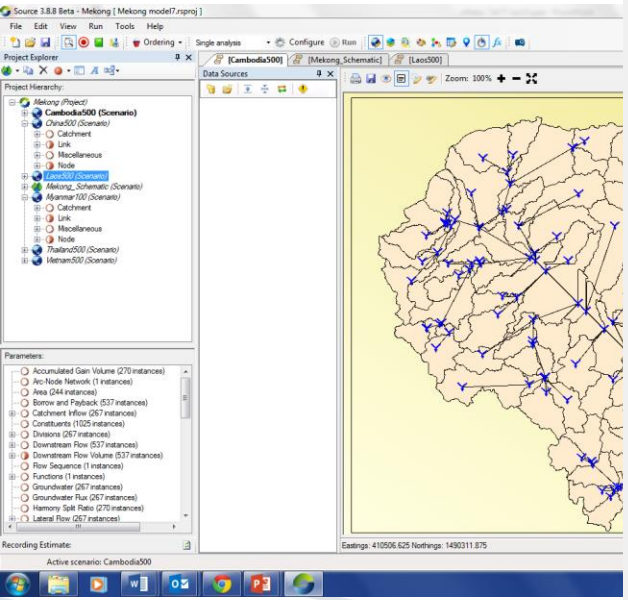


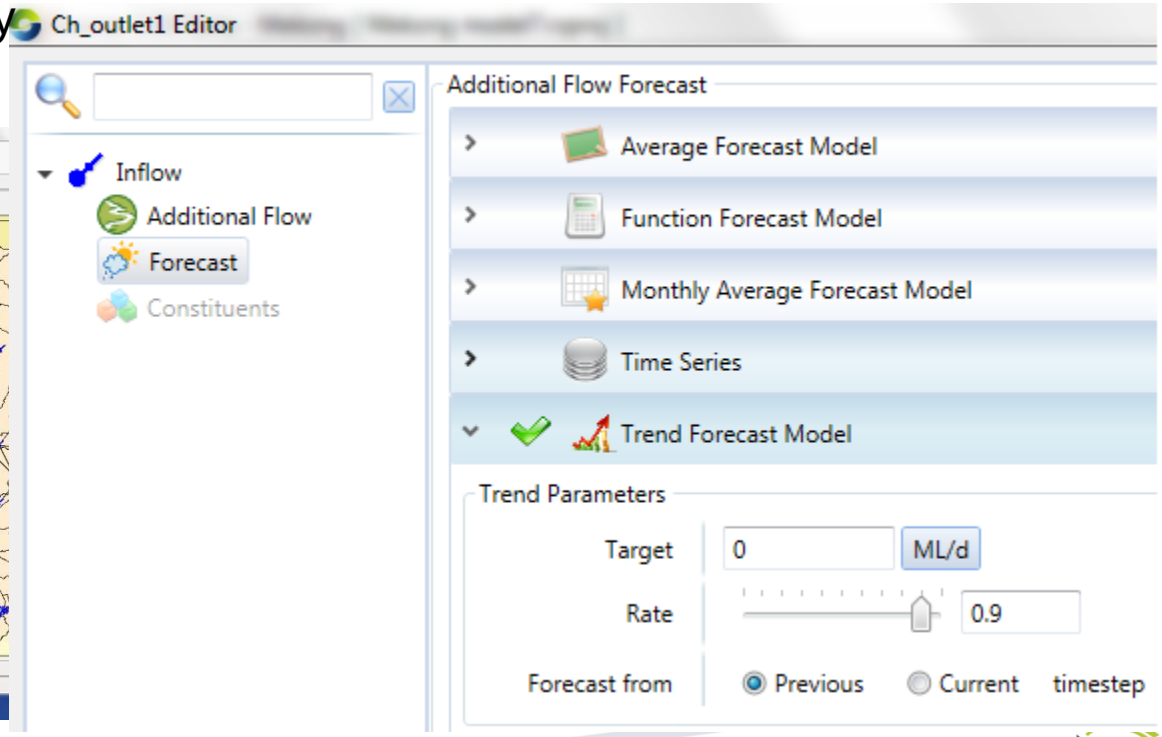


Define Supply and Demand by Location and Sector as standard report

eWater Support for Hydrology Component

1. Develop Model of Basin tailored for water balance (incl. juristictions, groundwater and sectoral water users)
2. Incorporate Rating Curves
3. Using Function Manager, bring in indicator metrics for hydrological conditions (drought, flood) consistent with MRC standards.
4. Create Historical Water Balances for Annual Reporting
5. Use model for Dry Season Operational Forecasting – generate indicator metrics with uncertainty

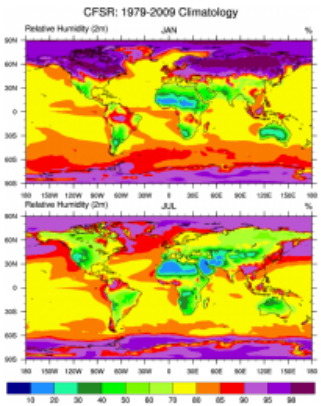




Climate Data

CLIMATE FORECAST SYSTEM REANALYSIS (CFSR)

Summary | Metadata | Data Access | References



The CFSR is a third generation reanalysis product. It is a global, high resolution, coupled atmosphere-ocean-land surface-sea ice system designed to provide the best estimate of the state of these coupled domains over this period. The CFSR includes (1) coupling of atmosphere and ocean during the generation of the 6 hour guess field, (2) an interactive sea-ice model, and (3) assimilation of satellite radiances. The CFSR global atmosphere resolution is ~38 km (T382) with 64 levels. The global ocean is 0.25° at the equator, extending to a global 0.5° beyond the tropics, with 40 levels. The global land surface model has 4 soil levels and the global sea ice model has 3 levels. The CFSR atmospheric model contains observed variations in carbon dioxide (CO2), together with changes in aerosols and other trace gases and solar variations. With these variable parameters, the analyzed state will include estimates of changes in the Earth system climate due to these factors. The current CFSR will be extended as an operational, real time product into the future.

KEY STRENGTHS:

- Superior to previous NCEP reanalyses with respect to: improved model, finer resolution, advanced assimilation schemes, atmosphere-land-ocean-sea ice coupling, assimilates satellite radiances rather than retrievals
- Accounts for changing CO2 and other trace gasses, aerosols, and solar variations
- Approaches the horizontal resolution of regional reanalyses like the NARR and Arctic System Reanalysis

CLIMATE FORECAST SYSTEM REANALYSIS (CFSR)

YEARS OF RECORD

1979/01 to 2010/12

Main variables

Atmosphere * Air Temperature * Geopotential Height * Precipitable water * Ocean

Type of data product

Atmospheric Reanalysis›NCEP CSFR

Institution and PIs

NCEP

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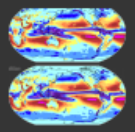
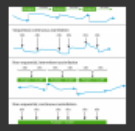
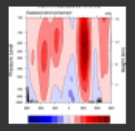


Atmospheric Reanalysis: Overview & Comparison Tables



Simplistic Overview of Reanalysis Data Assimilation Methods



NASA MERRA

eWater Support for PWUM & Hydrology Program

eWater in partnership with IKMP & ICBP will develop and implement capacity building and technology transfer support to MRC and Member Countries in the following ways:

1. Initially, a regional workshop involving senior modellers from MRCS and the Country modelling teams will be held to demonstrate the proposed approach to PWUM & Hydrology Component. This workshop would be prepared for and with National Mekong Committees and Secretariats, Line Agencies and the MRC Secretariat;

2. Implement a series of Regional Introduction Meetings, Regional & National Training workshops and Technical Support in consultation with ICBP, IKMP and eWater to enhance the capability of the Mekong River modelling community for the ongoing use of eWater tools for PWUM & Hydrology Component

3. eWater will provide in-house technical support to IKMP on modelling approaches, integration of Source with the DSF and working with IKMP modelling team to provide workshops and training courses in Source to PWUM and other components and programs as may request assistance.

eWater

eWater Source Modelling to Support Council Study

- Source as integration framework within DSF combining impact tools with Extended Toolbox Models (SWAT and ISIS, IWRM and VMOD)
- Analyse Multi-Reservoir Operation – Can augment IQQM
- Incorporate Environmental Flows (inform from DRIFT and Fisheries)
- Address impact of agreements and water source rights on strategies
- Evaluate scenarios and tradeoffs

eWater

Proposal to TACT:

1. Acknowledge eWater Source as progressive successor to IQQM and available via the MOU with MDBA

2. Agreement on the use of eWater Source as an additional approved tool for PWUM pilot studies and Hydrology Component

3. Acknowledge that eWater Source is recommended as a tool by TACT available to the Council Study subject to review and approval by RTWG.

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eWater Source