State water
Taking care of it

Computer Aided River Management (CARM)
Water where and when it matters.

Taking care of it

Overview

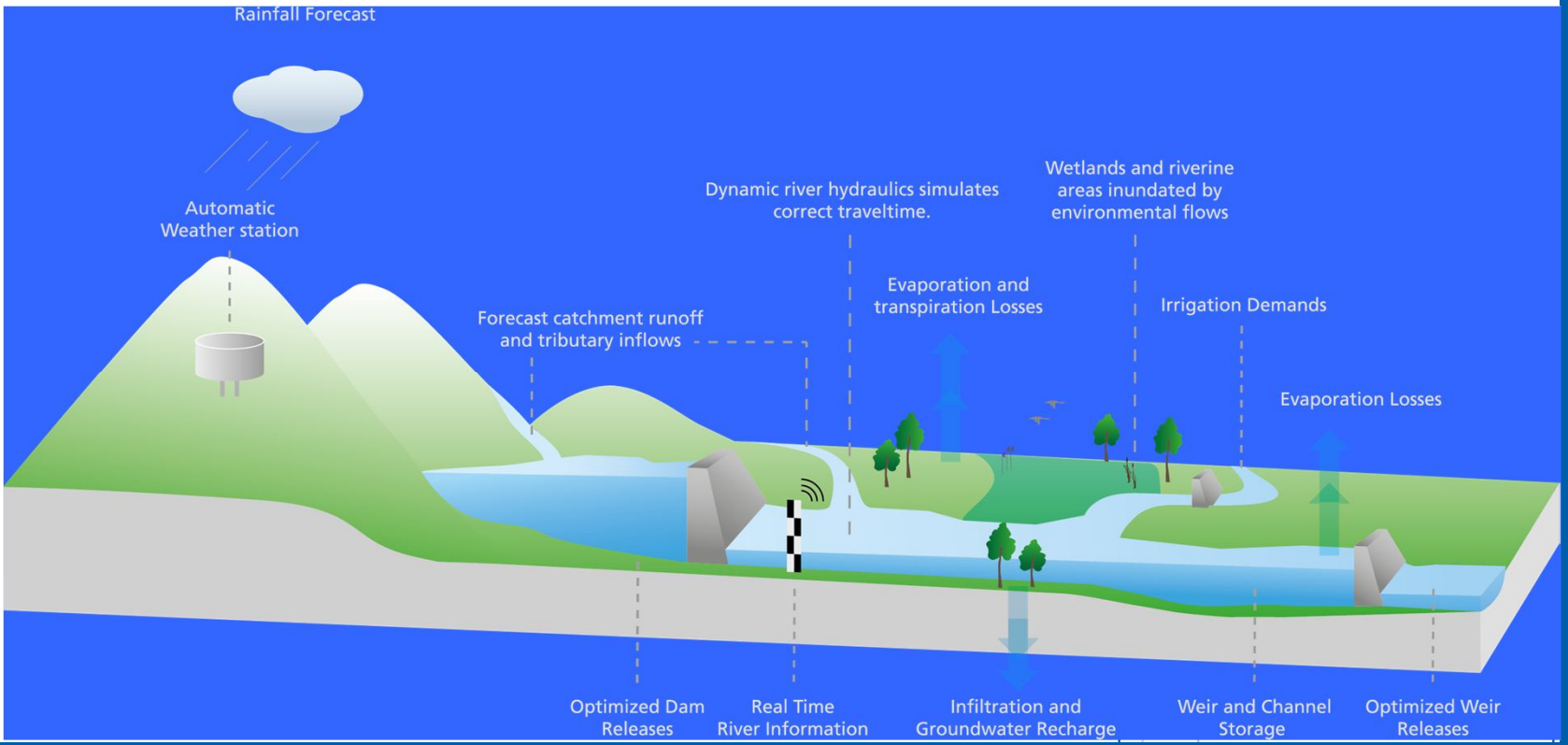
- Water where and when it matters. The time value of water.
- Computer Aided River Management (CARM) background
- CARM features
- Environmental & operational benefits
- Project milestones
- Summary

State water
Taking care of it

What is CARM?

Efficiency gains delivered through combining:

- Knowledge of river behaviour
- Measurements of river flows and diversions
- Forecast of inflows and demands



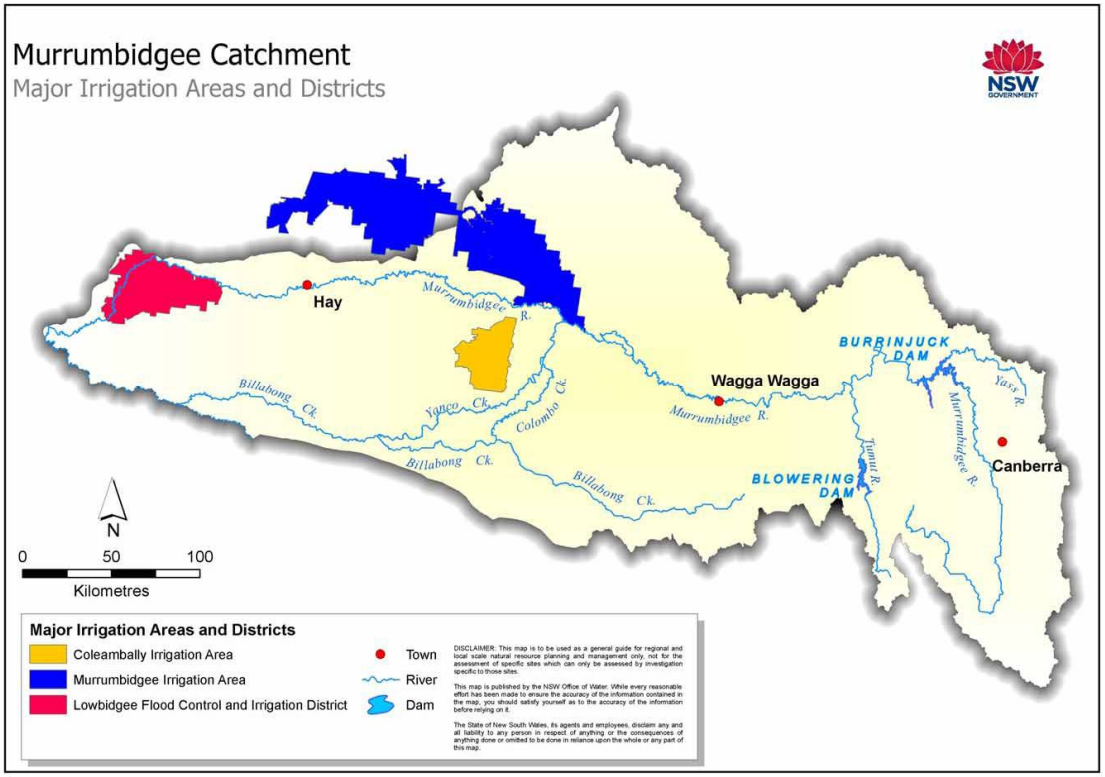
Project objective

To achieve water savings through automated efficient operation of the Murrumbidgee Regulated River in regional New South Wales; by acquiring and implementing

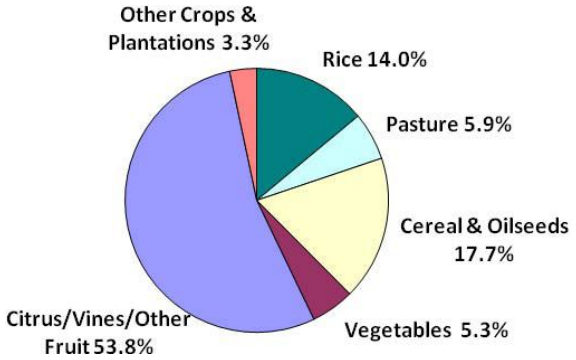
- ✓ a world class, scalable and modular river operations expert system that will innovatively make use of the recent advances in -
- ✓ hydrologic sciences and information & communication technology

State water
Taking care of it

Irrigation



- Irrigation(46%) and environment are biggest water users
- Murrumbidgee and Coleambally use 50% and 20% of all irrigation water



State water
Taking care of it

Environmental assets

- Murrumbidgee River channel and Mid-Murrumbidgee Wetlands
- Lowbidgee Floodplain
- Lowland floodplain wetlands below Balranald

Current Challenges for Efficient River Operations

Meeting water orders reliably

- Water orders may change
- Catchment inflows
- River behaviour (constantly changing with flow)
- Seepage into and out of the river from groundwater
- Managing weir levels and storages

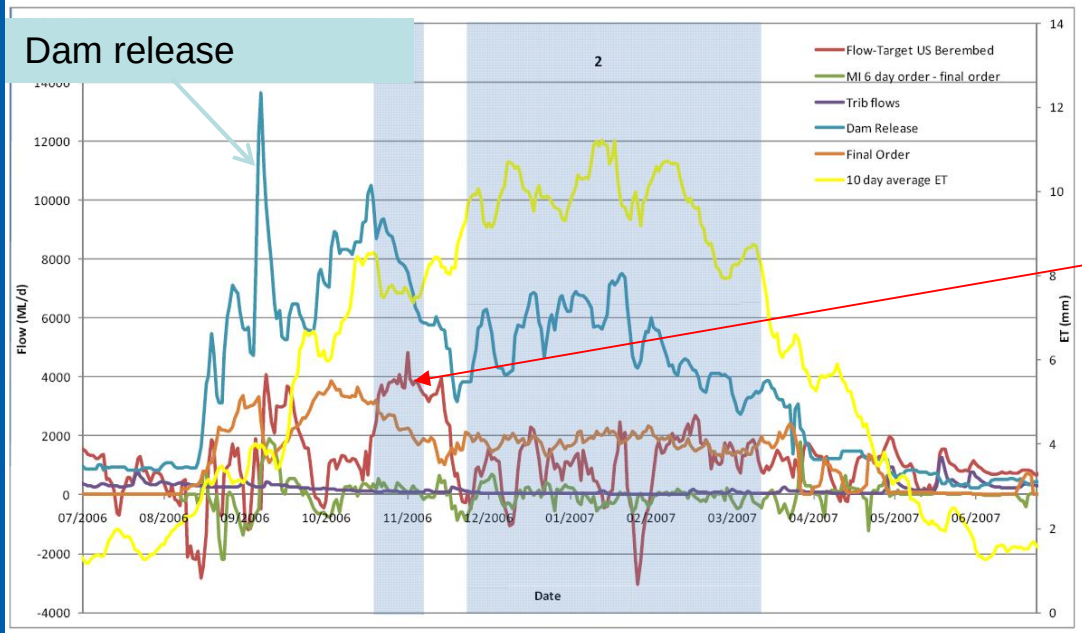
Constraints on State Water

- Manual daily operation relies on judgement and experience
- Limited availability to operators of real time and forecast data
- Simplified river behaviour in operational tools
- Aging operations technology

State water
Taking care of it

Result: Operational Surpluses and Shortfalls

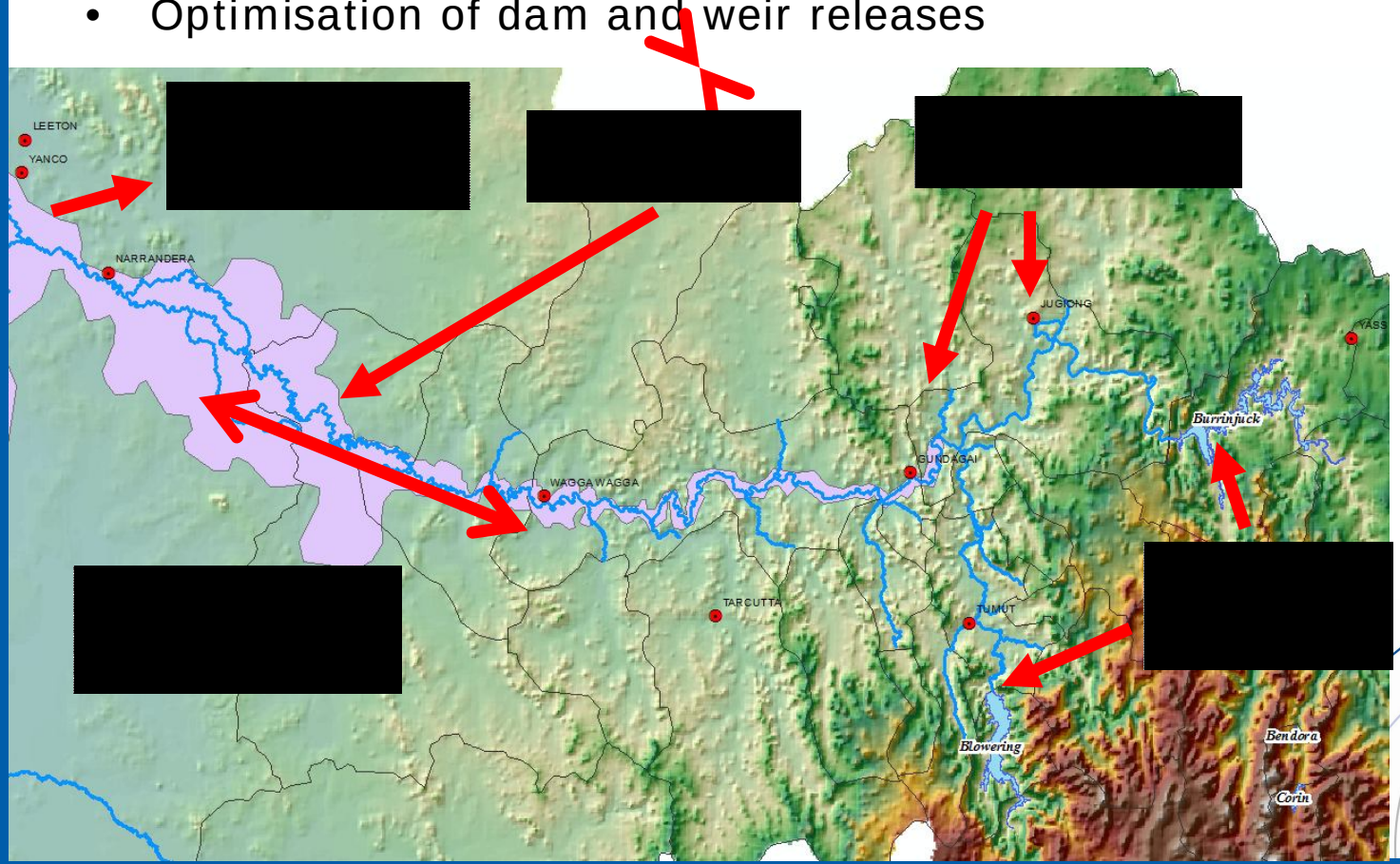
- Operational Surpluses point to too much water being released from dams (Report – SKM 2010)
- Main drivers to operational surplus identified:
  - Tributary inflows not fully taken into account
  - Irrigation demands change at short notice and are not forecasted
  - Water in channel storage not fully accounted



State water
Taking care of it

CARM Components

- River hydraulics and catchment hydrology computer simulation tools
- Real time information used to its maximum potential (“self correcting”)
- Forecast of catchment inflows, river losses and gains
- Optimisation of dam and weir releases



State water
Taking care of it

CARM Demonstration – Proof of Concept

Drivers

Historical release from Burrinjuck and inflow

CAIRO orders, MI 6 day and 1 day demand

CAIRO required flow at Narrandera

Optimisation Targets

6 day order – 1st Priority (must be met)

Changed Orders – 2nd Priority

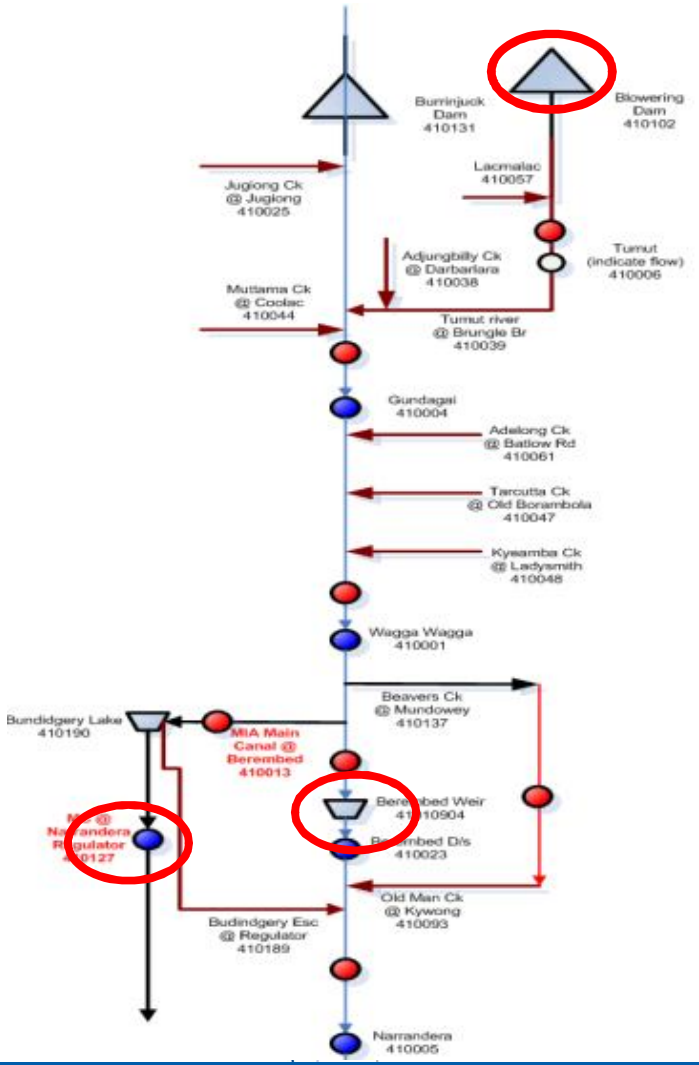
Storage Buffers at Berembed, Bundidgerry

Control variables

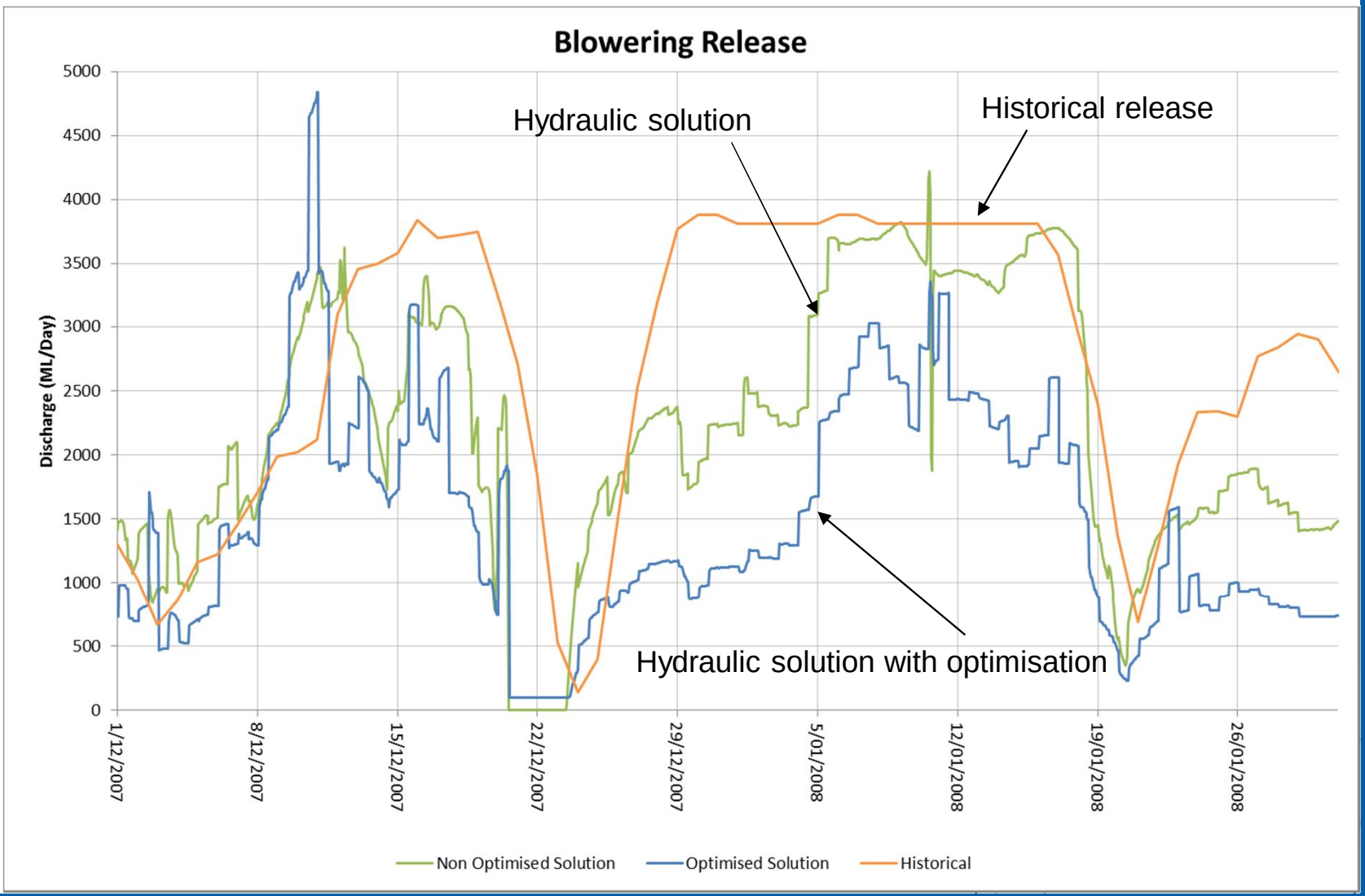
Blowering release

MI Canal release

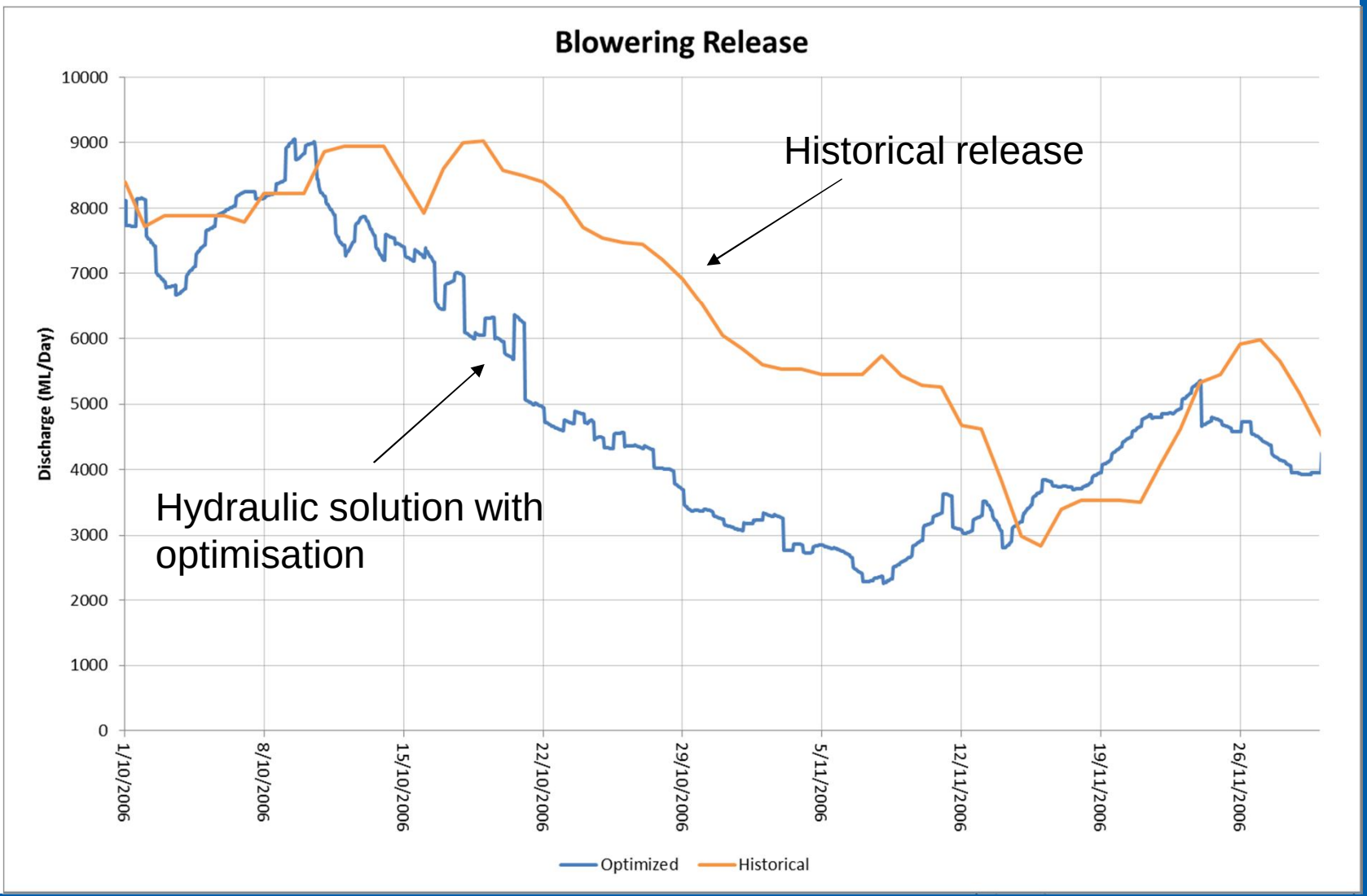
Bundindgery escape flows highly penalised



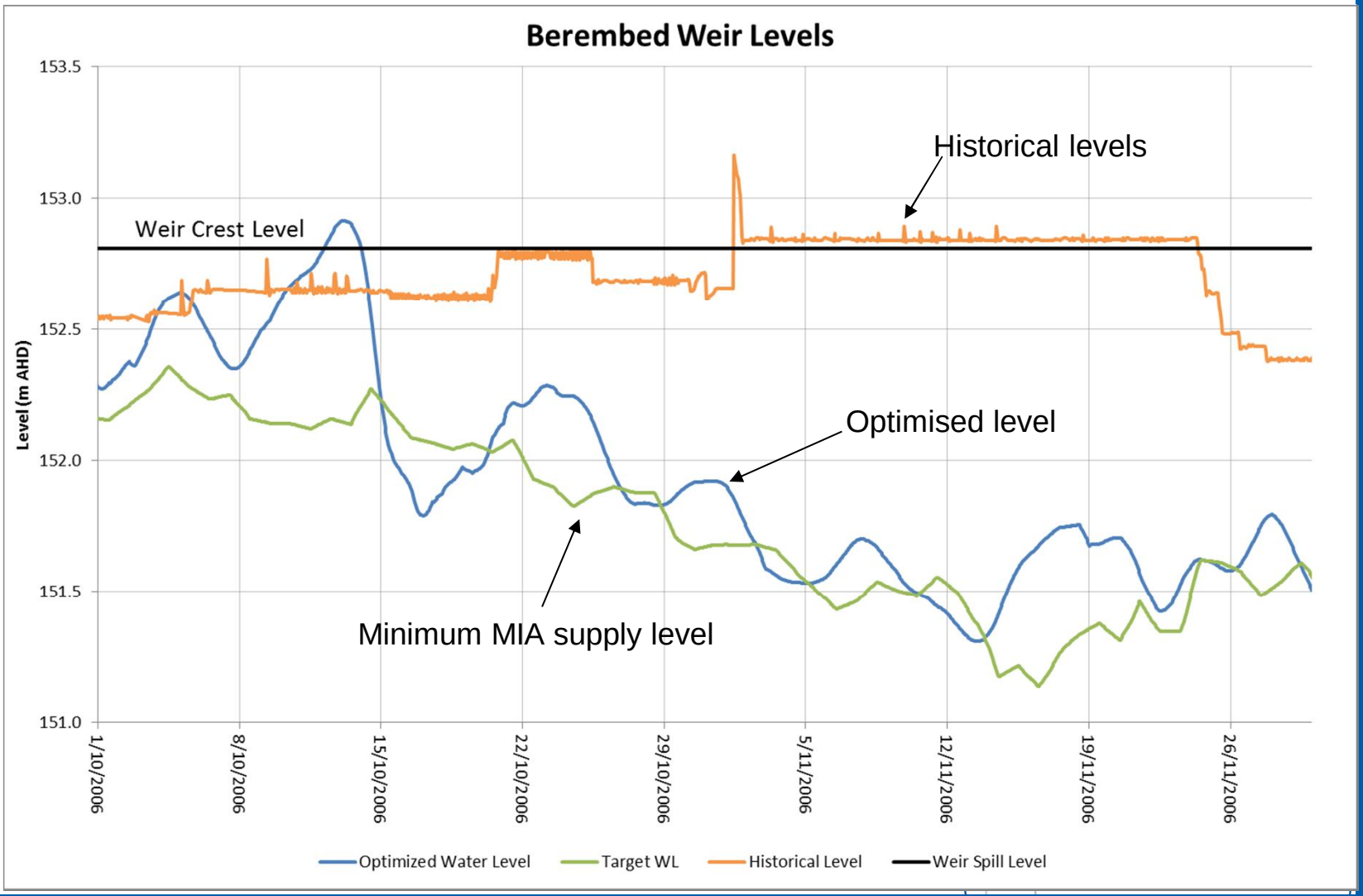
Wet Period: Release from Blowering



Dry Period: Release from Blowering

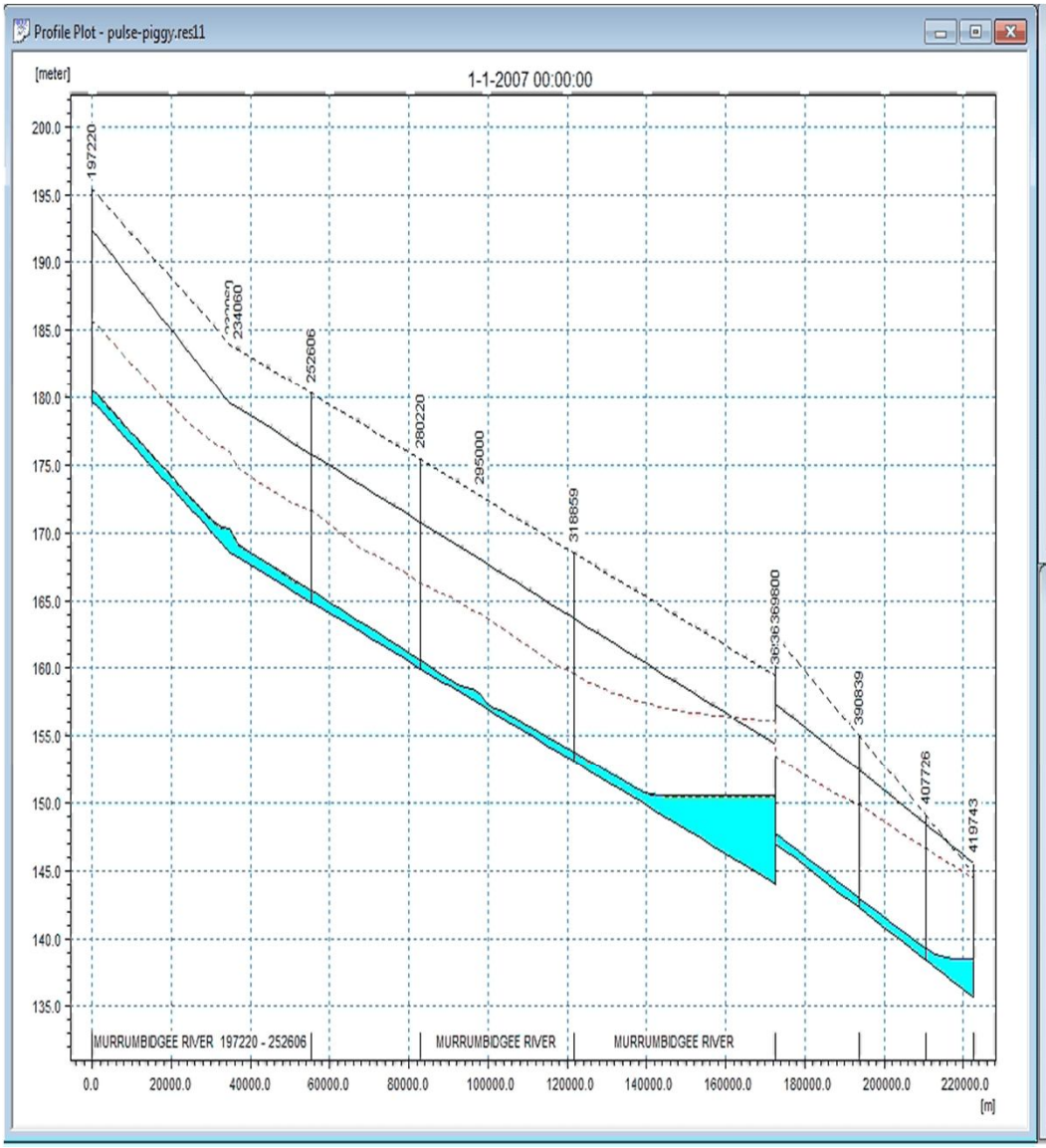


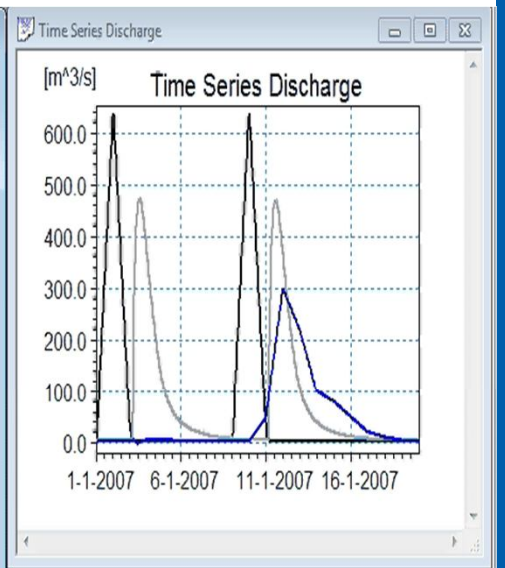
Dry period: Berembed Weir Levels

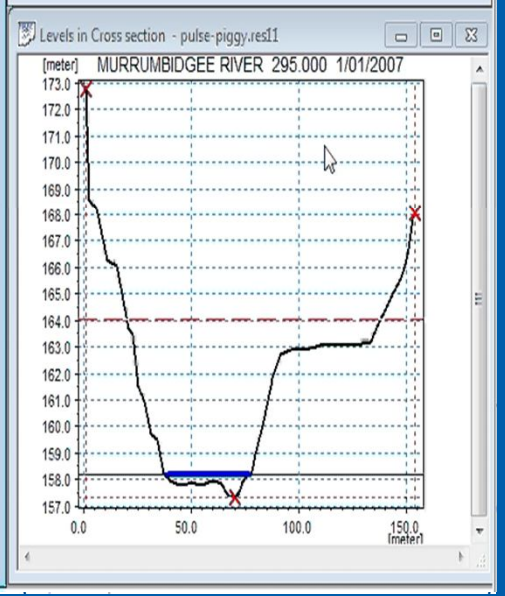


Real river hydraulics

Piggyback example







Environmental and operational benefits

Precision Releases……Efficiency of Operation

Water where and when it matters

- Operational Benefits
  - Automatic optimisation of releases (reduce pressures on operators)
  - Higher efficiencies through higher frequency of gate operations
  - Uses all real time measurements, forecasts and demands
  - Physical quantification of all “unknowns” (river hydraulics, inflows, losses)
  - Improved prediction of supplementary flow events

- Environmental Benefits
  - Improve the “environmental efficiency” of releases
  - Improved accounting of environmental water deliveries
  - Ability to shepherd & Piggyback environmental releases

State water

Taking care of it

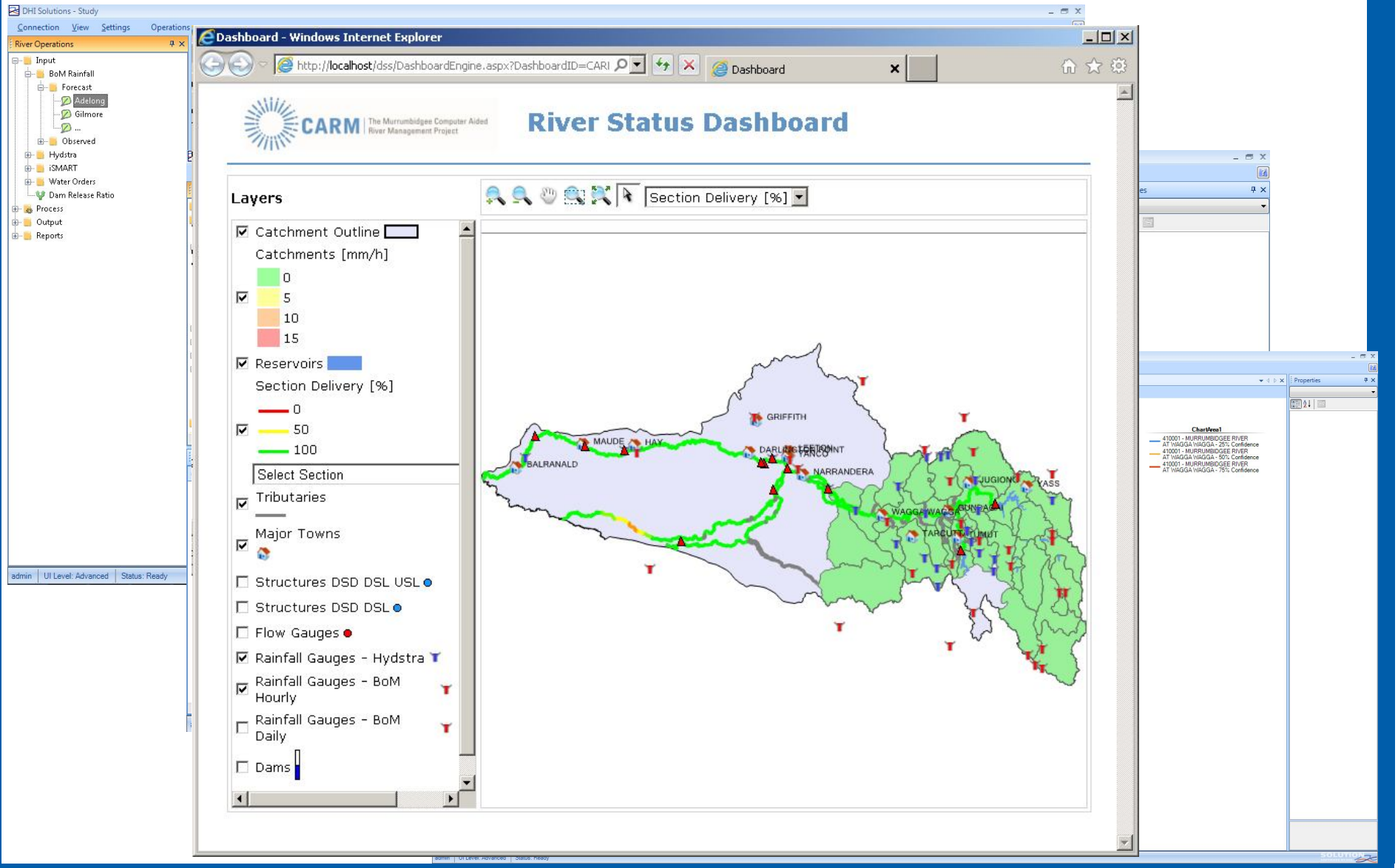
Project milestones

Stage 1	**-** Short listing of vendors (Aug 2009 – May 2010)
Stage 2	**-** Proof of concept evaluation (June 2010-Nov 2010)
Feb 2011	**-** Contract award
June 2011	**-** Real time data integration
July 2011	**-** Burrinjuck inflow model
Oct 2011	- Version 0.7 visual dash board & real time data (Test)
Nov 2011	- Calibrate MIKE models & demand modules
Nov 2011	- Version 0.8 River Operations (no optimisation) (Test)
Feb 2012	- Version 0.9 River Operations with optimisation (Test)
Mar 2012	- Version 0.95 Full Oracle integration (Test)
Apr 2012	- Version1.0 Enhanced with supplementary flows (Test)
Apr 2012	- Version 2.0 Enhanced with environmental flows (Test)
Jul 2012	**-** Release of version 2.6 (Staging)
Oct 2012	**-** Release of version 2.7 (Staging)
Dec 2013	- Version 3.0 Enhanced with operations planning transition to business as usual
Feb 2014	- Reporting modules & documentation
2014	- CARM adoption project
June 2014	- CARM Northern Basin Business Case

State water

Taking care of it

River Operator Tools



System Architecture

- Extensible, Scalable, Modular
  - System can be extended to provide new system capabilities
  - Scalable - system has been applied to river basins of all sizes
  - Many additional standard modules available (e.g. water quality, ecology…)
  - Supports multiple users in different physical locations

- Modular and open architecture
  - Simulation tools are separate from the system architecture
  - Future simulation tools are “plug in”
  - International standards for model interoperability (OpenMI standard)

- River Manager (eWater) Compatibility
  - data compatibility through Oracle
  - Open MI standards for model communications
  - System architecture is open

State water
Taking care of it

Summary

Current operations are suboptimal

- Older technology
- Further efficiency gains are unlikely

Modern technology improves efficiency

- Integrating real time data and simulation models
- Real river hydraulics - more than just box accounting models
- Automatic and computer optimized frequent operations

Precision water deliveries will

- release water from the dams when it's needed
- reduce operational surplus whilst improving reliability for irrigators
- maximise the efficiencies of environmental flow deliveries

State water

Taking care of it

Summary

- Reduced regulated releases – 200GL/yr in Murrumbidgee.
- What to do with the extra water in storage?
- SDL adjustment – unlock the time-value of this water.
- Northern Basin Business Case

State water
Taking care of it