Enhanced catchment water management plans and policies using hydrogeology, salinity, water quality and groundwater-surface water information

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Elements of this talk:

- **Rien** – Key elements of catchment water management plans and policies, catchment hydrogeological framework and water quantity

- **Baskaran** – salinity, water quality and conjunctive water management issues
Key components of catchment water management plans

- Hydrogeological framework
- Water quantity
- Salinity and water quality
- Ecosystems
- Connected water resources
- Catchment water management plans and policies
Upper Lachlan Valley – issues of concern

- Alluvial aquifers are a major groundwater resource, but limited availability
- Intensive agriculture and urbanisation - increased water demand and allocation pressure
- High risk aquifer (contamination) based on NSW state-wide aquifer risk assessment method
- Groundwater quantity, salinity and groundwater quality – water management issues in the catchment
Hydrogeology

- NSWDLWC Data Sources – Geology, Hydrogeology, Drilling, Geophysics, Monitoring Data of Observation Bores
- Climate, Physiography, Land Use
- Geology – Stratigraphy, Structure
- Hydrogeology – Conceptual hydrogeological model
- Hydrochemistry – Groundwater quality, environmental isotopes
Upper Lachlan Valley
Groundwater Management Zones
Upper Lachlan Valley

- Cowra
Viticulture
Elevation
DEM
Digital Elevation Model
Geology

- Cainozoic alluvial sediments in valley
- Palaeozoic rocks
Hydrogeological cross-section

- Top – actual
- Bottom – model

- Aquifers – sand waterbearing beds
- Semi-confining layers - clay
Lachlan Formation sediments
Cowra Formation sediments
Cowra Formation clays
Aquifer thickness
Bore hydrographs

- Water level changes
Groundwater Discharge

Use by waterbores

- Irrigated agriculture
- Pastoral - stock
- Industry
- Towns
- Domestic
Groundwater Quantity

- Recharge of groundwater
  - Groundwater recharge in catchment area
  - Groundwater recharge by river
- Discharge of groundwater
  - Natural discharge
  - Surface water – groundwater interaction
  - Environmental use
  - Artificial discharge (waterbores)
    - Water supply – agriculture
    - Water supply – urban use
Water Management

- Groundwater availability
- Groundwater demand and use
- Effects of development, sustainable yield
- Managing variable water availability, monitoring
- Better allocation and trading regimes
- Planning and regulation of groundwater use and quality
Water quality

- Salinity
- Turbidity
- Nutrients
- Contaminants
Water quality and connected water resources information for better water management

- Salinity and water quality assessment
- Groundwater and surface water interaction – towards conjunctive water management
Sampling locations

- 43 groundwaters and 8 surface waters selected for sampling
- Spatial distribution allowing reasonable representation in the study area
- Sampling in the Lachlan river & bores adjacent to rivers
Field sampling & analysis

Field sampling
- Groundwater sampled using a 50 mm Grundfos pump and surface waters using a telescope sampling pole

Sample analyses
- pH, EC, DO, redox potential and temperature measurement under field conditions
- Sample processing and measurement in the lab for major/minor ions, nutrients and agrochemicals
Low to high salinity groundwaters (257-3,980 μS/cm) whereas medium to high saline surface waters (297-1,894 μS/cm)

Bores along the river bed had low salinity (< 600 μS/cm) and it increases with distance from river

Deep aquifers less saline than shallow aquifers in the Cowra Formation

Salinity situation getting better or worse?
Nitrogen

- Groundwater: 0.002 – 8.0 mg/L
  Surface water: 0.002 - 0.12 mg/L

- Some groundwaters had elevated nitrate-N concentration

- Bores which had elevated nitrate-N were surrounded by irrigated vegetables and broad acre agriculture

- Improved land and water management practices appear to have a positive effect on nutrient transport
Phosphorus

- Groundwater: 0.009 – 0.935 mg/L
- Surface water: 0.009 - 0.12 mg/L
- Highest concentration in one bore – near Cowra sewage treatment plant
- Sources of phosphorus – anthropogenic and biogeochemical processes
- Some groundwaters & surface waters exceeded the national guidelines
Trace elements

- Arsenic, boron, fluoride, iron, manganese, selenium and zinc exceeded the drinking water or irrigation water guidelines in one or more groundwater.

- Some trace elements also exceeded the trigger value for the protection of aquatic ecosystem.

- Sources of trace elements – anthropogenic and biogeochemical processes.
Groundwater & surface water: towards conjunctive water management

Conjunctive water management is the management of hydraulically connected surface water and groundwater resources in a coordinated way….
Recognition of connectivity between Groundwater and surface water

- **Gaining stream**
  - River is gaining water from groundwater

- **Losing stream**
  - River is losing water to the aquifers

- **Increasing demand for water**
- **Impact on the MDB cap on groundwater use**
- **Groundwater use during drought**
- **Groundwater discharge to stream salinity**
Recharge - Groundwater levels and rainfall

Rainfall (mm)

Water level (m)

Recharge - Groundwater levels and rainfall

[Graph showing rainfall and groundwater levels from February 1973 to February 2000, with data points for different locations indicated by GW030359, GW030314, and GW030365.]
Changes in groundwater level and river level

- Groundwater level fluctuations are related to the Lachlan river levels.
- Water flows from river to the aquifers during high flow conditions.
- During low flow conditions groundwater can feed into the river.
Connection between Lachlan River and groundwater

- Oxygen-18 and deuterium isotope data further confirms the relationship between shallow groundwater and Lachlan River.
Upper Lachlan Valley – current water management policies and strategies

- NSW State Water Policy Framework
- Upper Lachlan Groundwater Management Plan (2001)
- Lachlan River Management Plan
- Lachlan Catchment Blueprint (2002)

- Groundwater recharge, salinity, water quality and groundwater-surface water interaction information
Conclusions

- Groundwater salinity is low near Lachlan River and increases with distance from the river.
- National guidelines used to define water quality targets and thresholds.
- Lachlan River and groundwater are hydraulically connected and should be managed together as a single resource.
- This study provides a useful guide for future research, monitoring, water management policies and protection strategies.