

# Spatial analysis of the groundwater resources of the Lower Namoi Valley

Roger C. Johnson

The Regional Institute Ltd  
Suite 139, 102 Longueville Road, Lane Cove NSW 2066  
Ph 02 9420 4001 Fax 02 9420 4002  
[rjohnson@regional.org.au](mailto:rjohnson@regional.org.au), [www.regional.org.au](http://www.regional.org.au)

## Abstract

In 1995 the Department of Land and Water Conservation (DLWC) released a draft management plan for the alluvial groundwater resources of the Lower Namoi Valley. The effect of the plan was to reduce groundwater allocations in the 1996/97 and 1997/98 water years to 75% and 65% respectively of base allocation. In 1997 discussion groups were held to seek community views regarding the social impact of the changes. The comments highlighted the need for greater community access to information that would increase understanding of the technical aspects of groundwater management policy.

This paper presents spatial data collated from DLWC sources using commercially available PC software. Groundwater data from 1968 to 1998 were analysed to determine the impact of abstraction on water levels across the Lower Namoi Valley through two drought cycles. Satellite imagery revealed that piezometers exhibiting extreme fluctuations in water level were located adjacent to high yielding bores supplying irrigation water to cotton fields that were in close proximity to the edge of the flood plain. The effect was observed to be localised and transitory. Implications for groundwater management policy are discussed.

## Introduction

The alluvium of the Lower Namoi Valley spreads out in a fan extending approximately 100 km downstream from Narrabri. The groundwater resources are drawn from alluvial sediments that have been accumulating for more than 15 million years. The volume of water in storage is estimated to be 20 million ML (Little and Ross, 1993).

The groundwater resources have been the subject of extensive monitoring over the past 30 years. Some 560 piezometers at 240 sites throughout the valley are monitored by DLWC and over 470 licensed bores on 175 properties are metered to obtain usage data. (DLWC, 1995). In 1989, the development and calibration of a groundwater model for the Lower Namoi Valley, based on the available data, was completed (Merrick, 1989).

In 1993, Status Report No 8 (Little and Ross, 1993) found that water levels were steady or rose over much of the area during the period between June 1988 and June 1992. There were minor amounts of localised land subsidence in the north east of Zone 1 due to groundwater extraction (Ross and Jeffrey, 1991).

In 1995, the groundwater model was updated and results presented to stakeholders but not published. In the same year, a draft management policy for the alluvial groundwater resources of the Lower Namoi Valley was released by DLWC. It was based on the results from the groundwater model and Status Report No 8. It concluded that it is "paramount to move away from excessive regulatory controls and to disseminate information

amongst all groups with an interest in the resource and encourage their full participation in the decision making process". It announced significant changes to the scale of conjunctive allocation and a 65% reduction in the groundwater only allocation to be implemented within the following two water years.

In March 1997, an interim groundwater management plan, incorporating status report and management guidelines was released following implementation of the policy for the 1996/97 water year.

The present study, commenced in 1997, sought to better understand the historical and spatial context of the data presented in the various DLWC reports.

## Methods

Data was provided by DLWC in three formats at a cost of approximately \$200.

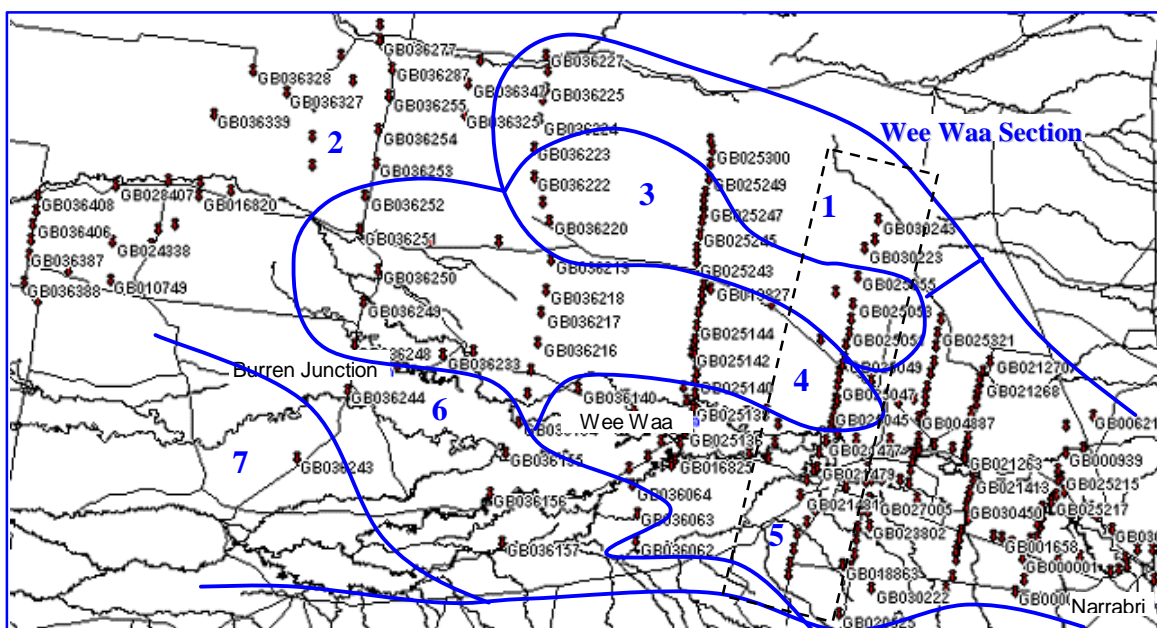
1. Point source data: A self extracting DBF file (800 Kb) containing 126,631 bore log records in the Namoi Valley from 1966 to 1996, rainfall and river flow data.
2. Vector data: Three DXF files containing the location of roads (278 Kb), rivers (482k) and the location of 18,000 bores in the Barwon region (4,731 Kb).
3. Raster data: False colour Landsat TM satellite image bands 5,4 & 3 captured November 1994, provided on CD as a TIFF image (33 Mb).

The point source data was extracted and opened in Microsoft Access, split into several smaller files and analysed in Microsoft Excel to produce charts of water level over time and space. The vector and raster data were combined using MapInfo version 4.5.

## Results and discussion

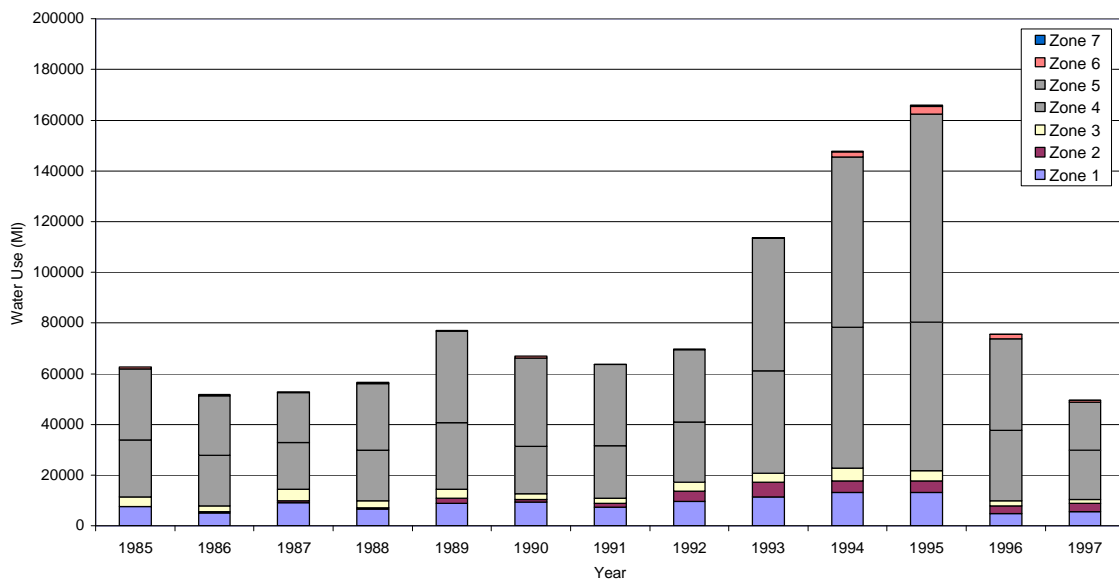
Groundwater levels are monitored at regular intervals at a series of piezometers transecting the valley (Figure 1). The alluvium has been divided into seven zones on the basis of groundwater characteristics (Little and Ross, 1993).

Figure 1 Locality map of the Lower Namoi Valley showing boundaries of the seven groundwater zones and location of piezometers and the Wee Waa Section.



There was a significant increase in groundwater use across the valley in 1993-1995 due to drought (Figure 2). The greatest increase occurred in Zones 4 and 5, triggered predominantly by the conjunctive allocation scale that enabled conjunctive users, at the time, to increase groundwater use from 1.5 ML/ha in a year of 100% surface allocation to 4.0 ML/ha in a year of zero surface water allocation (as occurred in 1994-95). Conjunctive use increased from approximately 20,000 ML in 1992 to 90,000 ML in 1995 while groundwater-only use increased from approximately 45,000 ML to 70,000 ML.

Figure 2. Cumulative Zone groundwater use from 1985 to 1997 (DLWC data)



Data from the 1982 drought period provide a useful historical context (Table 1) with water use decreasing from 143,846 to 31,981 following the drought, consistent with the reduction in water use in Zones 4 & 5 in 1996-97.

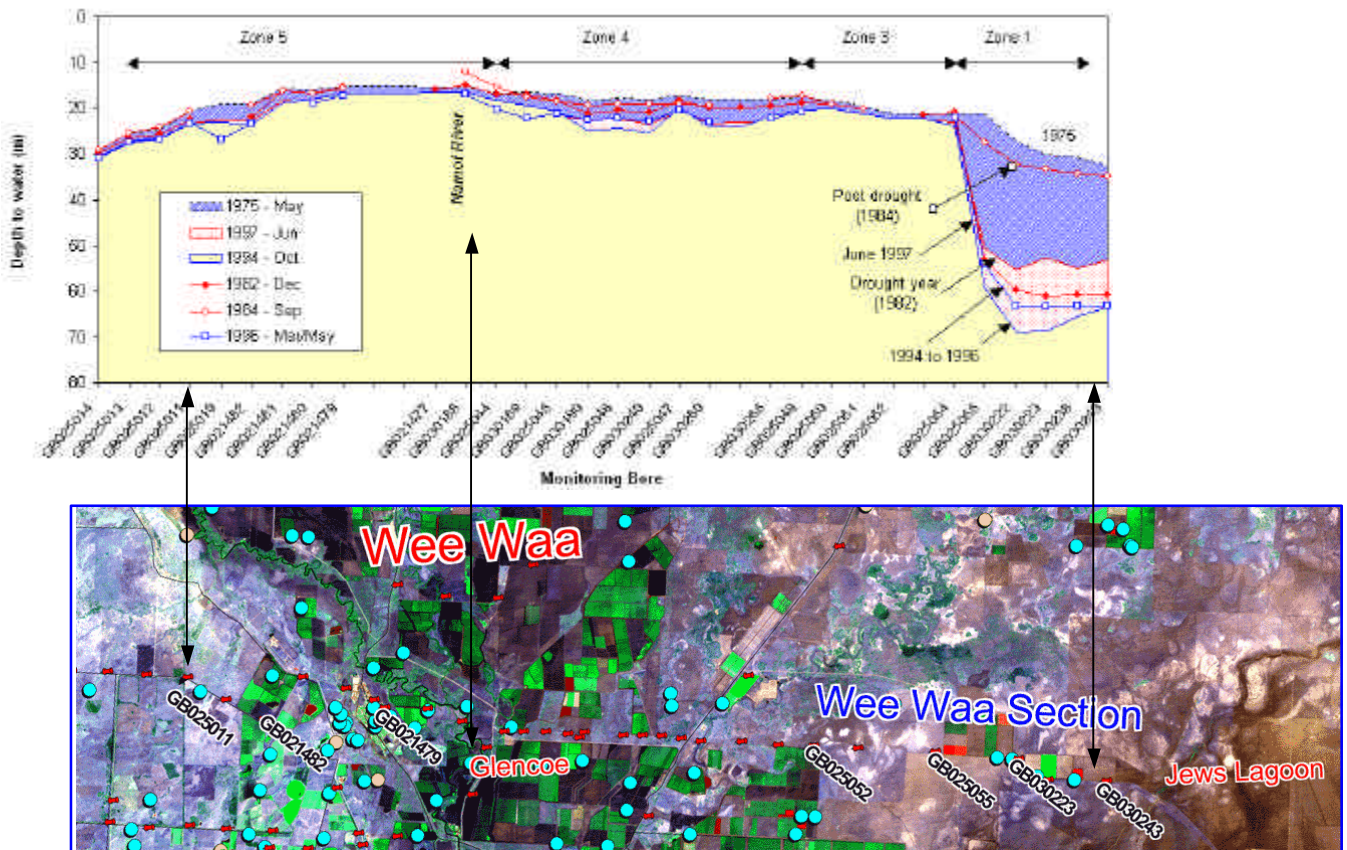
Table 1. Rainfall and water use from 1981 to 1986 (after Merrick, 1989)

Year	Wee Waa Rainfall (mm)	Groundwater use (ML) (September-August)
1981-82	438	119,103
1982-83	649	143,846
1983-84	845	31,981
1984-85	442	65,036
1985-86	427	64,234
mean	560	
Longterm mean	587	

The Interim Groundwater Management Plan and Status Report (March, 1997) presents key hydrographs from selected sections along the valley. For the Wee Waa Section, only Bores No 30243, 30222 and 30225, located in Zone 1 in the northern most part are presented as being representative of trends in groundwater level.

The groundwater levels and associated geo-physical resources across the Wee Waa Section of the Namoi Valley are shown in Figure 3. In zones 4 and 5 which contain the majority of the high yielding bores used for irrigating summer crops, primarily cotton, the fluctuations caused by the drought cycles of 1981-82 and 1992-93 are evident. In Zone 1, at the extreme northern edge of the alluvium, the draw down and recovery levels through the drought cycle suggest that impact of drought on the groundwater levels in the Lower Namoi Valley is localised and transitory

Figure 3. (a) Groundwater levels across the Namoi Valley, Wee Waa Section, from 1975 to 1996, highlighting recovery following 1982 drought. (b) Landsat TM image of the Wee Waa Section showing location of bores installed since 1980.

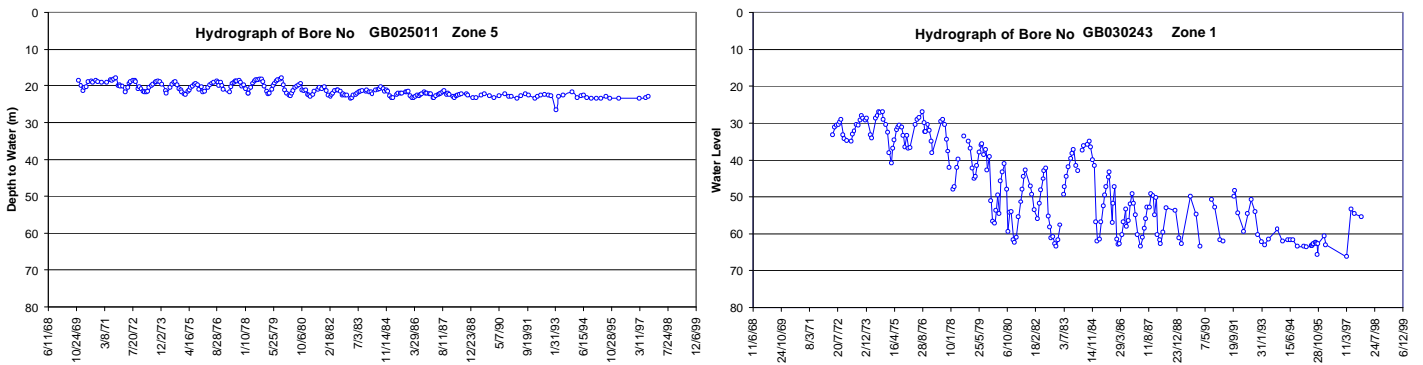


This report is the first time the location of the piezometers has been presented in relation to the associated geo-physical resources (Figure 3b), including the location of high yielding bores for irrigation (blue circles), the associated irrigated cotton fields (green) and the distribution of soil types across the valley as an indicator of the influence of the underlying geology. The possible causes of the dramatic fluctuation in water levels in Zone 1 are clear:

- Location at the edge of the alluvium as highlighted by the change in soil type.
- Proximity to nearby bores used to supply adjacent cotton developments

Hydrographs from piezometer no 30243, 30222 and 25055 are presented in the management plan (DLWC, 1997) as representative of trends in water level across the valley. However Figure 3 suggests they are misrepresentative of overall trends across the valley. Figure 4 shows hydrographs from Zone 5 and Zone 1, plotted at the same scale. Apart from Zone 1 the hydrograph for Zone 5 is typical of the majority of the valley.

Figure 4 Hydrographs for Bore No 25011, Zone 5 and Bore no 30243, Zone 1 showing water levels from 1968 to 1998.



## Conclusion

Spatial data is a critical component of any analysis of natural resources at a catchment scale. It can be easily and cheaply accessed and analysed by any interested member of the community using desk top computer systems. Investment in training and guidelines to facilitate this process would improve understanding of the issues and assist in the development of community based natural resource management policy.

A change in water policy in a catchment represents a re-distribution of wealth in the community. The implementation of changes to groundwater policy in the Lower Namoi Valley occurred within a short time frame, three years, and was based on analysis that did not include available spatial and historical data. This study found that by including historical data and satellite imagery in the analysis, a different picture emerged.

This study found that the dramatic variations in water level exhibited by the hydrographs for Zone 1 were not representative of trends across the majority of the Lower Namoi Valley. It raises the question of the long term impact of short term increases in water use due to drought and the need for site specific groundwater management policy.

## References

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