State of the catchments 2010

Groundwater

Namoi region

State Plan target

By 2015, there is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses.

The intent of the target as defined by the Natural Resources Commission (NRC) is to 'ensure that groundwater continues to support ecosystem function, human health and economic activity'.

Background

The target is broad-ranging in terms of the values that it is attempting to improve. The three key areas addressed by the target are outlined below:

Ecosystem function

Ecosystems that are fully or partially reliant on groundwater to maintain ecosystem function are known as groundwater dependent ecosystems (GDEs). These occur across both surface and subsurface landscapes and are highly variable. GDEs have their species composition and natural ecological processes determined by groundwater (ARMCANZ & ANZECC 1996).

A detailed technical report describes the methods used to derive the information contained in this report. At the time of publication of the *State of the catchments (SOC) 2010* reports, the technical reports were being prepared for public release. When complete, they will be available on the NOW website: www.water.nsw.gov.au.

Note: All data on natural resource condition, pressures and management activity included in this SOC report, as well as the technical report, was collected up to January 2009.

GDEs are classified into six broad types:

- karst and caves
- groundwater dependent wetlands
- aquifers
- base flow rivers and streams
- terrestrial vegetation
- estuarine and near-shore marine ecosystems.

Human health

This element of the target refers to the maintenance of beneficial uses of groundwater by preventing deterioration in groundwater quality or contamination by pollutants. Groundwater pollution can take many forms, ranging from saltwater intrusion and the release of such matrix elements as iron and arsenic from over-extraction, to contamination from pollution events (eg chemical spills, leakages, or contaminated runoff into poorly constructed bores).

Economic activity

Maintenance of a range of beneficial uses (as defined by the NRC) is achieved by keeping groundwater extraction at sustainable levels. This provides a level of security of supply and decreases the risk of contamination and ecological harm occurring from over-extraction.

Within the Namoi region there are alluvial, fractured rock and porous rock aquifer province groundwater management areas (GWMAs). Table 1 identifies the GWMAs in the region. The location of the GWMAs is shown in Figure 1.

Table 1 GWMAs in the Namoi region

Alluvial GWMAs	Fractured rock GWMAs	Porous rock GWMAs
Upper Namoi Alluvium	New England Fold Belt	Great Artesian Basin
Lower Namoi Alluvium	Warrambungle Basalt	Gunnedah Basin
Great Artesian Basin Alluvial	Liverpool Ranges Basalt	Oxley Basin
Peel Valley Alluvium	Peel Valley Fractured Rock	
Miscellaneous alluvium of the Barwon region		

The highest yielding and most actively used bores in the Namoi region are located in the alluvial aquifers. The Upper Namoi and Lower Namoi GWMAs have a water management plan that commenced in November 2006. The level of entitlement prior to the commencement of the plan exceeded the long-term annual average extraction limit (LTAAEL). This is the proportion of the long-term average annual recharge of water to the groundwater system available for extraction. The ten-year plan reduces the level of water entitlements to the LTAAEL. Licence holders have also received structural adjustment through the Achieving Sustainable Groundwater Entitlements (ASGE) scheme to alter their enterprises to the reduced level of entitlement.

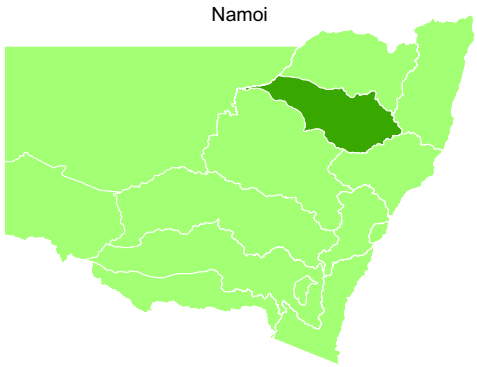
The Peel Valley Alluvium is another significant aquifer system in the region. It is highly connected to the Peel River. There is significant use of the system and a management plan was implemented in July 2010 to manage the connectivity between the groundwater and river system.

A water management plan commenced for the Great Artesian Basin (GAB) in July 2008. The plan will ensure the sustainable use of groundwater and protection of GDEs with a dependence on the GAB.

Coal mining and coal exploration are currently occurring in the Oxley Basin and Gunnedah Basin porous rock GWMAs. Mining in these GWMAs has the potential to cause localised impacts and potentially impact on adjacent aquifers.

The New England Fold Belt and Peel Valley Fractured Rock GWMAs have diverse characteristics, a consequence of the broad area they cover. In the upper catchments they contribute flows to streams and are a source of spring flows. These systems support a diverse range of aquatic and terrestrial ecosystems, either directly or indirectly. They also ensure the availability of stock and domestic water for landholders.

Map of the catchment



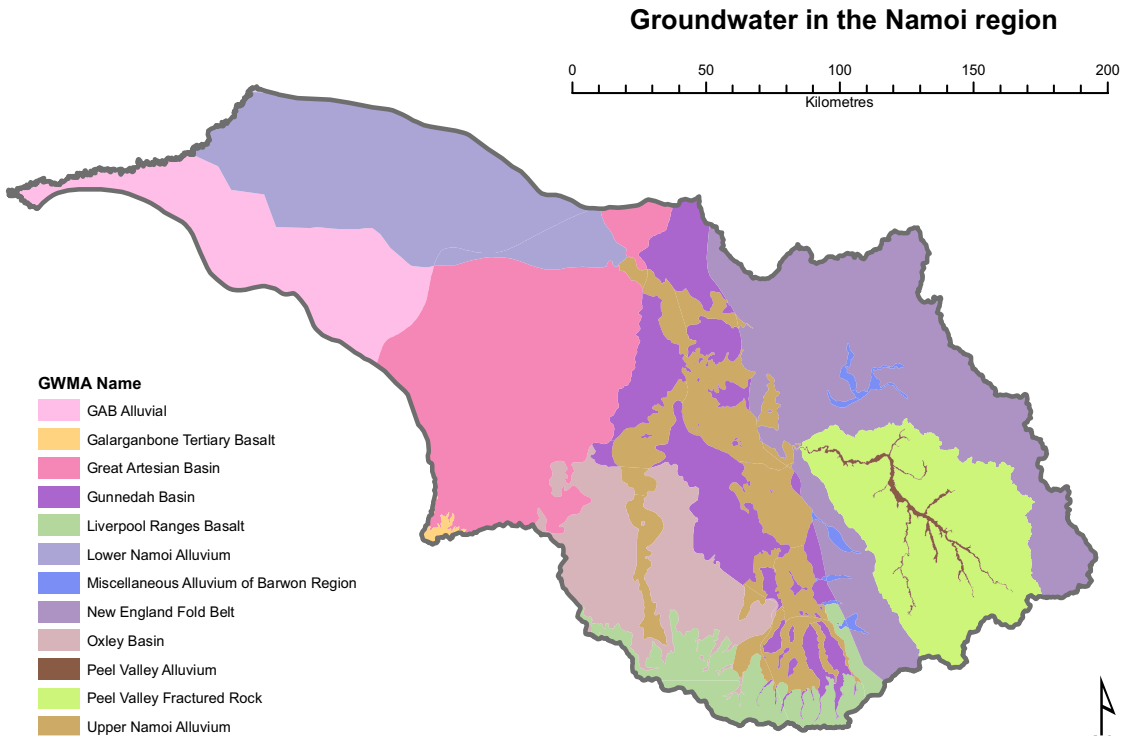


Figure 1 Namoi region groundwater management areas

Assessment

The assessment of condition and pressure for the groundwater aquifers in the region has been based on the GWMAs. The assessment focuses on the whole of each GWMA, including the areas extending beyond the Namoi region.

Current monitoring focuses on the influence of groundwater use on groundwater levels. Monitoring is concentrated in the areas of groundwater use for irrigation and commercial and town water supply. It consists of the monitoring of groundwater levels and metering of use.

The assessment of condition and pressure relative to the target has been based on both available information and expert opinion within the NSW Government. Seven indicators were used to assess both condition and pressure. Of those seven indicators, one was quantifiable for both condition and pressure using available information. The condition indicator quantified is the ratio of the amount of groundwater actually extracted and used in a given year compared with the LTAAEL. The pressure indicator quantified is the ratio of the total annual entitlements for extraction held by licence holders compared with the LTAAEL. Low ratios for these indicators would result in a ranking of 'very good' for condition and 'very low' for pressure.

The other six indicators used for assessing condition and pressure were determined using expert opinion, as current monitoring of aquifer systems in NSW does not provide sufficient data for more comprehensive analysis.

Condition

In addition to the quantifiable indicator of extraction vs LTAAEL, the six other indicators of condition used to asses each groundwater source within the Namoi region are described in Table 2.

Table 2 Description of condition indicators

Indicator	Description
Extraction vs LTAAEL	The total annual usage compared with LTAAEL available for extraction
GDE condition	The condition of GDEs in the region, in terms of their access to the amount and quality of groundwater they require
Landscape condition	The condition of the wider landscape in terms of potential changes caused by land-use to groundwater quality and the volume of water available for recharging the aquifer: Increased recharge causes groundwater levels to rise, which can have an impact on the productivity of agriculture and the condition of urban infrastructure. Taken together, these measures can be used to make an assessment of landscape condition
Regional groundwater levels	Change in regional groundwater levels from the influence of extraction: Where groundwater levels are not monitored, changes in the duration of pumping time that groundwater is available for basic landholder access and other licensed users can be used as a surrogate
Local groundwater levels	Change in local groundwater levels from the influence of extraction
Groundwater quality	Groundwater quality, as measured by the following: • groundwater acidity • groundwater salinity • nutrient concentrations • contamination from heavy metals and hydrocarbons • changes in beneficial use category (resulting from groundwater quality changes) • freshwater/saltwater interface (indicated by electrical conductivity)
Aquifer integrity	The integrity of the aquifer matrix, which can be affected by dewatering and compaction with consequent ground subsidence or upsidence, or by various land-use activities

The Upper Namoi GWMA is divided into 12 management zones to enable a representative analysis of the GWMA. The assessment of condition and pressure has been based on these zones.

The GWMAs in the region are generally in good to very good condition (see Table 3). There is a very poor condition ranking for the indicators of the impacts of localised and regional groundwater use in many of the Upper Namoi zones and in the Lower Namoi GWMA. Groundwater use is causing large variations and declines in groundwater levels.

Groundwater use in a number of the Upper Namoi zones and Lower Namoi GWMA is close to or exceeds the LTAAEL due to the use of supplementary aquifer access licences. The available water from supplementary aquifer access licences will be reduced to zero by 2016. The purpose of these licences is to assist groundwater users to adjust to a level of use equivalent to the LTAAEL. The users are also receiving structural adjustment through the ASGE scheme.

Table 3 Groundwater source condition summary

GWMA no. and name	GDE Condition	Data Confidence	Trend	Landscape Condition	Data Confidence	Trend	Regional Groundwater Levels	Data Confidence	Trend	Local Groundwater Levels	Data Confidence	Trend	Groundwater Quality	Data Confidence	Trend	Aquifer Integrity	Data Confidence	Trend	Percentage Use to the LTAAEL	Data Confidence	Trend	GWMA Condition Index
001 Lower Namoi Alluvium					L	?		H	↔		H	↔		M	↑		H	?		H	↑	
004 Upper Namoi Alluvium Zone 1					L	↔		H	↔		H	↔		L	?		L	?		H	↑	
004 Upper Namoi Alluvium Zone 2					H	↔		H	↔		H	↔		L	↔		L	↔		H	↑	
004 Upper Namoi Alluvium Zone 3					H	↔		H	↑		H	↑		L	?		H	↔		H	↑	
004 Upper Namoi Alluvium Zone 4					M	↔		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 5					M	↔		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 6					M	↔		H	↔		H	↔		L	?		H	↔		H	↑	
004 Upper Namoi Alluvium Zone 7					M	↔		H	↔		H	↔		L	?		H	↔		H	↑	
004 Upper Namoi Alluvium Zone 8					M	↔		H	↑		H	↑		L	?		H	?		H	↑	
004 Upper Namoi Alluvium Zone 9					M	↔		H	↑		H	↑		L	?		H	?		H	↑	
004 Upper Namoi Alluvium Zone 10					M	↔		H	↑		H	↑		L	?		H	?		H	↑	
004 Upper Namoi Alluvium Zone 11		L	?		M	↔		H	↑		H	↑		L	?		H	?		H	↑	
004 Upper Namoi Alluvium Zone 12					M	↔		H	↑		H	↑		L	?		H	↔		H	↑	
005 Peel Valley Alluvium					M	↔		H	↔		H	↔		L	?		H	↔				
023 Miscellaneous Alluvium Barwon Region					M	↔		H	↔		M	↔		H	↔		H	↔				
063 GAB Alluvial					M	↑		H	↔		M	↔		M	?		H	?				
601 Great Artesian Basin		M	?					L	↔		M	↔		L	?		H	?				
604 Gunnedah Basin		L	?		L	?		L	?		L	?		L	?		L	?				
608 Oxley Basin–Inland					M	↔		M	↔		M	↔		L	↔		H	↔				
805 New England Fold Belt–Inland					M	↔		M	↔		M	↔		L	?		H	↔				
813 Warrumbungle Basalt					L	↔		L	↔		L	↓		L	↔		L	↔				
814 Liverpool Ranges Basalt					L	↔		L	↔		L	↓		L	↔		L	↔				
819 Peel Valley Fractured Rock					M	↔		M	↔		M	↔		L	?		H	↔				

Condition

- Very good
- Good
- Fair
- Poor
- Very poor
- No data

Trend

- ↑ Improving
- ↔ No change
- ↓ Declining
- ? Unknown

Data confidence

- H High
- M Medium
- L Low

Generally, groundwater resources in the region are not overused. The highest use is occurring in the Upper Namoi Alluvium zones and the Lower Namoi Alluvium GWMA. The level of groundwater use in the region is shown in Figure 2. Groundwater use in the Lower Namoi Alluvium GWMA is possibly impacting on the groundwater quality. More information on the project (Barret, Williams & Smith 2006) is included in the 'further reading' section of this report.

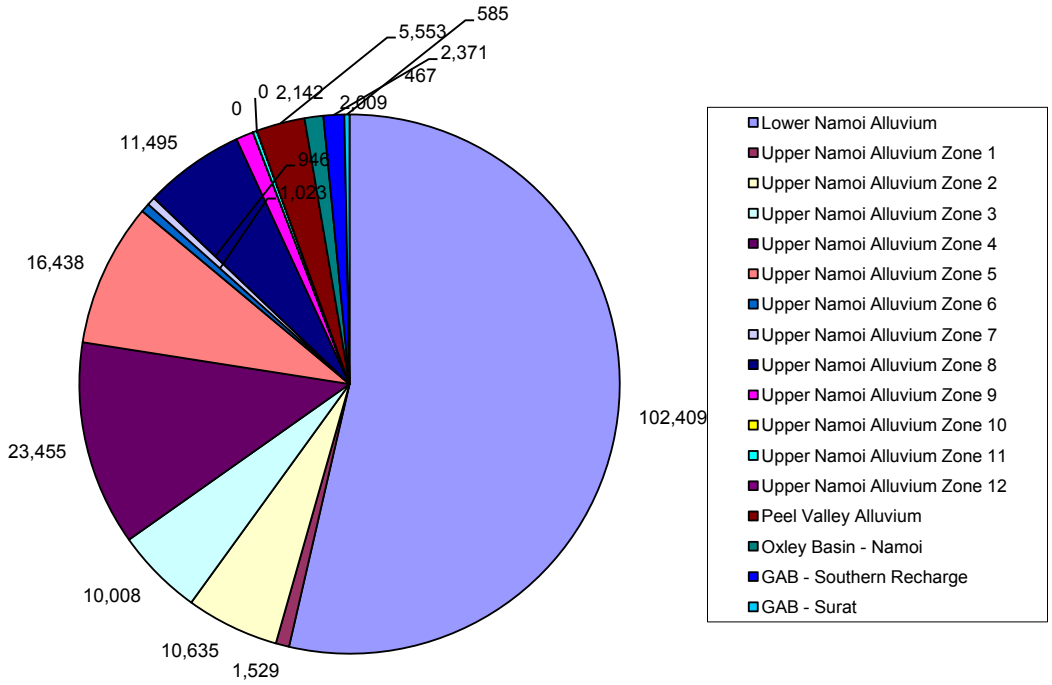


Figure 2 2007–08 metered groundwater use in the Namoi region (megalitres)

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has completed an assessment of the sustainability of the surface and groundwater systems at a catchment scale as part of the Murray–Darling Basin Sustainable Yields Project. The assessment was based on 18 regions representing the major tributaries of the Murray–Darling Basin including the Namoi region. The reports can be viewed at www.csiro.au/partnerships/MDBSY.html.

The condition assessment of the Gunnedah Basin GWMA is based on the area outside of the region and may not reflect the actual condition of the GWMA in the region.

There are significant knowledge gaps in relation to the location, condition and water requirements of GDEs. This is reflected in the assessment of GDE condition in Table 3. In localised areas where there are concerns about the potential impact of groundwater use on GDEs, appropriate licence conditions, such as setting a minimum distance between a bore and a GDE, are implemented to limit the impact of groundwater extraction on groundwater levels and water quality.

A desktop assessment by the former Department of Water and Energy (DWE 2008) identified high priority GDEs in the region, as shown in Figure 3. The desktop assessment methodology does not currently include terrestrial ecosystems.

In the Great Artesian Basin (GAB), depressurisation of the aquifer system has reduced the area that is artesian. This is affecting some terrestrial GDEs that have a reliance on the water. The NSW Cap and Pipe the Bores Program should assist in increasing groundwater pressures and maintaining the GDEs in the region.

A study has been undertaken in the Maules Creek area to identify the ecological impact of the drying up of the creek, caused by groundwater use in the area. Refer to the 'further reading' section for more information in the paper by Serov et al. (2009).

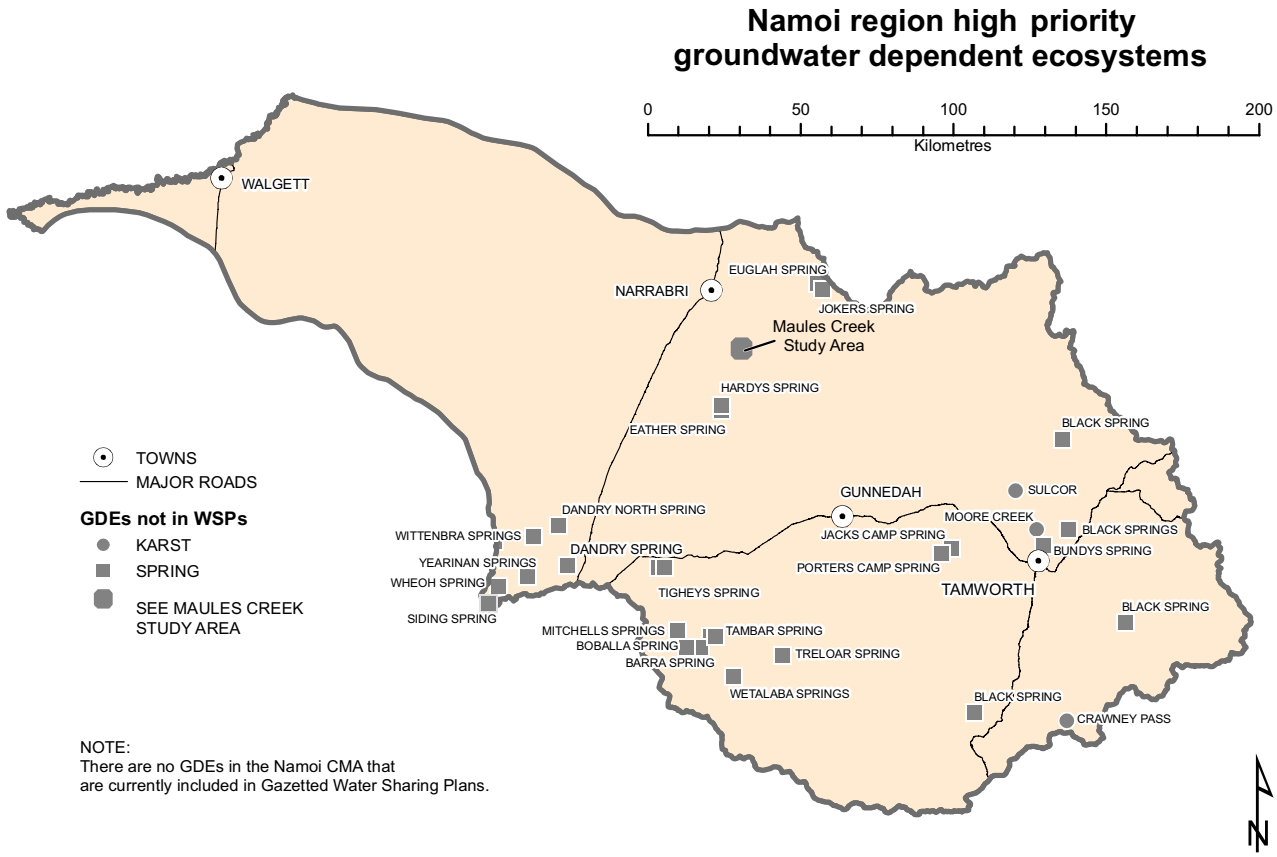


Figure 3 High priority identified GDEs
*** There is a report in preparation for Maules Creek study area – see 'further reading' section**

Pressures

'Pressures' in this report refers to the potential impacts of human activity on the groundwater system. (NB: This is different from the 'pressure' term as used in the discipline of hydrogeology.)

In addition to the quantifiable indicator of entitlements vs LTAAEL, the six other indicators of pressure used to assess each groundwater source within the Namoi region are described in Table 4.

Table 4 Description of pressure indicators

Indicator	Description
Entitlements vs LTAAEL	The total annual entitlements compared with the LTAAEL available for extraction
GDE groundwater availability	The pressure on GDEs from long-term and seasonal changes in groundwater levels, including the influence of changes in groundwater levels in highly connected systems
Land-use pressures	The pressure of land-use on aquifer systems. The indicator also identifies the pressure that shallow groundwater levels place on productive land or urban areas (eg the creation of salinity issues), and combines both these measures into a single indicator

Regional impacts	The extent to which current groundwater extraction could potentially affect regional groundwater levels
Localised impacts	The extent to which current groundwater extraction could potentially affect localised groundwater levels
Groundwater quality impacts	Potential contamination of groundwater from: • various discrete or dispersed sources • migration of water of a lower quality • acidification from exposure of acid sulfate soils through the lowering of groundwater levels • changes to seawater and groundwater interfaces from extraction in coastal sand aquifers
Aquifer structure pressures	The effect on groundwater flow systems from compaction, or changes to aquifer material through groundwater extraction and from the removal of aquifers in mining or quarrying activities

The main pressures in the region are land-use change in the Upper Namoi zones, Lower Namoi and Peel Valley Alluvium GWMAs and groundwater use is above the LTAAEL. In these GWMAs there are localised areas where there is a concentration of groundwater use, which is causing either large annual variations or long-term declines in groundwater levels. The level of use is also placing pressure on the regional groundwater levels and groundwater quality. The implementation of a water management plan in the Upper Namoi zones and Lower Namoi GWMA will reduce allocations to the LTAAEL by 2016, reducing the pressure on these systems. The Peel Valley Alluvium GWMA is included in The Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock WSP, which commenced in July 2010. These pressures have resulted in a poor to very poor ranking for the GWMAs (see Table 5).

The pressure assessment of the Gunnedah Basin GWMA is based on the area outside of the region and may not reflect the actual condition of the GWMA in the region.

There is limited knowledge on the location of GDEs within the region, especially terrestrial ecosystems. Their identification is required prior to any assessment of the pressure on these systems being conducted.

Table 5 Groundwater source pressure summary

GWMA no. and name	GDE Groundwater Availability	Data Confidence	Trend	Land-use Pressures	Data Confidence	Trend	Regional Impacts	Data Confidence	Trend	Localised Impacts	Data Confidence	Trend	Groundwater Quality Impacts	Data Confidence	Trend	Aquifer Structure Pressures	Data Confidence	Trend	Entitlement/Share Component to the LTAAEL	Data Confidence	Trend	GWMA Pressure Index
001 Lower Namoi Alluvium					H	↔		H	↓		H	↔		L	?		M	?		H	↑	
004 Upper Namoi Alluvium Zone 1					H	↔		H	↓		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 2					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 3					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 4					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 5					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 6					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 7					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 8					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 9					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 10					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 11					H	↑		H	↑		H	↔		L	?					H	↑	
004 Upper Namoi Alluvium Zone 12					H	↑		H	↑		H	↔		L	?					H	↑	
005 Peel Valley Alluvium					H	↓		H	↓		H	↓		L	?		M	?		H	↔	
023 Miscellaneous Alluvium Barwon Region					H	↑		H	↔		M	↓		L	?		H	?		H	↔	
063 GAB Alluvial					M	↓		H	↔		M	↔		L	?		H	?		H	↔	
601 Great Artesian Basin		L	↑		M	↔		L	↔		M	↔		M	?		H	?		H	↔	
604 Gunnedah Basin					M	↓		L	↔		L	↓		H	↔		H	↓		H	↔	
608 Oxley Basin–Inland					M	↓		M	↔		M	↔		L	?		H	?		H	↔	
805 New England Fold Belt–Inland					H	↓		M	↔		M	↔		L	?		H	?		H	↔	
813 Warrumbungle Basalt					M	↔		L	↔		L	↔		L	?		H	?		H	↔	
814 Liverpool Ranges Basalt					H	↔		M	↔		H	↔		L	?		H	?		H	↔	
819 Peel Valley Fractured Rock					H	↔		M	↔		M	↔		L	?		H	?		H	↔	

Pressure

- Very low
- Low
- Moderate
- High
- Very high
- No data

Trend

↑	Increasing
↔	No change
↓	Decreasing
?	Unknown

Data confidence

H	High
M	Medium
L	Low

Management activity

Regional initiatives

The State Plan natural resource management targets are being addressed through state, regional and local partnerships. The catchment action plans (CAPs) and the investment programs that support the CAPs are the key documents that coordinate targeted projects for the improvement of natural resources across NSW. The CAPs describe the whole-of-Government approach, and specify

regional targets and activities that contribute to the achievement of the state-wide targets. The Namoi CAP can be found at www.namoi.cma.nsw.gov.au/52.html?5.

Land-use planning in the region is primarily achieved through local environmental plans (LEPs). All LEPs in the state are currently being reviewed by local governments in consultation with NSW Government agencies and the local community. The plans aim to ensure that appropriate development occurs in the landscape with consideration of future population demands, economic issues and the protection of natural resources and environmental assets in the area. LEPs are statutory controls against which development proposals are assessed. With respect to groundwater, LEPs ensure that development is prevented or restricted in locations where there is a high likelihood of groundwater contamination or the potential for development to increase salinity within the landscape.

Land-use pressures

Groundwater systems in the Namoi region are influenced by land-use activities such as the regulation of the Namoi River and land clearing. Saline outbreaks occur in the mid and lower slopes of the region. The driver for these outbreaks is recharge to the aquifer system, which is increasing groundwater levels, causing shallower watertables and raising salinity generally in the lower areas of the landscape.

Management activities in the region include investing in revegetation and the management of remnant vegetation and perennial pastures in dryland areas undertaken by the Namoi Catchment Management Authority (CMA).

Groundwater use and entitlement

The groundwater target is being addressed at the state level through water sharing plans (WSP) for groundwater sources where there is over-allocation of entitlements or a need to protect high value ecosystems. The implementation of WSPs, which are plans to ensure the equitable and sustainable sharing of water, will ensure long-term water level management for GDEs and other beneficial uses. However, some groundwater systems in NSW will remain under stress until current processes to reduce use to sustainable levels are complete. Key initiatives to meet this challenge include:

- continuing the implementation of current WSPs
- completing the remaining WSPs in the Murray–Darling Basin by 2011 and elsewhere before 2013
- expanding the existing groundwater level monitoring network through capital funding by the NSW Government
- adjusting future WSPs where necessary to account for climate change impacts
- effectively implementing the monitoring, evaluation and reporting strategy.

There are a number of groups in the region undertaking significant work that is contributing to better outcomes for groundwater systems. These groups include:

- the Caroona Coal Project Community Consultative Committee, which engaged the University of NSW Water Research Laboratory to conduct an independent expert review of proposed groundwater investigations and monitoring by BHP Billiton for the regional exploration phase of the Caroona Coal project
- the NSW Office of Water, which conducts ongoing resource management, has placed an embargo on new bores, undertakes occasional groundwater water quality monitoring, and maps groundwater systems

- Cotton Catchment Communities Cooperative Research Centre, which conducts studies on issues such as water quality and three-dimensional modelling of connectivity of groundwater systems.

Groundwater dependent ecosystems

There are a number of activities being implemented around NSW to better understand GDEs, including:

- a trial remote sensing project to identify terrestrial GDEs in the Lower Macquarie GWMA
- staged spatial mapping of potential GDEs across NSW.

Further reading

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