

State of the catchments 2010

Groundwater

Border Rivers–Gwydir 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 matrix elements such 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 Border Rivers–Gwydir region there are alluvial, fractured rock and porous rock aquifer province groundwater management areas (GWMAs). Table 1 identifies the GWMAs in the region. The locations of the GWMAs are shown in Figure 1.

Table 1 GWMA in the Border Rivers–Gwydir region

Alluvial GWMAs	Fractured rock GWMAs	Porous rock GWMAs
Lower Gwydir Alluvium	New England Fold Belt	Great Artesian Basin
Lower Namoi Alluvium	Inverell Basalt	Gunnedah Basin
GAB Alluvial		
Miscellaneous alluvium of the Barwon region		
Border Rivers Alluvium		

The highest yielding and most actively used bores in the region are located in the alluvial aquifers. The Lower Namoi and Lower Gwydir GWMAs have a water management plan that commenced in October 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 entitlement 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 Border Rivers Alluvium is the other significant alluvial aquifer system in the region. It is connected to the Barwon River, Macintyre River and Dumaresq River. There is consultation between New South Wales and Queensland on the management of the alluvial aquifer system. A temporary trading policy also manages the level of trade to limit growth in potential river losses and manage groundwater use.

The New England Fold Belt GWMA has diverse characteristics because of the broad area it covers. In the upper catchment it contributes flows to streams and is the 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.

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

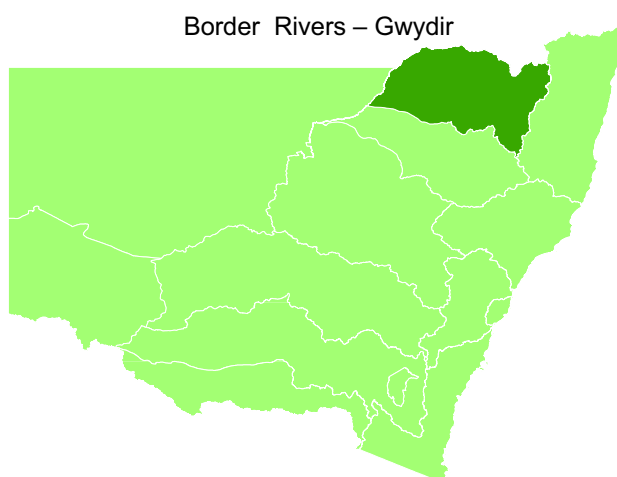
Coal mining and coal exploration are currently occurring in the Gunnedah Basin porous rock GWMA. Mining in this GWMA has the potential to cause localised impacts and potentially impact on adjacent aquifers.

The Great Artesian Basin (GAB) GWMA is the largest porous rock aquifer system in the region and most well known in Australia. The GAB is hundreds of metres thick in the region. It underlies south-western Queensland, north-western NSW and northern South Australia.

The GAB has been experiencing a decline in groundwater pressure associated with many free flowing bores (GABCC 1998). The NSW Cap and Pipe the Bores Program is ensuring that these free flowing bores are rehabilitated and capped, with water piped for domestic and stock purposes.

There are a number of mound springs that are fed by water from the GAB. The decline in groundwater pressure from the GAB is impacting on the condition of the mound springs (Brownbill 2000).

Map of the catchment



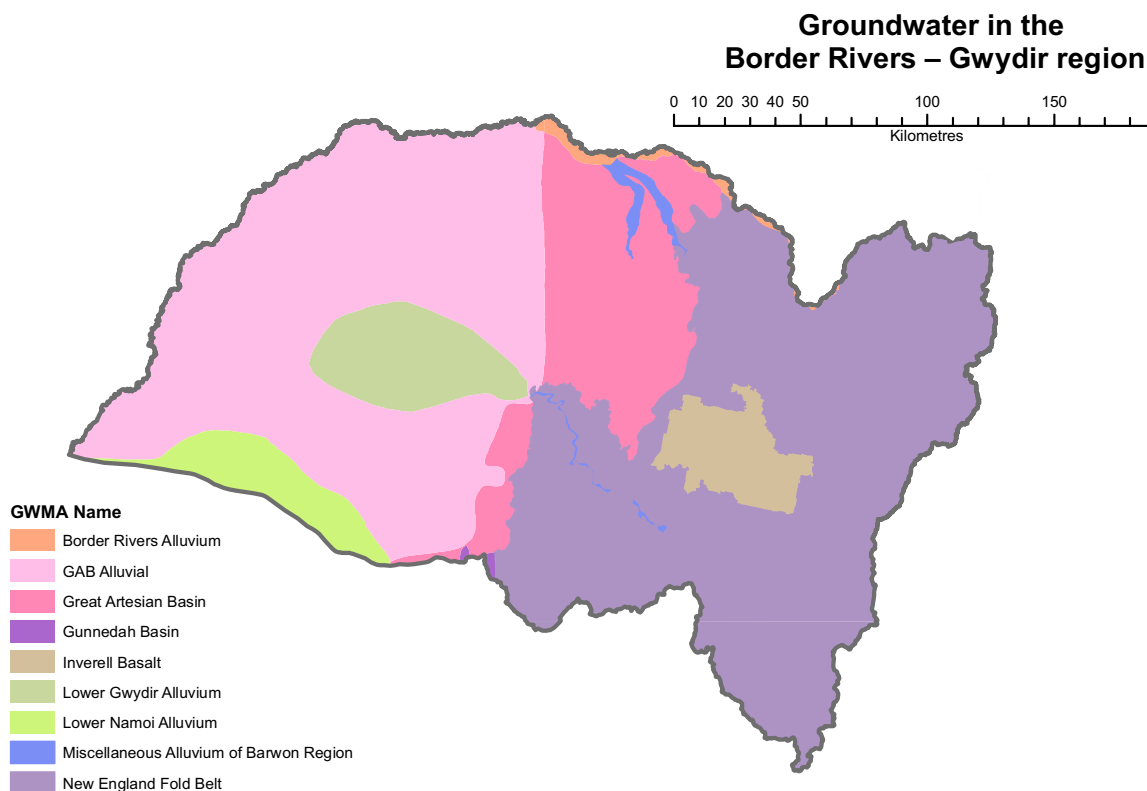


Figure 1 Border Rivers–Gwydir region groundwater management areas

Assessment

The assessment of condition and pressure for the groundwater aquifers in the region has been based on the GWMA's. The assessment focuses on the whole of each GWMA, including the areas extending beyond the Border Rivers–Gwydir region.

Current monitoring focuses on the influence of groundwater use on groundwater levels. Monitoring is concentrated in the areas of groundwater use for irrigation, 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 assess each groundwater source within the Border Rivers–Gwydir region are described in Table 2.

Table 2 Description of condition indicators

Indicator	Description
Extraction vs LTAAEL	The total annual usage compared with the 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: <ul style="list-style-type: none"> • 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 GWMA in the Border Rivers–Gwydir region are generally in good to very good condition (see Table 3). There is a very poor condition ranking for the regional groundwater levels and local groundwater levels indicators in the Lower Namoi and Lower Gwydir GWMA and for the local groundwater level indicator in the Border Rivers GWMA. In these GWMA, groundwater use is causing large variations and declines in groundwater levels. Groundwater use in the Lower Namoi and Lower Gwydir GWMA is close to or exceeding the LTAAEL due to the use of supplementary aquifer access licences. The available water for 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 Achieving Sustainable Groundwater Entitlements scheme.

Table 3 Groundwater source condition summary

	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
GWMA no. and name																						
001 Lower Namoi Alluvium				Green	L	?	Red	H	↔	Red	H	↔	Orange	M	↑	Red	H	?	Orange	H	↑	Yellow
003 Lower Gwydir Alluvium				Yellow	M	↔	Red	H	↔	Red	H	↑	Green	L	?	Green	H	↔	Orange	H	↑	Yellow
022 Border Rivers Alluvium				Green	M	↔	Green	H	↔	Green	H	↔	Green	L	?	Green	L	?	Red	M	↔	Green
023 Miscellaneous Alluvium Barwon Region				Green	M	↔	Green	H	↔	Green	M	↔	Green	H	↔	Green	H	↔				Green
063 GAB Alluvial				Green	M	↑	Green	H	↔	Green	M	↔	Green	M	?	Green	H	?				Green
601 Great Artesian Basin	Yellow	M	?				Green	L	↔	Green	M	↔	Green	L	?	Green	H	?				Green
604 Gunnedah Basin	Green	L	?	Green	L	?	Green	L	?	Green	L	?	Green	L	?	Green	L	?				Green
803 Inverell Basalt				Green	M	↔	Green	M	↔	Green	M	↔	Green	L	?	Green	H	↔				Green
805 New England Fold Belt–Inland				Green	M	↔	Green	M	↔	Green	M	↔	Green	L	?	Green	H	↔				Green

Condition	Trend	Data confidence
	Very good	↑ Improving
	Good	↔ No change
	Fair	↓ Declining
	Poor	? Unknown
	Very poor	
	No data	
		H High
		M Medium
		L Low

Groundwater use in the Border Rivers Alluvium GWMA exceeds the LTAAEL, as the LTAAEL is based only on rainfall recharge and does not include natural river leakage into the aquifer. In other GWMA's in the region, groundwater use does not exceed the LTAAEL. The level of groundwater use in the region is shown in Figure 2.

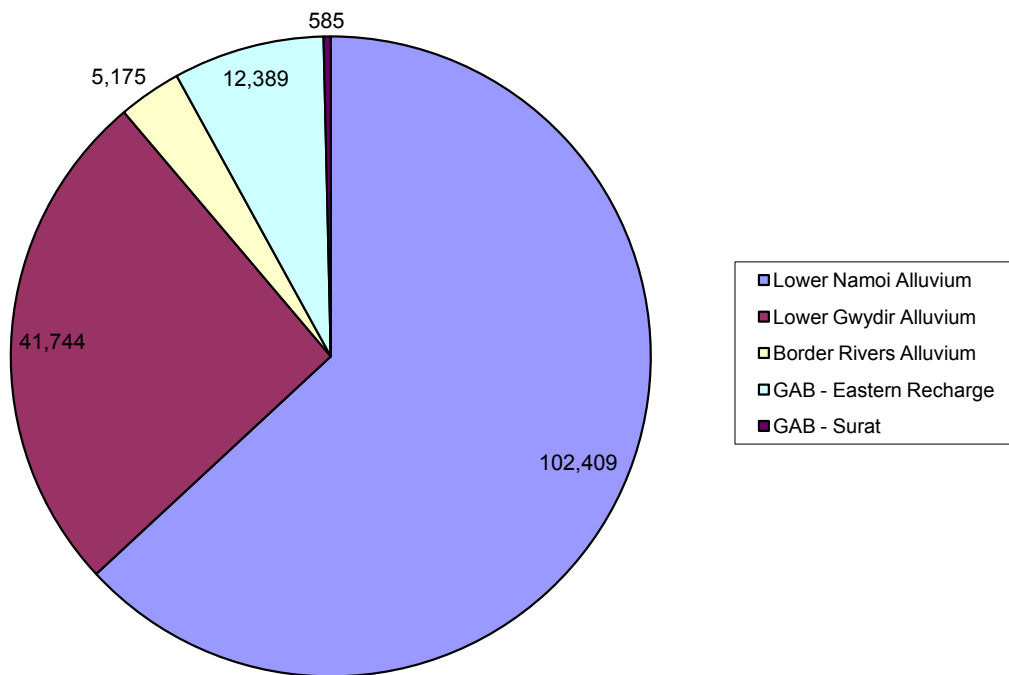


Figure 2 2007–08 metered groundwater use in the Border Rivers–Gwydir region (megalitres)

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 Border Rivers and Gwydir regions. The reports can be viewed at www.csiro.au/partnerships/MDBSY.html.

There is limited information on the condition of GDEs in the Border Rivers–Gwydir region. 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, depressurisation of the aquifer system has reduced the area that is artesian. This is affecting 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.

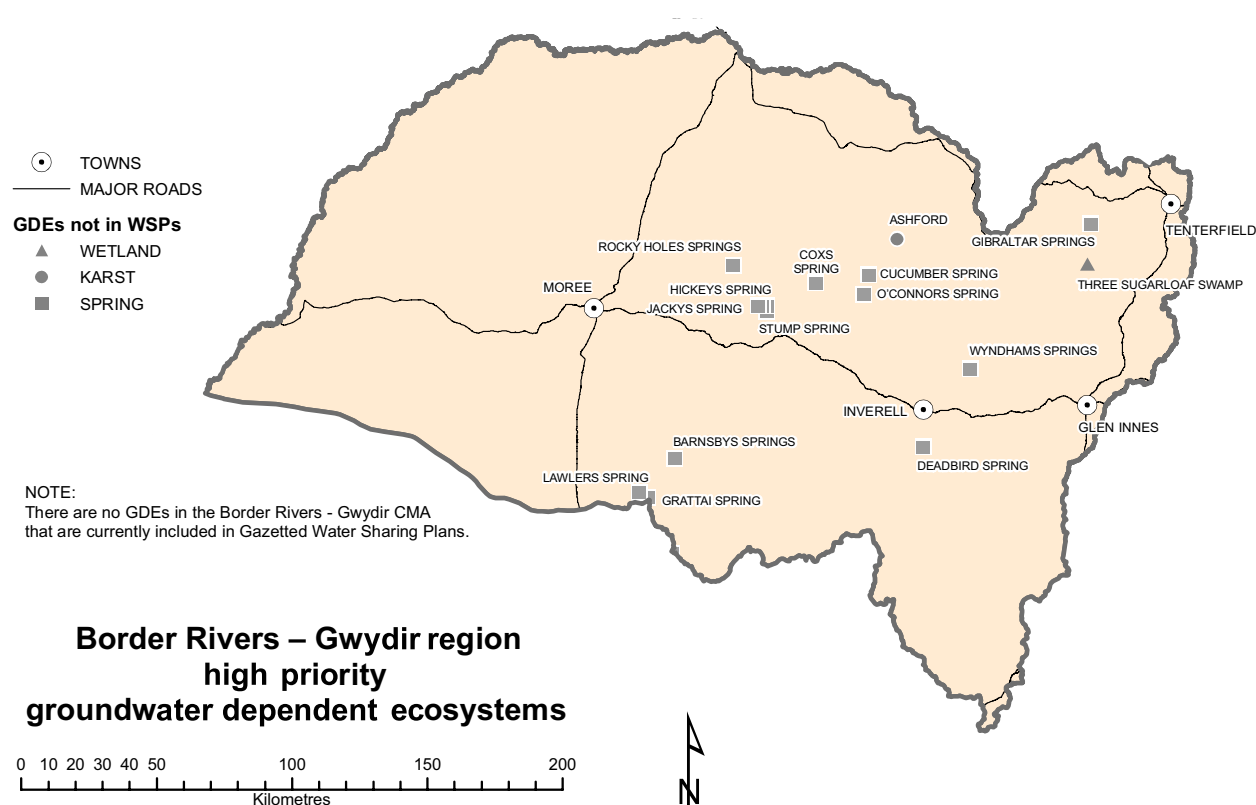


Figure 3 High priority identified GDEs

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 Border Rivers–Gwydir 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	<p>Potential contamination of groundwater from:</p> <ul style="list-style-type: none"> • 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, groundwater use in some GWMA's and the level of entitlement compared with the LTAAEL (see Table 5). The main land-use change pressures are river regulation and agriculture. River regulation has altered the natural river behaviour and its relationship with the associated groundwater aquifers. This has altered the surface water groundwater interaction with the river system. Agriculture has altered the amount of water that leaks through the root zone from rainfall and through irrigation.






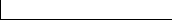
In the Lower Namoi Alluvium, Lower Gwydir Alluvium and Border Rivers Alluvium GWMA's, the level of entitlement exceeds the LTAAEL. In the Lower Namoi Alluvium and Lower Gwydir Alluvium, a water management plan implemented in 2006 will reduce groundwater entitlements to the LTAAEL.

In the Lower Namoi Alluvium, Lower Gwydir Alluvium and Border Rivers Alluvium GWMA's 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 Gunnedah Basin GWMA is a small area in the region. The pressure assessment of the Gunnedah Basin GWMA is based on the area outside of the region.

There is limited knowledge on the location of GDEs within the Border Rivers–Gwydir 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			Land-use Pressures			Regional Impacts			Localised Impacts			Groundwater Quality Impacts			Aquifer Structure Pressures			Entitlement/Share Component to the LTAAEL			GWMA Pressure Index		
	Data Confidence	Trend		Data Confidence	Trend		Data Confidence	Trend		Data Confidence	Trend		Data Confidence	Trend		Data Confidence	Trend		Data Confidence	Trend				
001 Lower Namoi Alluvium					H ↔			H ↓			H ↔		L ?			M ?			H ↑					
003 Lower Gwydir Alluvium					H ↔			H ↓			H ↔		L ?			M ?			H ↑					
022 Border Rivers 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 ↔					
803 Inverell Basalt					H ↓			M ↔			M ↔		L ?			H ?			H ↔					
805 New England Fold Belt–Inland					H ↓			M ↔			M ↔		L ?			H ?			H ↔					

Pressure		Trend		Data confidence	
	Very low	↑	Increasing	H	High
	Low	↔	No change	M	Medium
	Moderate	↓	Decreasing	L	Low
	High	?	Unknown		
	Very high				
	No data				

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 Border Rivers–Gwydir CAP can be found at www.brg.cma.nsw.gov.au/index.php?page=catchment-action-plan.

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 Border Rivers–Gwydir region are influenced by land-use activities such as the regulation of the Border Rivers and Gwydir 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 by the Border Rivers–Gwydir Catchment Management Authority (CMA)
- irrigation water use efficiency projects to reduce leakage past the root zone and reduce the use of excess water carried out by the Border Rivers–Gwydir CMA.

Groundwater use and entitlement

The groundwater target is being addressed at the state level through water sharing plans (WSPs) 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 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 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
- a project identifying the influence of groundwater use or groundwater quality is being undertaken by the NSW Office of Water.

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
- a project to identify GDEs across the region and the volume of groundwater required for the ecosystems to remain viable, carried out by the Border Rivers–Gwydir CMA.

Further reading

- ARMCANZ & ANZECC 1996, *National Principles for the Provision of Water for Ecosystems*, Occasional Paper SWR No 3, Sustainable Land and Water Resource Management Committee, Subcommittee on Water Resources, Canberra.
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