

State of the catchments 2010

Groundwater

Sydney Metropolitan 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 Sydney Metropolitan region there are coastal sands 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 GWMAs in the Sydney Metropolitan region

Coastal sands GWMAs	Porous rock GWMAs
Botany Sandbeds	Sydney Basin–Central
Metropolitan Coastal Sands	

The Botany Sandbeds GWMA is the most actively used aquifer in the region. The aquifer is used in the urban area to supply water for domestic and industrial purposes. The area has been used heavily by industry for at least 100 years. This was largely before any environmental controls were in place, and basic measures to prevent pollution were not considered.

A range of industries operated in the Botany area, such as tanneries, metal platers, service stations and depots, landfills, dry cleaners and wool scourers. As a result, chemicals such as chlorinated hydrocarbons and other solvents, petroleum hydrocarbons (such as petrol and diesel), and some heavy metals such as chromium, nickel, lead and arsenic may have contaminated the aquifer.

Currently, eight sites in the area are regulated by DECCW under the *Contaminated Land Management Act 1997*. Four of these sites have been cleaned up and the remaining four are in the process of being cleaned up.

An order under the *Water Act 1912* prevents the use of domestic bores within an area known to be contaminated. The area of the Botany Sandbeds to which the order applies is shown in Figure 2. The application for new bore licences is also embargoed for the Botany Sandbeds aquifer system, although there are exemptions. The order can be found at www.water.nsw.gov.au/Water-management/Water-quality/Groundwater/Botany-Sand-Beds-aquifer/Botany-Sands-Aquifer/default.aspx.

The northern area of the Botany Sandbeds aquifer system is used by multiple users and is a fresh water aquifer which, like the whole aquifer system, has a high permeability.

The majority of the Sydney Metropolitan region is underlined by Sydney Basin porous sandstone rock. The aquifer is mainly used as a domestic water supply, with some industrial purposes. It is known to be saline in places and is susceptible to contamination due to its permeability.

Map of the catchment

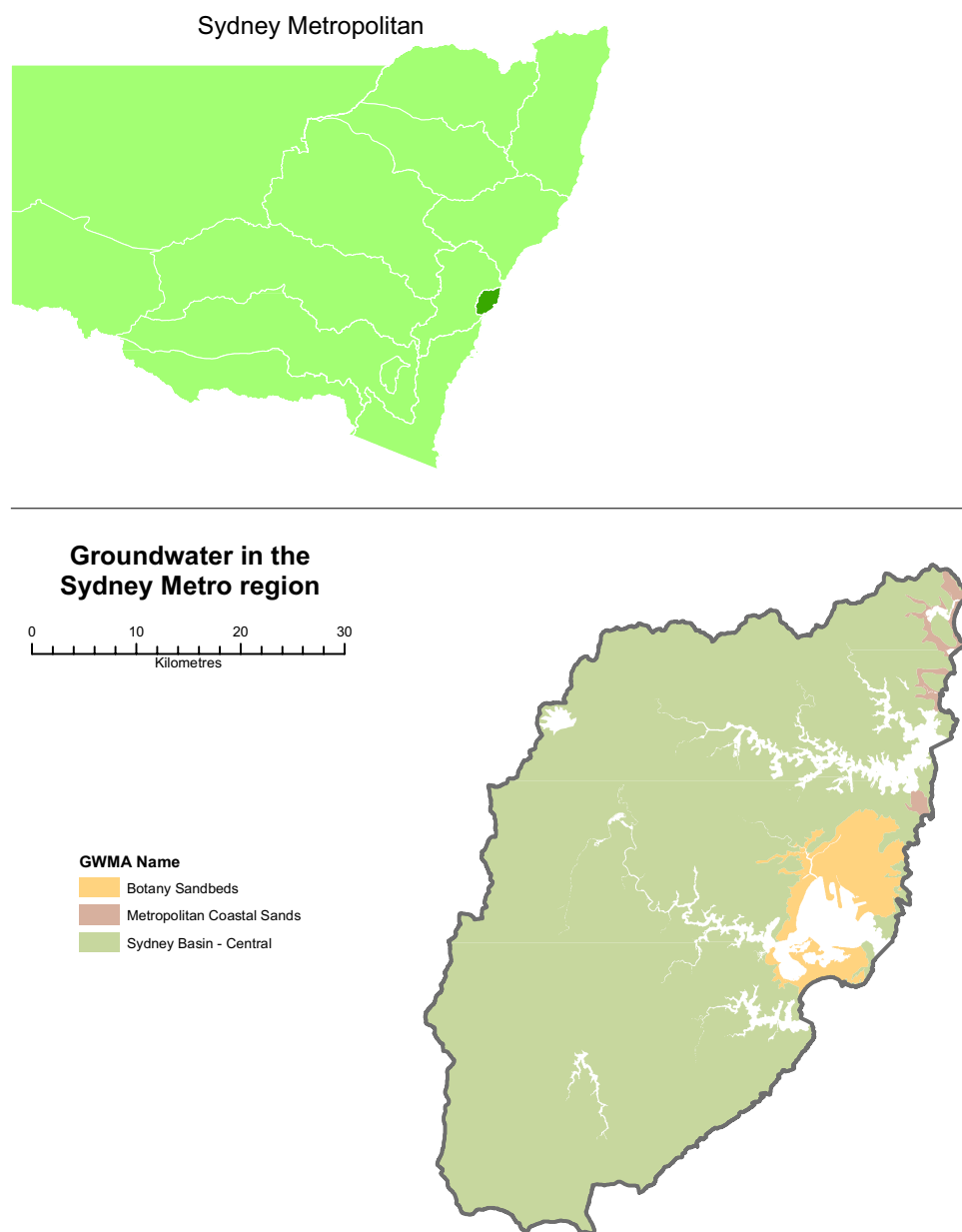


Figure 1 Sydney Metropolitan region groundwater management areas

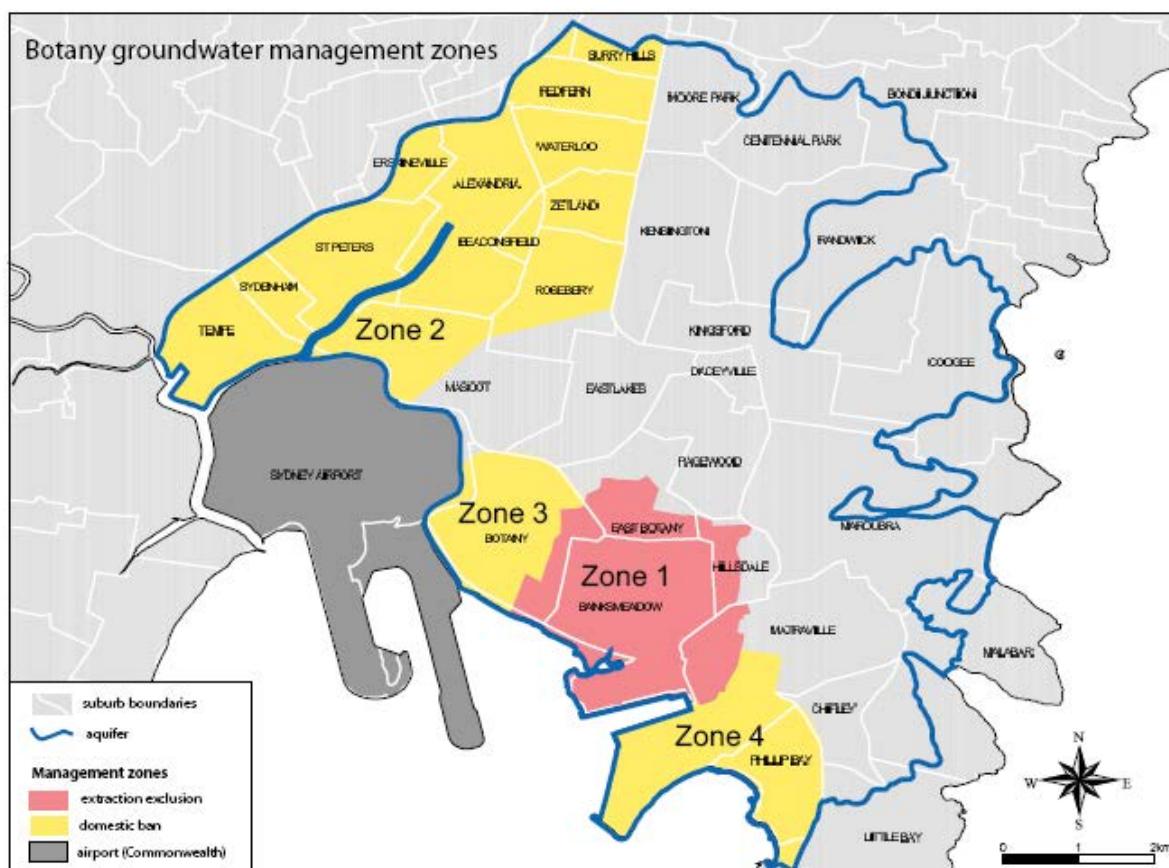


Figure 2 Botany groundwater management zones and exclusion zone (DWE 2007)

Assessment

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

Monitoring focuses on groundwater levels in areas where there is a concentration of groundwater use for irrigation, mining and urban water supply, and areas where there is a close interaction between groundwater and surface water systems.

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 long-term annual average extraction limit (LTAAEL) is the proportion of the long-term average annual recharge of water to the groundwater system available for extraction. 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 New South Wales 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 Sydney Metropolitan 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 Botany Sandbeds and Metropolitan Coastal Sands GWMA are the main aquifers used in the region. These are generally in good to very good condition, except for the area of the Botany Sandbeds GWMA that has been contaminated and is currently undergoing remediation (Table 3). The area influenced by groundwater contamination is shown in Figure 2.

The poor to very poor condition of the Sydney Basin–Central GWMA is based on the influence of mining on the aquifer system that occurs in the GWMA outside the region (Table 3). The declining trend is associated with the continuation and further development of mining in the GWMA.

There is limited information on the condition of GDEs in the 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.

The locations of the high priority GDEs and GDES identified in water sharing plan (WSP) areas are shown in Figure 3.

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																						
018 Botany Sandbeds	Very good	L	?	Good	M	↔	Fair	M	↔	Good	L	↔	Poor	M	↑	Very good	M	↔				Good
067 Metropolitan Coastal Sands				Good	M	↔	Fair	M	↔	Good	L	↔	Good	L	↔	Very good	M	↔				Good
616 Sydney Basin–Central	Very poor	M	↓	Poor	M	↓	Very poor	H	↓	Very poor	M	↓	Poor	M	↔	Very poor	M	↓				Poor

Condition

Very good	↑	Improving
Good	↔	No change
Fair	↓	Declining
Poor	?	Unknown
Very poor		
No data		

Trend

Data confidence

H	High
M	Medium
L	Low

Sydney Metro region high priority groundwater dependent ecosystems

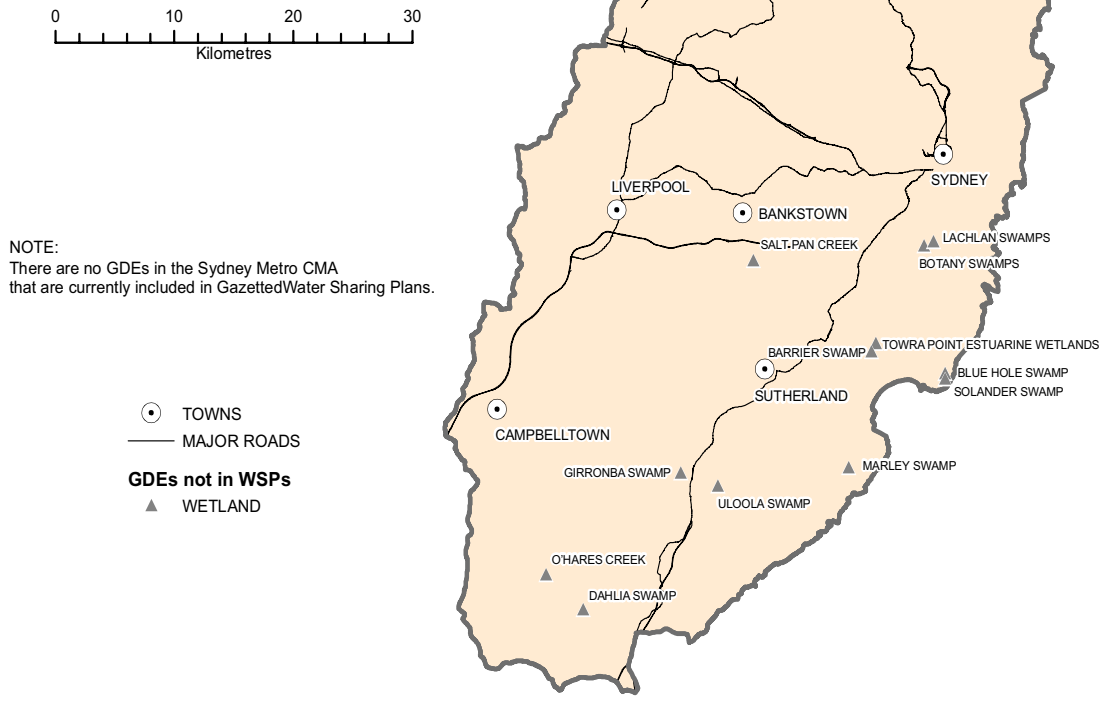


Figure 3 High priority identified GDEs

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 Sydney Metropolitan 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: <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






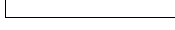
The major pressure on the GWMA in the region is the level of development (Table 5). The pressures on the Botany Sandbeds and Metropolitan Coastal Sands GWMA are associated with contamination and the level of development in the metropolitan area. The main pressure in the Sydney Basin–Central GWMA is mining.

The high pressure rankings for the GWMA are associated with the following:

- Metropolitan Coastal Sands GWMA – the dewatering of the aquifer for the construction of underground car parks has been a significant landscape change in the area. The use of fertilisers and agricultural chemicals on golf courses in the area potentially places pressure on the groundwater quality
- Botany Sandbeds GWMA – the contamination of the aquifer in the industrial area around Botany Bay and the ongoing industrial land-use in the area poses the potential for contamination to occur
- Sydney Basin–Central GWMA – the pressure is due to existing mining activities that cause dewatering of the aquifer and permanently alter the aquifer matrix.

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		
018 Botany Sandbeds	H	↔		H	↑		H	↔		M	↔		H	↔		H	↔		H	↔		
067 Metropolitan Coastal Sands	H	↔		H	↑		H	↔		M	↔		H	↔		H	↔		H	↓		
616 Sydney Basin–Central	M	↓		H	↓		H	↓		H	↓		H	↔		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. A draft of the Sydney Metropolitan CAP has been developed.

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 Sydney Metropolitan region are influenced by land-use activities such as urban development and groundwater contamination. The Sydney Coastal Councils Group has produced a groundwater management handbook that outlines the need for the protection of groundwater resources and the legislative framework for managing groundwater.

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. In the Sydney Metropolitan region, the groundwater resources are subject to a water sharing plan for the metropolitan area.

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:

- 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 number of activities are being implemented to better understand groundwater systems, including:

- the expansion of the existing groundwater level monitoring network
- the implementation of telemetered time series groundwater level monitoring sites in the inland alluvial water sharing plan areas.

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
- assessment of groundwater flow systems in the Capertee and Warragamba areas by the Sydney Metropolitan Catchment Management Authority (CMA), Southern Rivers CMA and DECCW, which will assist with the development of management options for reducing salinity outbreaks and identifying GDEs at risk.

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.

DWE 2007, *Botany Groundwater Management Zones*, Department of Water and Energy, Parramatta, available at www.naturalresources.nsw.gov.au/water/botany_bay.shtml#zones.

DWE 2008, *Process to Identify Potential and Known High Priority Groundwater Dependent Ecosystems*, Department of Water and Energy, Armidale, unpublished.

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