



Water Sharing Plan for the Castlereagh River Unregulated and Alluvial Water Sources

Background document for amended plan 2016



Published by the NSW Department of Primary Industries, Water

Water Sharing Plan for the Castlereagh River Unregulated and Alluvial Water Sources - Background document for amended plan 2016

Published in September 2016. Incorporates amendments to the plan following inclusion of the Castlereagh River above Binnaway Water Source.

This report may be cited as:

Rabbidge T. (2016) Water sharing plan for the Castlereagh Unregulated and Alluvial Water Sources: Background document for amended plan 2016. NSW Department of Primary Industries, Sydney

More information

www.dpi.nsw.gov.au

Acknowledgments

Cartographic map outputs: by James Petrovic, DPI Water as provided for "Water resources and management overview: Castlereagh catchment" by Dayle Green, DPI Water (unpublished).

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Introduction

Water sharing plans are being progressively developed for rivers and groundwater systems across New South Wales following the introduction of the *Water Management Act 2000* (WMA 2000). These plans protect the health of our rivers and groundwater while also providing water users with perpetual access licences, equitable conditions, and increased opportunities to trade water through separation of land and water. In July 2004, 31 water sharing plans commenced in NSW, bringing these water sources and some 80% of water extracted in NSW under the management and licensing provisions of the WMA 2000.

In recent years, water sharing plans for unregulated¹ rivers and groundwater systems have been completed using a broad scale 'macro' approach based on whole river catchments or aquifer systems. Approximately 95% of the water extracted in NSW is now covered by the WMA 2000. The macro planning process was designed to develop water sharing plans covering most of the remaining water sources across NSW. Each macro plan covers a large river basin rather than a single sub-catchment, or in the case of groundwater systems, cover a particular type of aquifer (for example fractured rock). These macro plans generally apply to catchments or aquifers where there is less intensive water use.

General information on the macro planning process is available in the water sharing plans section of the DPI Water website www.water.nsw.gov.au. This includes:

- *Macro water sharing plans - the approach for unregulated rivers. A report to assist community consultation* – explains the method used to classify and set water sharing rules for unregulated streams across the state
- *Macro water sharing plans - the approach for unregulated rivers. Access and trading rules for pools* – explains the method used to set access and trading rules for pools within unregulated sources across the state
- *Macro water sharing plans - the approach for groundwater. A report to assist community consultation* – explains the macro approach to groundwater methodology, including assessment of risk and determination of sustainability indexes for aquifers

This document provides background to the development of the rules in the Water Sharing Plan for the Castlereagh and Alluvial Water Sources, including amendments made in 2016 to incorporate the Castlereagh River above Binnaway which was previously covered by a separate water sharing plan. This document is part of a range of material available specifically on the Castlereagh plan including:

- the *Water Sharing Plan for the Castlereagh River Unregulated and Alluvial Water Sources* – a legal instrument written in its required statutory format
- *Water sharing plans - Inland NSW unregulated and alluvial water sources – Overview* - a plain English version of the plan explaining the key sections and rules
- Rule summary sheets for each water source summarising the proposed water management rules.

¹ The supply of water in unregulated rivers is typically not controlled by releases of water from dams but rather is dependent solely on rainfall and natural river flows.

An amended plan for the unregulated Castlereagh catchment

Until July 2016, the *Water Sharing Plan for the Castlereagh (below Binnaway) Unregulated and Alluvial Water Sources* comprised seven water sources that covered a large percentage of the water extraction within the Castlereagh valley. The catchment above Binnaway was excluded as it was subject to the earlier *Water Sharing Plan for the Castlereagh River above Binnaway Water Source*.

The *Water Sharing Plan for the Castlereagh River above Binnaway Water Source 2003* was part of the first round of water sharing plans developed in NSW. In 2013, following a review of the plan by the NSW Natural Resources Commission, in conjunction with the Department of Primary Industries, Water (DPI Water), the previous NSW Minister for Primary Industries approved the replacement of the plan. The plan, which commenced in 2004, was due to be replaced by June 2016.

The Minister directed that any changes to inland plans should be limited due to the impending development of water resource plans under the Murray-Darling Basin Plan. Proposed changes must be permitted under the WMA 2000, and also need to consider the significant amount of consultation which was undertaken in their initial development.

In line with the review outcome that there would be no change to the intent of the existing plan rules, the *Water Sharing Plan for the Castlereagh (below Binnaway) Unregulated and Alluvial Water Sources 2011*, which commenced on 1 October 2011, has been amended to include the Castlereagh River above Binnaway Water Source.

The merging of this replacement plan with the current *Water Sharing Plan for the Castlereagh (below Binnaway) Unregulated and Alluvial Water Sources* is consistent with the “macro” planning approach i.e. one water sharing plan covering all unregulated water sources within a catchment. It will also bring both plans into line with the current legislative and policy framework for water sharing in NSW.

Changes to the provisions of the 2003 water sharing plan have occurred for a number of reasons including: changes to policy, updates to legislation, updated data, outcomes of audits, and stakeholder requests. As the provisions in these plan areas have been operating for over a decade, and the initial plans were developed in close consultation with stakeholder groups, DPI Water has aimed to avoid unnecessary changes and focus on improving provisions based on the information sources mentioned above.

Purpose of the plan

Why are water sharing plans being prepared?

Expansion of water extraction across NSW in the twentieth century has placed most valleys at or close to the limit of sustainable water extraction. This has seen increasing competition between water users (towns, farmers, industries and irrigators) for access to water. This has also placed pressure on the health and biological diversity of our rivers and aquifers.

In December 2000, the NSW parliament passed the *Water Management Act 2000* (WMA 2000) which has the overall objective of “sustainable and integrated management of the State’s water for the benefit of both present and future generations” (DLWC 2001). Water sharing plans play a major role in achieving this objective by providing a legal basis for sharing water between the environment and consumptive water users.

Under the WMA 2000, the sharing of water must protect the water source and its dependent ecosystems and must protect basic landholder rights. Sharing or extraction of water under any other right must not prejudice these. Therefore, sharing water to licensed water users is effectively the next priority for water sharing. Among licensed water users, priority is given to water utilities and licensed stock and domestic use, ahead of commercial purposes such as irrigation and other industries.

Plans also recognise the economic benefits that commercial users such as irrigation and industry can bring to a region. Upon commencement access licences held under the *Water Act 1912* are converted to access licences under the WMA 2000 and land and water rights are separated. This facilitates the trade of access licences and can encourage more efficient use of water resources. It also allows new industries to develop as water can move to its highest value use.

In conjunction with the WMA 2000, plans also set rules so that commercial users can also continue to operate productively. In general, commercial licences under the WMA 2000 are granted in perpetuity, providing greater commercial security of water access entitlements. Plans also define the access rules for commercial users for 10 years providing all users with greater certainty regarding sharing arrangements.

Benefits for water users

The introduction of water sharing plans will benefit water users by providing:

- greater certainty by setting water sharing arrangements for a 10 year period
- clear trading and access rules which will help foster trading of water
- greater security with existing water licences converted to perpetual water access licences under the WMA 2000

Environmental considerations

Water sharing plans are required to reserve water for the overall health of the river and to protect specific ecosystems that depend on river flows, such as wetlands, lakes, estuaries and floodplains. This share of water reserved for the environment is also intended to sustain the river system’s aquatic fauna and flora.

Unregulated water sources

Rivers naturally experience a range of flows which are necessary for different hydrologic, geomorphic, biological and chemical processes to occur. Flood flows are required to scour channels, rework sediments, and inundate floodplains; medium flows oxygenate water and allow fish passage; and low flows maintain connectivity and assist the survival of aquatic and riparian flora and fauna. To preserve a healthy river system this range of stream flows must be maintained.

Unregulated streams in western NSW experience long periods of no flow interspersed with rare flows of varying magnitude. Fauna and flora have evolved with these conditions and depend heavily on river pools and lagoons which provide refuge during the extended periods of low rainfall and runoff.

In order to protect a proportion of these low flows for the benefit of the environment, the water sharing plan imposes new access restrictions on days when flows are low. This is achieved by establishing 'cease to pump' rules that require users to stop taking water when flow declines below a set level. When the plan commences, surface water licences in all unregulated water sources will be subject to cease to pump rules (excluding licences held by local water utilities, licensed stock and domestic users, and licences used for food safety and essential dairy care²).

Each unregulated water source was classified as having either high, medium or low instream values. Appendix 2 details the features considered when assessing the water source values that are impacted by extraction. High instream value water sources are, by default, protected by the plan by not allowing any trades in. Trades are allowed into some water sources with lower value in order to encourage the movement of extraction from high to lower environmental value areas.

Alluvial groundwater sources

Aquifers are underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be usefully extracted. Aquifers can store large volumes of water, often accumulated over thousands, or even tens of thousands of years. Water enters (or recharges) aquifers via rainfall, surface flows from rivers and lakes, or flow from adjacent aquifers. Water sharing plans aim to achieve sustainable groundwater extraction by limiting extractions to a proportion of the aquifer recharge. The remainder of the recharge is reserved for the environment.

Some groundwater sources are highly connected to surface water, so that taking water from one source affects the other. In groundwater systems defined as 'highly connected', environmental water may also be provided through linked 'cease to pump' rules to ensure taking groundwater does not adversely affect surface water flows.

Water sources are defined as 'highly connected' if 70 per cent or more of groundwater pumped in an irrigation season is derived from stream flow (see section *Managing surface water and groundwater connectivity*). For the purposes of managing surface and groundwater connectivity, the Castlereagh Alluvial Water Source is considered to be less highly connected to the unregulated Binnaway to Gilgandra Water Source.

² There are limited exemptions for licensed stock and domestic and town water supply purposes which allow access to very low flows. See section "Access to very low flow"

Scope of the plan

The amended water sharing plan covers two discrete water resources of the Castlereagh catchment, within what is known as the Central West Water Management Area. Incorporating both these resources into the one plan recognises their interaction and allows for the development of water sharing rules that are linked and are equitable within and between these resources.

The two water resources are:

- the unregulated rivers – now comprising seven discrete water sources which cover all of the rivers and streams in the Castlereagh River catchment
- the groundwater in the alluvial aquifer.

When developing the plan, the level of connectivity, the relative level of impact and the timing of connection between the surface water and alluvial aquifer was considered. Due to the nature of the connectivity between the alluvial aquifer and the river system (i.e. less highly connected), the surface water and groundwater associated with the alluvial aquifer will not be managed as a single resource.

The plan does not cover the aquifers of the porous and fractured rock of the NSW Murray-Darling Basin and the NSW Great Artesian Basin, which are covered in separate groundwater plans.

Water management units

Water sharing plans are developed using various ‘water management units’: water sources, management zones and extraction management units.

The plan area is divided into **water sources**, which often coincide with sub-catchment boundaries. It is at the water source level that water sharing rules are developed. There are 8 water sources in the Castlereagh River Unregulated water sharing plan. Of these, seven are surface water sources and one is a groundwater sources.

Water sources can be subdivided into **management zones** (MZ) where finer resolution of rules is required. In this plan both the Binnaway to Gilgandra Water Source and the Castlereagh River above Binnaway Water Source have been divided into management zones.

Where appropriate, an **extraction management unit** (EMU), consisting of one or several water sources, is specified for the purpose of establishing a geographic area over which the LTAAEL applies. An available water determination (AWD) is made for each licence category within the EMU and any growth in extraction above the LTAAEL is managed across the EMU, not at an individual water source level.

Where an EMU is not specified, the LTAAEL applies to the water source and any growth in extraction above the LTAAEL is then managed at that level.

The Castlereagh Valley Extraction Management Unit is comprised of the seven surface water sources within this plan.

Table 1 provides a summary of the hierarchy of water management units used in this plan. Their spatial extent is shown in Appendix 1.

Table 1: Water management units for this water sharing plan

New water source is shaded in grey

Extraction management unit	Water source	Management zone	
Surface Water			
Castlereagh Valley	Binnaway to Gilgandra	Castlereagh River Binnaway to Gilgandra Binnaway to Gilgandra Tributaries	
	Castlereagh River above Binnaway	Castlereagh River-Timor Dam to Pound Yard Weir Castlereagh River-Pound Yard Weir to Merryula Road Crossing Castlereagh River-Merryula Road Crossing to Belar Creek Confluence Castlereagh River-Belar Creek Confluence to New Mollyann Road Belar Creek Independent Tributaries	
	Castlereagh River below Coonamble		
	Castlereagh River Gilgandra to Coonamble		
	Nedgera Creek		
	Teridgerie Creek		
	Tooraweenah to Coonamble Tributaries		
	Groundwater		
	N/A	Castlereagh Alluvial Groundwater	

Objectives of the plan

The objectives of the Castlereagh River Unregulated water sharing plan are to:

- protect, preserve, maintain and enhance the important river flow dependent and high priority groundwater dependent ecosystems of these water sources
- protect, preserve, maintain and enhance the Aboriginal, cultural and heritage values of these water sources
- protect basic landholder rights
- manage these water sources to ensure equitable sharing between users
- provide opportunities for enhanced market based trading of access licences and water allocations within environmental and system constraints
- provide water allocation account management rules which allow sufficient flexibility in water use
- contribute to the maintenance of water quality
- provide recognition of the connectivity between surface water and groundwater
- adaptively manage these water sources
- contribute to the “environmental and other public benefit outcomes” identified under the “Water Access Entitlements and Planning Framework” in the Intergovernmental Agreement on a National Water Initiative (2004).

Description of the plan area

The Castlereagh River valley

The Castlereagh River valley is located on the central north-western slopes of NSW. The Castlereagh River rises in rugged broken country in the Warrumbungle Ranges near Coonabarabran and flows south-west then north-west for 549 kilometres to its confluence with the lower Macquarie River (Figure 1). The Castlereagh Valley occupies an area of about 17,410 square kilometres. The terrain is predominantly flat with about a fifth of the catchment area undulating to hilly and a small area of mountainous land. The maximum elevation is about 1210 meters.

The river starts from an elevation of around 850 metres and then flows south through hilly country to the town of Binnaway. Downstream, the river sweeps around in a broad curve first to the west and then north-west, through the towns of Mendooran, Gilgandra and Gulargambone. Within this reach of the river the Castlereagh is notable for its extensive in river sand beds. Below Gulargambone the river continues in a north-westerly direction across the flat western plains where elevations are less than 200 metres. The river passes through Coonamble and eventually at the far end of the catchment runs parallel to the Barwon River. In this extreme northern section of the catchment the floodplain between the Barwon and Castlereagh Rivers is intersected by Womat and Wanourie Creeks, which carry flows from the Barwon to the Castlereagh River during major floods. The Castlereagh River joins the Macquarie system close to its confluence with the Barwon River near Brewarrina. The river's discharge is highly variable with large sections of sandy riverbed which is often dry.

Figure 1: The Castlereagh catchment

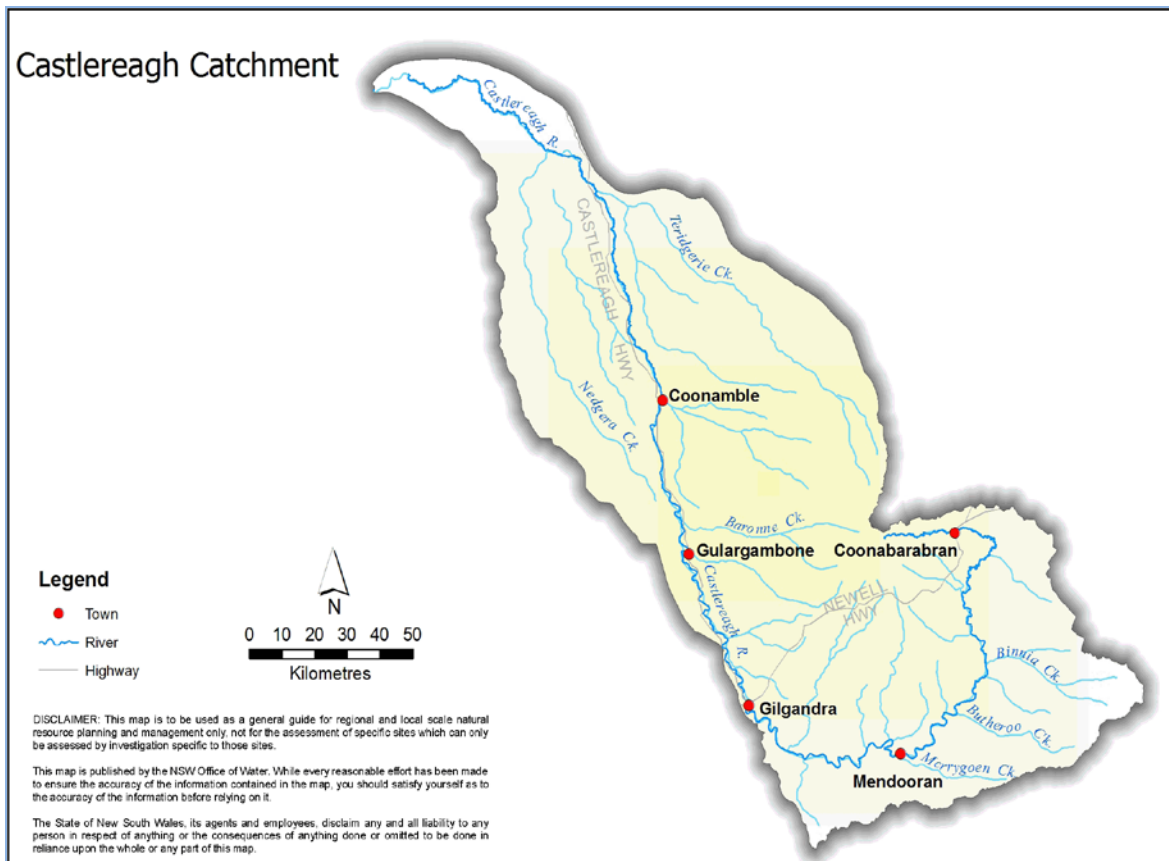
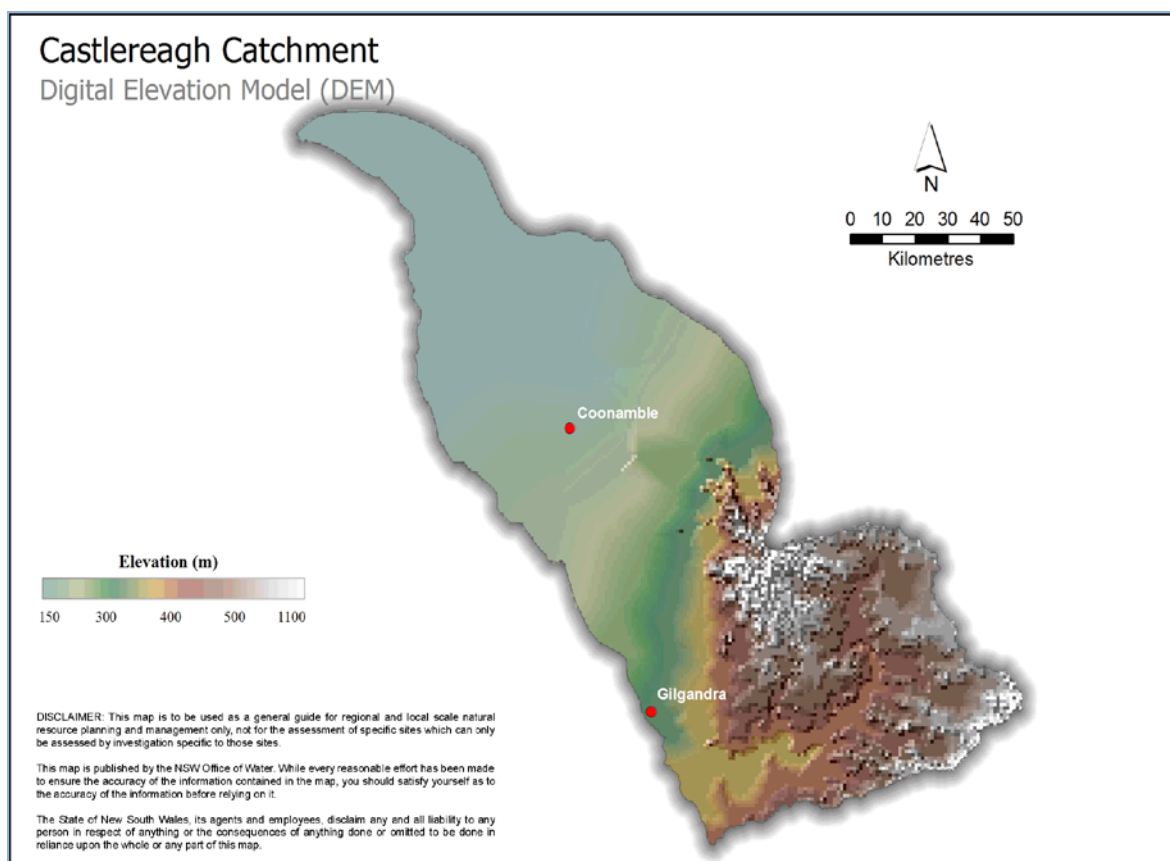


Figure 2: Topography and elevation of the Castlereagh catchment



The Castlereagh is an unregulated river. There is no major storage dam within the catchment however a number of small weirs along the river provide local storage for irrigation, recreation and town water supplies. Land use throughout the catchment is dominated by grazing and dryland cropping. Very little irrigation occurs within the valley.

Approximately 9,000 people live within the towns and villages that are located along the banks of the Castlereagh River. Of these, 86 per cent live in the major towns of Coonabarabran, Gilgandra and Coonamble which all have populations of around 2,500 people. Smaller villages including Binnaway, Gulargambone and Mendooran support populations of 300 to 500 people.

High environmental value areas

There is nearly 76,000 hectares of land conserved within national parks, and conservation areas within the Castlereagh catchment. The larger of these protected areas are located in the upland area (Warrumbungle National Park) and 30 kilometres southeast of Gilgandra (Goonoo State Conservation Area), with the remaining smaller protected areas generally scattered in the eastern third of the plan area.

The Warrumbungle National Park features a rugged volcanic landscape of rocky spires and domes, and deep canyons from where the headwaters of the Castlereagh River begin. It supports a number of vegetation communities including grassy woodlands of white gum and narrow leaved ironbark, rough-barked apple and river red gums along the creek channels, and low shrubby heathlands on more exposed rocky sites (Department of Environment, Climate Change and Water, 2010). A wide variety of fauna are found within the park including a large koala population. It is also the only area in NSW west of the Great Dividing Range where threatened brush-tailed rock-wallabies can be found (National Parks and

Wildlife Service, 1997). The Goonoo State Conservation Area is an area that was converted from State Forest in 2005. The forest comprises the largest remaining area of blue-leaf ironbark in the state and provides habitat for the endangered mallee fowl.

Wetlands

There are very few wetlands within the Castlereagh catchment. The upper catchment is too steep and hilly for the development of wetlands, and many of the floodplain wetlands of the lower catchment have been cleared for agriculture. Kingsford *et al.* (2003) mapped 17,000 hectares of wetlands within the catchment, with most of this area representing two large areas of floodplain woodland and shallow swamps that are associated with Nedgera and Mowlma Creeks on the lower floodplain.

Significant biodiversity

The Castlereagh catchment provides aquatic and terrestrial habitats for a range of threatened species and ecological communities that are protected under the *Threatened Species Conservation Act 1995*.

Within the Castlereagh catchment there are 16 threatened plant species, with six of these listed as endangered. There are also 52 threatened animal species comprising 31 birds, 20 mammals, and one snake. Highly endangered mammals that are found within the catchment include the brush-tailed rock wallaby, bilby, golden bandicoot and burrowing bettong. The largest number of threatened plant and animal species are found in the upper catchment as this is where the most extensive areas of uncleared habitat exist.

The *Fisheries Management Act 1994* lists five aquatic species and one aquatic endangered ecological community that are found within the Castlereagh catchment (Table 2).

Table 2: Threatened aquatic species of the Macquarie-Bogan-Castlereagh catchments

Common Name	Scientific Name	Status
Trout cod	<i>Maccullochella macquariensis</i>	Endangered
River snail	<i>Notopala sublineata</i>	Endangered
Silver perch	<i>Bidyanus bidyanus</i>	Vulnerable
Purple spotted gudgeon	<i>Mogurnda adspersa</i>	Endangered
Olive perchlet	<i>Ambassis agassizii</i>	Endangered Population
Darling River EEC	Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River	Endangered Ecological Community

Land use history

The area covered by the plan lies at the convergence of the territories of three Aboriginal language groups, the Gamilaraay to the northeast, the Wiradjuri to the south and the Wayilwan to the west. Archaeological evidence suggests that Aboriginal people have occupied the land to the east of Gilgandra for up to 25,000 years (Fox, P., 1996. Warrumbungle National Park). Specific Aboriginal sites around Gilgandra that have been identified and studied include rock shelters, open campsites and scarred trees. The large waterhole in the Castlereagh River that characterised Gilgandra provided an attractive location for Aboriginal people. The Coonabarabran tribe of the Gamilaraay people camped

on the eastern side of the river and Mole tribe of the Wiradjuri on the western side (Christison 2009).

At the time of European settlement, the Castlereagh catchment supported a complex mosaic of forests, temperate and semi-arid woodlands, wetlands, shrub lands, heaths and grasslands. Clearing and subsequent degradation has reduced this natural vegetation cover to a large number of small, isolated remnants on the less fertile and productive soils. In many instances the dominant species of those communities, which have been heavily cleared, are still relatively common in the landscape. However, remnants often occur as single trees or small groups of mature or senescent trees. In the case of native grasslands, remnant elements are generally scattered throughout the improved pastures, which dominate much of the region, as well as roadside remnants and travelling stock routes.

The major landform elements of the area are the:

- Liverpool Plains - extensive black soil plains punctuated by low sedimentary and volcanic hills. The grasslands and open woodlands on the alluvial plains and foot slopes of the hills have been mainly cleared and are used for cropping.
- Pilliga Outwash - a gently undulating plain of deep sandy soils formed by outwash from the sandstone hills to the east. Some of the more productive soils around the margins have been cleared for agriculture but most of the higher areas remain covered by State forests.
- Pilliga - contains extensive sandstone hills with areas of higher basalt peaks and has predominantly sandy soils. Much of the forest has been cleared, but there are large areas of State forest, especially on lands with rockier or shallower soils.

In the same manner that the river supported Aboriginal society, European settlement and pastoral and agricultural use of the land has been defined by the Castlereagh River, Terrabile Creek, Tooraweenah Creek and Wallumburrawang Creek for over 170 years.

The first European record of the area was made by George Evans in 1818 who, after being directed north east by John Oxley, discovered the Castlereagh River and described the area between the Warrumbungle Range and the Castlereagh River as “an open plain, over which was rather better travelling...” and “...good open forest country, abounding with kangaroos”.

Squatters established the first runs in the district during the 1830s. Increases in the price of wool in the late 1840s led to changes in land use and an increasing rise to dominance by sheep farming in western New South Wales. The fortunes of pastoralists were given an additional boost by the gold rushes of the early 1850s, which created an increase in demand for meat.

Closer settlement increased the number of people living on the land in the 1860 to 1880 period when wheat growing moved away from coastal areas of NSW. Despite this development, much of the region around Gilgandra continued to be characterised by large cattle and sheep runs. Droughts, floods and adverse market conditions combined to drive many smaller and more marginal property holders off the land (Christison 2009).

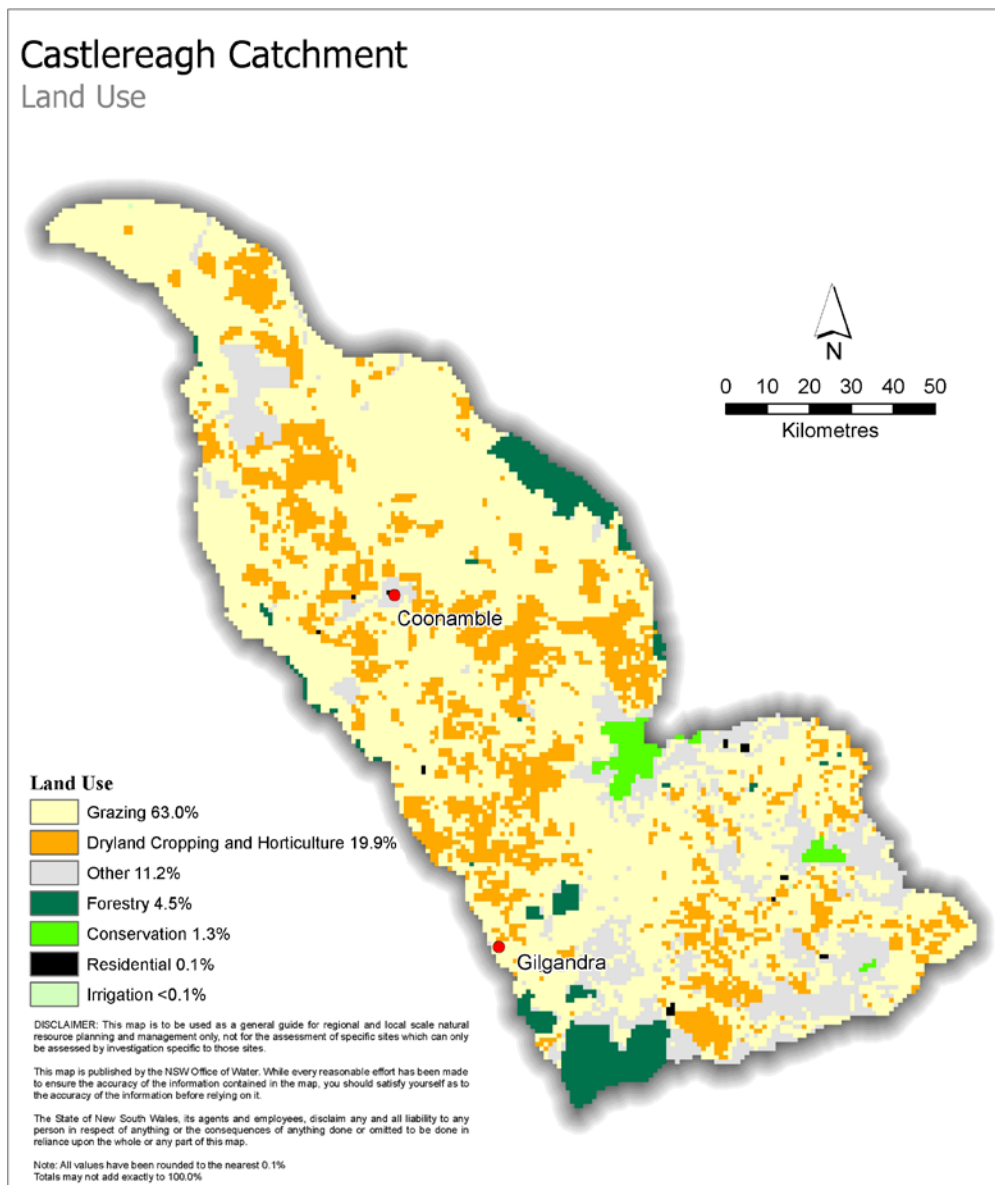
Today the Castlereagh catchment is predominantly an agricultural area with sheep and beef cattle grazing occupying 63 per cent of the catchment and winter cereal cropping being the other main farming enterprise (see Table 3 and Figure 3). Cropping includes cereals (wheat, barley, oats, rye and sorghum), oil seed crops (canola, safflower, sun flower and linseed) and legume crops (chick peas, field peas, faba beans, cow peas and lab lab).

Table 3: Land use types in the Castlereagh catchment

Land use category	Area (ha)	Proportion of catchment (per cent)
Grazing	1,096,054	63.0
Dryland cropping and horticulture	346,386	19.9
Other	195,210	11.2
Forestry	78,040	4.5
Conservation	22,234	1.3
Residential	2,398	0.1
Irrigation	327	<0.1
TOTAL	1,740,650	100.0

Source: 2001/02 Land use mapping of Australia, Bureau of Rural Sciences

Figure 3: Land use in the Castlereagh catchment



There are also some small mixed farming enterprises including areas growing olives, native and cut flowers and lavender as well as raising emus, buffalos and silver perch.

Farming is the basis for the Castlereagh valley's economy and the major towns of Coonabarabran, Binnaway, Gilgandra, Gulargambone and Coonamble all have a proud history as agricultural service centres. These towns are also the centres for business and community and provide access to jobs, shops, services, leisure and recreational facilities. There are a number of smaller rural villages scattered across the valley, which offer a variety of services for the local community.

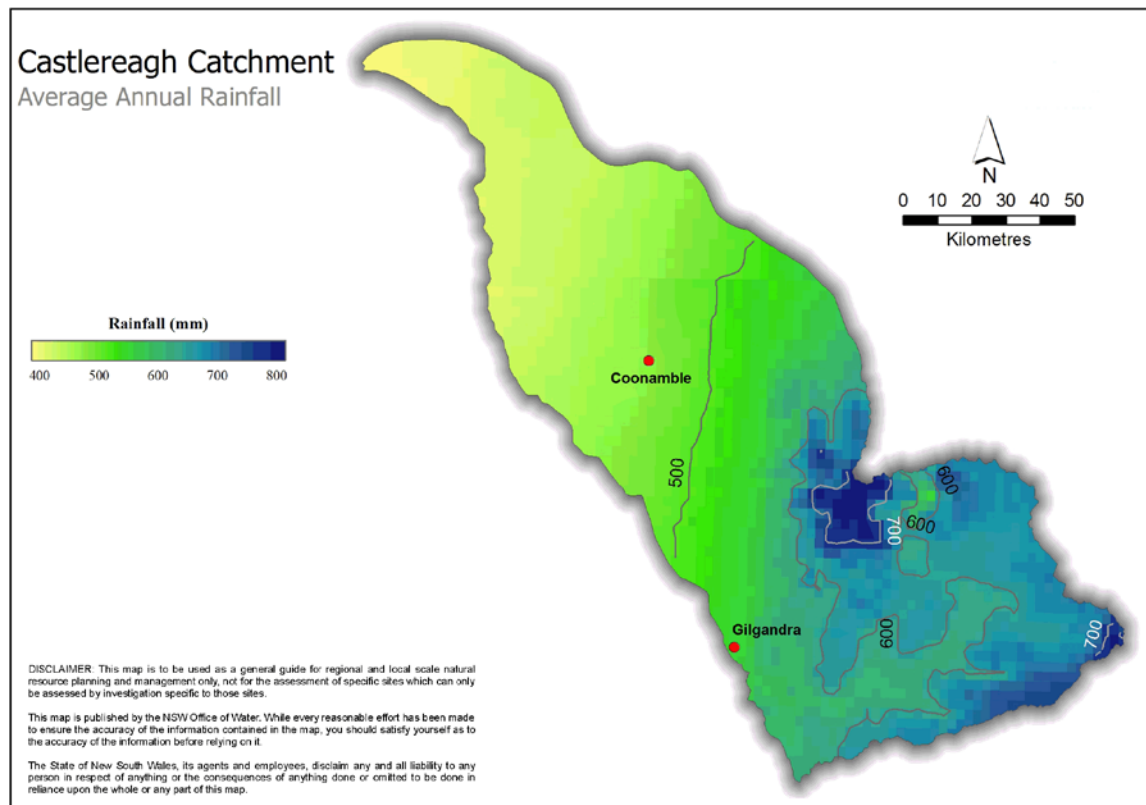
The human population of the three local government areas that cover the Castlereagh catchment (Warrumbungle, Gilgandra and Coonamble Shires) is projected to decline in the period to 2036 by around 12 per cent from the 2006 population. Although natural increase (births minus deaths) will remain positive, this will be more than offset by net migration losses (New South Wales State and Regional Population Projections, 2006-2036: 2008 Release, NSW Department of Planning).

Climate

In general, the climate for the Castlereagh catchment could be described as one of cool, moderately wet to dry winters, and hot, dry to very dry summers. Average duration of sunshine, from south-east to north-west, ranges from five to seven hours per day in June to 10 to 11 hours per day in December.

Highest annual rainfalls in the Castlereagh River Basin are recorded over the high ground above the 500 metre contour along the eastern and north-eastern boundaries of the catchment. In this area, annual median rainfalls exceed 600 mm. The middle sections of the Castlereagh experience an annual median rainfall of about 300 to 400 mm (see Figure 4).

Figure 4: Average annual rainfall in the Castlereagh catchment



Around half of the annual rainfall is recorded during November – March (Figure 5). Rainfall also varies dramatically from year to year. As an example, annual rainfall at a number of centres in the region has varied from less than 200 per cent to greater than 50 per cent of the annual average figure.

Average annual evaporation varies from around 1,400 millimetres in the upper catchment to 2,100 millimetres at the northern end of the catchment.

The Castlereagh catchment generally experiences hot summer temperatures (approx. 16 °C to 32 °C) and mild winter temperatures (approx. 3 °C to 17°C) (Figure 6).

Figure 5: Average monthly rainfall at Coonamble 1878-2010

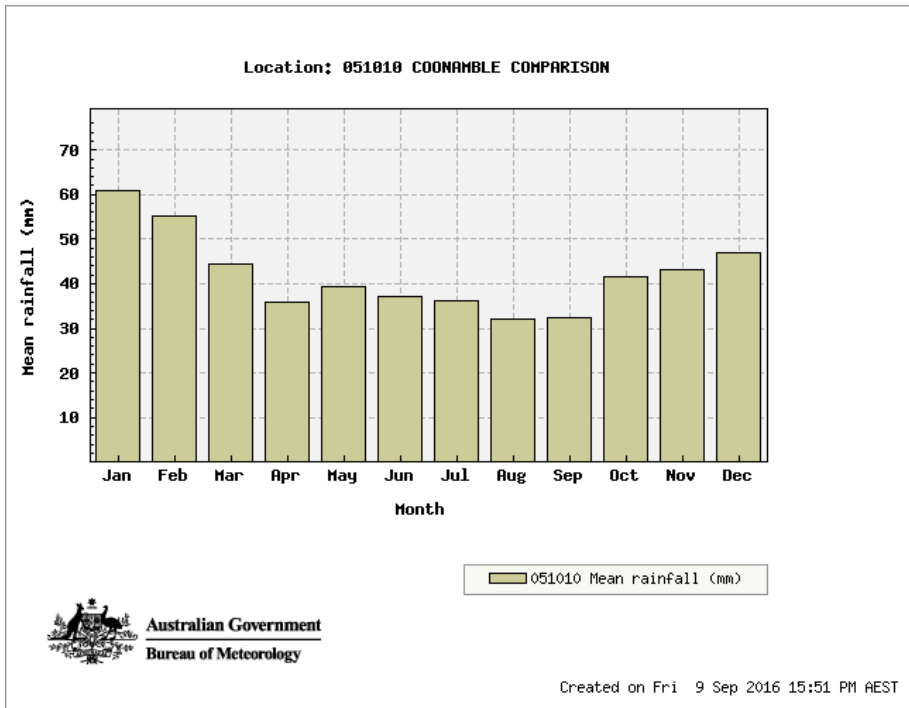
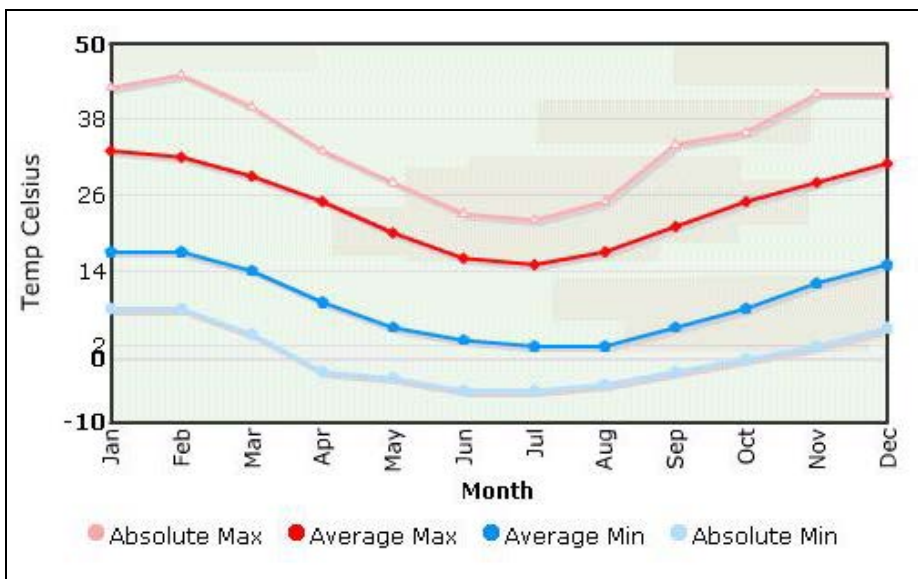


Figure 6: Annual average temperature range at Gilgandra



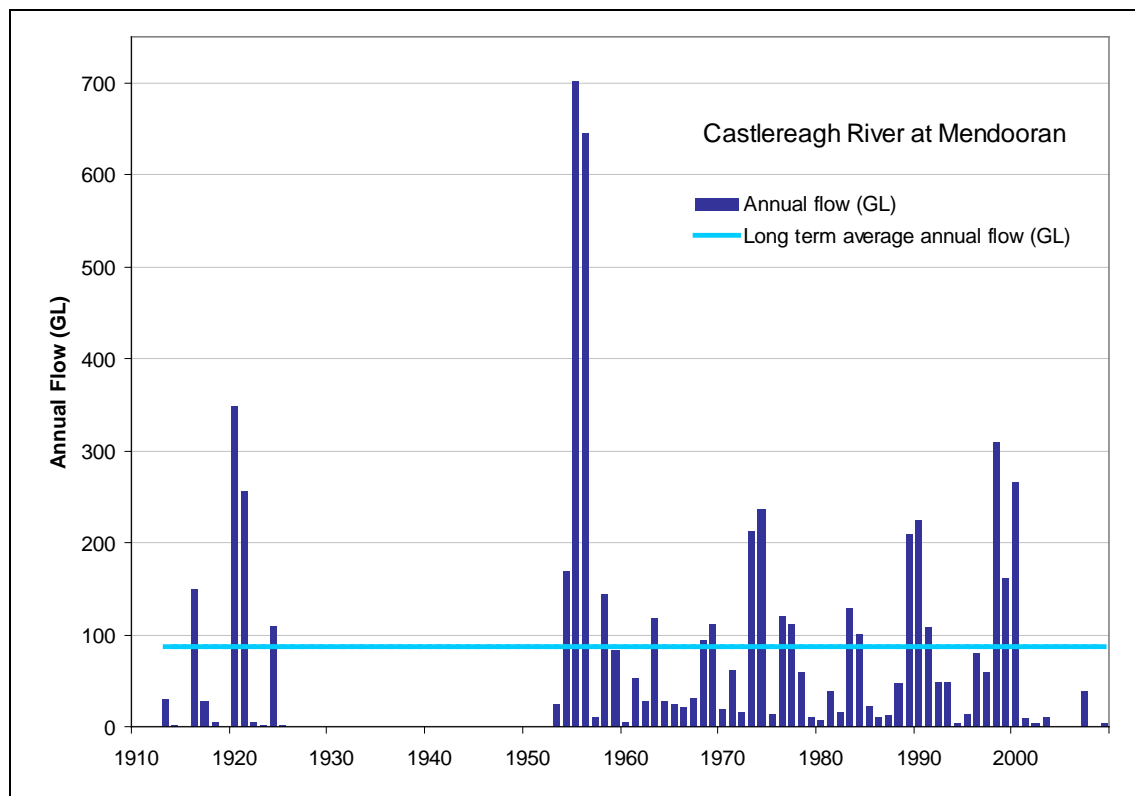
Streamflows

Data from the existing stream gauging stations shows that flow in the river reaches a maximum at Coonamble after which flows decrease significantly towards the end of the river system.

The longest period of recorded stream flows in the river is at Mendooran. Gauging commenced here in 1913, although there is a long period of missing data when gauging was suspended during the 1930s and 40s. The long term average annual flow at Mendooran is 86.7 gigalitres (Figure 7). In the early part of the record, and in the drought conditions of recent years there have been a number of years for which no flow at all has been recorded in the river. The highest annual flows occurred in 1955 and 1956 with 600-700 gigalitres recorded in both years. Drought conditions prevailed in the Castlereagh catchment for the ten years from 2000 to early 2010 with significantly below average flow, however since then there have been a number of flood events.

The largest flood at Mendooran occurred in February 1955 with a peak flow exceeding 118,000 megalitres. Moderate to large floods up to 50,000 ML/d have occurred on average every 5-10 years. The most recent flood events have occurred in February-March 2012, March 2013, and September 2016

Figure 7: Annual flow in the Castlereagh River at Mendooran 1913-2010



There are seven active gauging stations within the Castlereagh catchment (Table 4). Two stations on Belar Creek (420003 and 420021) in the north west of the catchment are used as flow reference points for the upper catchment. There are two gauges on the main Castlereagh channel upstream of Binnaway. The most upstream of these is at Ulamambri (420019) while the gauge at Hidden Valley (420017) is located around 20 km upstream of Binnaway.

Table 4: Active stream gauging stations in the plan area

Station name	Water source	Station no.	Catchment (km ²)	Period of record	
				Start	Finish
Belar Creek at Warkton (Blackburns)	Castlereagh above Binnaway	420003	133	10/12/1951	Ongoing
Castlereagh River at Hidden Valley	Castlereagh above Binnaway	420017	1166	25/02/1980	Ongoing
Castlereagh River at Ulamambri	Castlereagh above Binnaway	420019	n/a	13/05/1977	Ongoing
Belar Creek at Grahams Crossing	Castlereagh above Binnaway	420021	n/a	12/10/2001	Ongoing
Castlereagh River at Mendooran	Binnaway to Gilgandra	420004	3,600	1/01/1953	Ongoing
Castlereagh River at Lucas Bridge upstream Gilgandra (records Flood levels for BOM only)	Binnaway to Gilgandra	420901	1,590	1/08/1999	Ongoing
Castlereagh River at Gungalman	Castlereagh River below Coonamble	420020	16,534	30/05/2001	Ongoing

There are three gauges in the catchment downstream of Binnaway (of which two are currently used as flow reference points). A number of other gauging stations were discontinued during the period from 1980 to 2002 for a variety of reasons, including the difficulty of maintaining gauges in the presence of large areas of mobile sand beds.

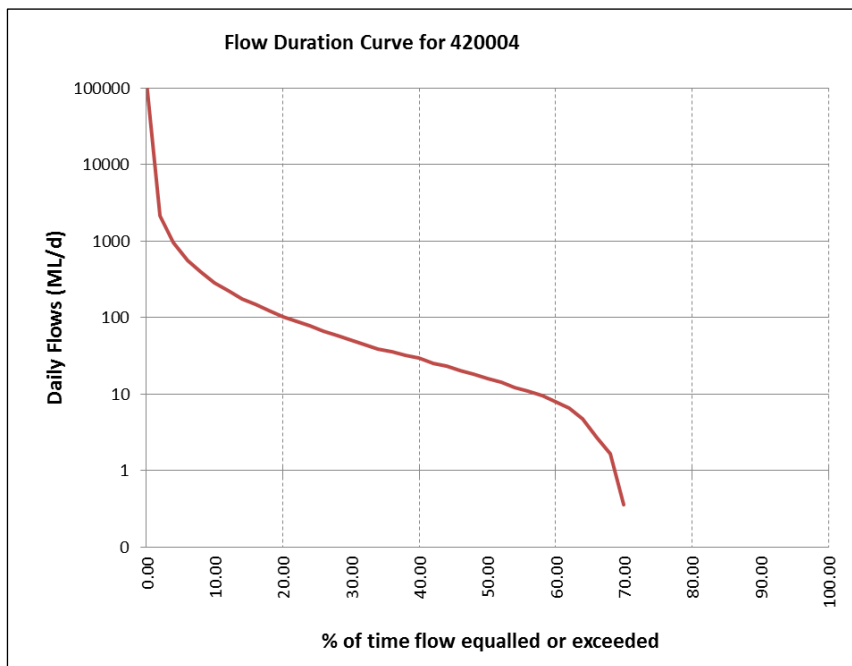
Flows within the Castlereagh River and its tributaries are highly variable, particularly in the middle and lower parts of the catchment. Flow percentiles for gauges in the upper catchment show that flow is present for at least 95 per cent of the time, but only in very small quantities (Table 5). At Belar Creek (420003) the 80th percentile flows is 2.3 ML/d while the 50th percentile (half of all recorded flows) is only 4.3 ML/d. Similarly in the Castlereagh River at Hidden Valley (420017) the 80th percentile is 3.3 ML/d and the 50th percentile is 12.1 ML/d. In contrast, the Castlereagh River at Mendooran ceases to flow 30 per cent of the time (Figure 8).

For the tributaries, specifically the water sources of Tooraweenah to Coonamble Tributaries, Nedgera Creek and Teridgerie Creek, there is not enough data nor similarity between them to be able to define a representative percentile flow that can be used as a guide in setting access rules.

Table 5: Percentile flows for selected gauges in the upper catchment

Station	Percent of time flow is exceeded											
	5	10	20	30	40	50	60	70	80	90	95	100
	Flow (ML/d) for percentile											
420003	100.3	46.5	19.1	10.5	6.5	4.3	3.7	2.9	2.3	1.5	1	0
420017	347.9	168.2	64.2	31.1	17.8	12.1	7.6	5.3	3.3	1.5	0.7	0

Figure 8: Flow duration table for 420004 Castlereagh River at Mendooran



Groundwater

The Castlereagh Alluvial groundwater source is defined as the unconsolidated alluvial deposits associated with the reach of the Castlereagh River extending from Binnaway downstream to Gilgandra. This groundwater source covers an area of approximately 212 square kilometres.

These alluvial sediments were deposited on the eroded surface of Mesozoic rocks of the Great Artesian and Oxley Basins. The palaeo valley created on this eroded surface was first filled by high energy deposits of coarser gravels and sands which were then buried by more recent flood plain deposits of silt and clay. The resultant alluvial valley is generally about two kilometres wide but narrows down where the ancient palaeo valley cuts through the more resistive rocks. The thickness of alluvium varies from a few meters around Binnaway to about 80 metres near Gilgandra.

The Castlereagh Alluvial does not include the river-bed sediments constrained within the channel of the river which consists of alluvial sediments and channel in-fills from banks that are deposited on the river bed (for more details see section *Water extraction in the unregulated water sources*).

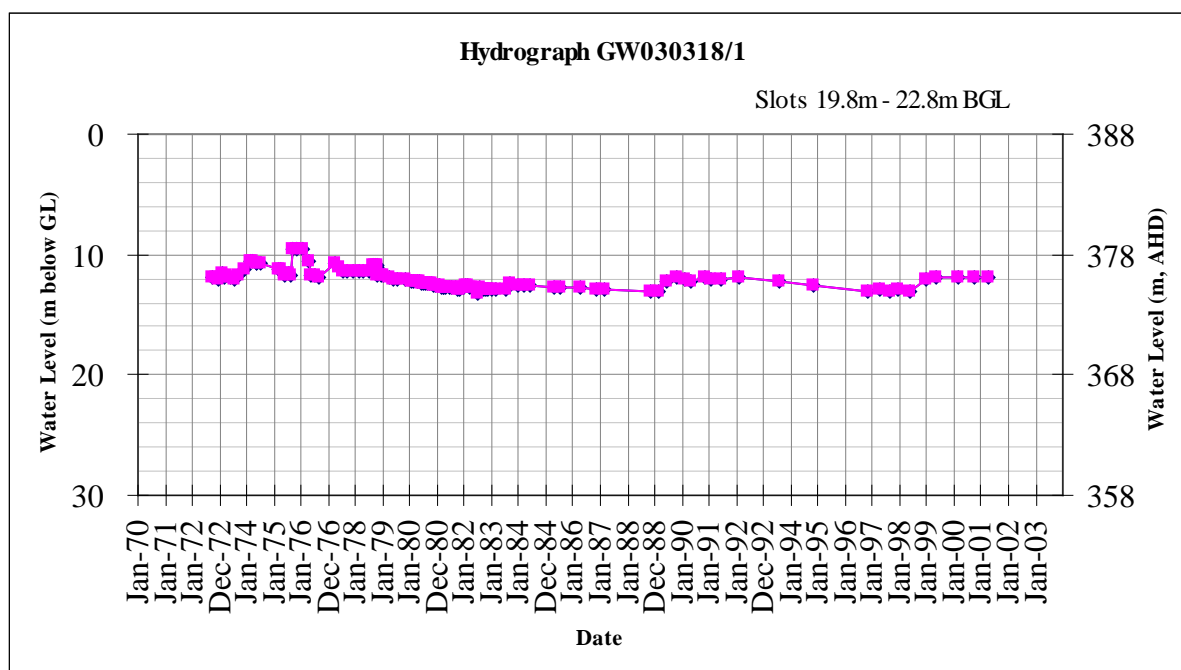
The Castlereagh Alluvial is mainly recharged by rainfall, side slope run-on and partly by Castlereagh River flow. The relationship between the alluvial aquifer and river flow is likely to follow a pattern of recharge (river to aquifer) during high surface flows and discharge (aquifer to river) in low flow conditions. The regional groundwater flow follows the direction of river flow.

Groundwater quality is of the highest category and the alluvial aquifer yields small to moderate volumes for stock, domestic and irrigation supply suitable for all purposes. The aquifer rarely produces large volumes suitable for high intensity irrigation and generally the yield is less than five litres per second.

The seven licensed production bores in the alluvial aquifer and 103 basic right bore licences are estimated to extract 630 megalitres per year which is 25 per cent of the annual recharge.

DPI Water (and its predecessors) has monitored groundwater in the Castlereagh Alluvial since the 1970s using a network of 22 monitoring bores, this however has been discontinued over the last eight years. Available monitoring data show that the water table level is flat and shows no significant response to either pumping or river heights (see Figure 8).

Figure 9: Typical hydrograph for Groundwater monitoring bores in the Castlereagh Alluvial



Climate change and variability

Following the November 2006 Water Summit on the southern Murray-Darling Basin (MDB), the then Prime Minister and MDB state Premiers commissioned the CSIRO to report on sustainable yields of surface and groundwater systems within the MDB. The CSIRO Murray-Darling Basin Sustainable Yields Project assessment was undertaken for 18 regions including the Macquarie-Castlereagh region.

The CSIRO made the following conclusions for the Macquarie-Castlereagh region (CSIRO 2008):

- Current average surface water availability is 1567 GL/year and net diversions are 371 GL/year or 24 per cent of the available water. This is a moderately high level of development. Groundwater use is about 182 GL/year or 33 per cent of total water use.
- The recent climate (1997 to 2006) was similar to the long-term average climate.
- The best estimate of climate change by 2030 would reduce surface water availability by eight per cent and surface water diversion by four per cent.
- Future development of commercial plantation forestry is expected to be negligible. A 16 per cent growth in farm dams by 2030 is expected which would reduce runoff by 1.5 per cent. Groundwater extraction is expected to grow by 125 per cent by 2030 to become around 54 per cent of average total water use.

However, the CSIRO also reported that the hydrological effects of climate change in the MDB remain very uncertain. Rainfall-runoff modelling with climate change projections from global climate models indicates that future runoff in the Macquarie-Castlereagh region is more likely to decrease than increase. The CSIRO report suggests that the best estimate 2030 climate scenario is a six per cent reduction in mean annual runoff. The extreme estimates (from different climate models under high global warming) range from a 25 per cent reduction to a 30 per cent increase in mean annual runoff.

Under the best estimate 2030 climate, there would be an eight per cent reduction in water availability, nine per cent reduction in end-of-system flows and a four per cent reduction in surface water diversions overall. Under the wet extreme 2030 climate there would be increases of 25 per cent in average water availability, 41 per cent in end-of-system flows and 12 per cent in surface water diversions (in the absence of any preventative growth-in-use mechanisms). Under the dry extreme 2030 climate there would be decreases of 25 per cent in average water availability, 28 per cent in end-of-system flows and 16 per cent in surface water diversions.

Water entitlement and use

There are 233 surface water licences totalling 23,618 ML of entitlement and seven ground water licences totalling 583 ML of entitlement in the area covered by the plan. The total entitlement represents approximately 27 per cent of the average annual flow at Mendooran. The majority of licences are used for irrigation, with a proportion also used for town water supply. Water is also extracted from unregulated rivers and alluvial sediments within the plan area through basic landholder rights (not requiring a licence).

Current water entitlement across the plan water resources is listed in Table 6.

Table 6: Total entitlement, average usage and number of licences for each water resource

Water resource	Entitlement (ML/year)	Average use (ML/year)	Number of licences
Unregulated surface water sources			
Castlereagh above Binnaway	5217		63
Binnaway to Gilgandra	8484		65
Castlereagh River Gilgandra to Coonamble	4861		81
Castlereagh River below Coonamble	4868		13
Nedgera Creek	12		2
Teridgerie Creek	62		3
Tooraweenah to Coonamble Tributaries	114		6
Groundwater Source			
Castlereagh Alluvial	583	545	6

Water extraction in the unregulated water sources

The majority of the unregulated surface water licences are located adjacent to the Castlereagh River in the Castlereagh above Binnaway water source. Most of the remaining licences are located adjacent to the Castlereagh River between Binnaway and Coonamble.

Many of the licences in this downstream reach of the river extract from the coarse grained river bed sediments constrained within the channel of the river. In this reach underground water pockets are formed in the river bed sediments where porous sand and gravel deposits are either enclosed or underlain by clay. The river water saturates these river-bed sediments during high flow events and moves as base flow through them. During low flow times, base flow in the river-bed sediments discharges downstream into the river at places wherever the river bed becomes more uniform or the sediments become over saturated. Spear points along the Castlereagh River access water from these water pockets within the riverbed sediments. The design of the spear points allows access to the water up to a depth of about eight metres below the associated water pump.

Within the balance of the plan area there are considerably fewer licences due to the combination of less fertile soils, low rainfall and unreliable water flows resulting in grazing and dryland cropping being the most common agricultural activities.

The water that is extracted in the Castlereagh River catchment is utilised for a range of agricultural uses but is mainly used in spring and autumn as a supplement to rainfall for fodder and cereal crops.

Detailed long term water use is not available in the unregulated rivers because there is not yet broad scale metering in these water sources. Some metering has been rolled out over the last few years for bigger users through the NSW Water Use Monitoring Program.

Water extraction in the alluvial groundwater source

The alluvial groundwater licences are also located adjacent to the main trunk of the Castlereagh River between Binnaway and Gilgandra. Above Mendooran the alluvial deposits are relatively shallow with a depth of 15 metres or less, and with yields of less than five litres per second. The most productive bores occur within the deep sediments that occur in the Gilgandra area where the alluvium is up to 120 metres deep. Groundwater in this area is generally of good quality and bores may yield up to 40 litres per second (Water Resources Commission, 1984). Approximately 60 per cent of all alluvial aquifer licences are located downstream of Mendooran.

Of the total entitlement, 99 per cent is used for irrigation purposes and one per cent for industrial purposes.

Detailed water use is not available in the alluvial water source because there is not yet broad scale metering in place. NSW DPI Water is exploring this issue through its Water Use Monitoring Program.

Local water utility requirements

A number of local councils extract from the rivers and streams within the plan area to provide urban settlements with town water supplies (see Table 7).

Table 7: Town water supplies, location and entitlement volume in the plan area

Local Water Utility / work	Water source	Town supplied	Entitlement (ML/yr)
Warrumbungle Shire / river extraction	Castlereagh above Binnaway	Coonabarabran	959
Warrumbungle Shire / river extraction	Binnaway to Gilgandra	Merrygoen	175
Gilgandra Shire / river extraction	Castlereagh River Gilgandra to Coonamble	Gilgandra	1,500
Gilgandra Shire / river extraction	Tooraweenah to Coonamble Tributaries	Tooraweenah	37
Coonamble Shire / river extraction	Castlereagh River Gilgandra to Coonamble	Gulargambone	58
		Coonamble	50

Policy and planning framework

A number of national, state and regional plans and policies have guided, and impact on, the development of water sharing plans for NSW, including:

- *Water Management Act 2000*
- *Access Licence Dealing Principles Order 2004*
- National Water Initiative
- Murray-Darling Basin Cap Agreement
- The Basin Plan
- Natural Resource Commission state-wide targets
- Catchment Action Plans
- NSW water planning policies and other considerations

The Water Management Act 2000

The *Water Management Act 2000* (WMA 2000) is based on the concept of ecologically sustainable development i.e. managing current development so that it will not threaten the availability of resources for future generations. The WMA 2000 recognises the need to allocate water for the environmental health of our rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water through the separation of water access from land title.

Water sharing plans are the main tool through which the WMA 2000 achieves its objective. The major changes required to water management have meant that the WMA 2000 has been progressively implemented, and the *Water Act 1912* progressively phased out as water sharing plans commence.

The latest copy of the [WMA 2000](#) is available from the NSW government legislation website.

Access Licence Dealing Principles

The *Access Licence Dealing Principles Order 2004* (hereafter referred to as the Dealing Principles) draws on the objects and water management principles of the WMA 2000 and provides state-wide guidance and rules for applications to undertake water dealings including trade.

The Dealing Principles specify that dealings must consider:

- the impacts on other water users
- the impacts on the water source
- the impacts on indigenous, cultural, heritage and spiritual matters
- maximising social and economic benefits

The Dealing Principles specify rules for different types of dealings (such as conversion to a new category, subdivision, consolidation, assignment of rights or allocation, changing water sources, amending extraction components and interstate dealings). They specify the requirements that must be met for a dealing to be permitted, and the conditions under which a dealing is prohibited.

Water sharing plans must be consistent with the Dealing Principles. Water sharing plans can also put additional restrictions in place such as restricting trade into a particular area due to its environmental values or hydrologic stress.

National Water Initiative

The National Water Initiative (NWI) was signed by the Council of Australian Governments (COAG) in June 2004. Through the NWI, governments across Australia, including NSW, have agreed on actions to achieve a more cohesive national approach to managing, measuring, planning, pricing and trading water. The NWI recognises the continuing need to increase the productivity and efficiency of Australia's water use, whilst servicing rural and urban communities, and ensuring the health of river and groundwater systems.

The NWI sets out guidelines, outcomes and timelines for water plans and planning processes. Until 2014 the NWI was implemented and monitored by the National Water Commission, an independent statutory body responsible for providing advice to COAG on national water issues. The Commission was responsible for undertaking a biennial assessment of each state's progress with implementing the NWI.

The role of the National Water Commission ceased in December 2014 and its water management functions are in the process of being transferred to other agencies. Assessment of progress in the implementation of the NWI will be transferred to the Productivity Commission along with monitoring the effectiveness of the implementation of the Murray–Darling Basin Plan and associated Basin State water resource plans.

Murray-Darling Basin Cap Agreement

The Castlereagh valley is part of the Macquarie-Castlereagh region in central-west New South Wales and covers 6.9 per cent of the total area of the Murray-Darling Basin (MDB) and is subject to agreements and statutes which cover water management within the Basin. The water sharing plan for the Castlereagh valley therefore has to be developed within the context of the proposed Basin Plan.

In 1994 the Murray-Darling Basin Ministerial Council (MDBMC) undertook an assessment of water diversions across the Basin. This found that the level of diversions at that time was placing stress on both the environmental health of our river systems and the reliability of supply to water users; and that diversions were continuing to increase. In response, the MDBMC introduced a diversion limit – known as the Cap – in 1995.

Schedule F of the *Murray-Darling Basin Agreement* was introduced in 1996 and set the operating framework for the Cap. In NSW, the Cap is defined as the average yearly volume of water that would have been diverted under 1993/94 levels of development and management rules. The Cap does not apply to groundwater diversions.

Under the Agreement, plans are required to be developed to ensure consistency with the Cap. This means that the long-term average annual extraction limit (LTAAEL) for regulated and unregulated water sources must be equal to or less than the Cap. NSW has chosen to divide the Cap into unregulated and regulated components.

In regulated water sources, licences have been volume-based for a long time, and therefore require the metering of water extractions, which has provided a good basis for establishing the Cap. However, in unregulated water sources, irrigation licences were previously issued on the basis of the area of land to be irrigated, rather than a specific volume of water. The volumes of extractions from unregulated water sources have therefore not been monitored, which makes the establishment of a Cap problematic. In response, a volumetric conversion

process was developed. As part of this process, irrigation licence holders were surveyed as to the area that they had irrigated over the six year period from 1993/94 and conversion rates developed to establish licensed entitlements and derive average levels of water use. There was no pattern of growth in irrigated areas over the survey period in any of the river systems, so the Cap is based on the information calculated as an average of the yearly assessments over the survey period.

The Basin Plan

The Commonwealth *Water Act 2007* requires the Murray-Darling Basin Authority (MDBA) to develop a water management plan for the Murray-Darling Basin. The Basin Plan will be a legally enforceable document that provides for the integrated management of all the Basin's water resources. Some of the main functions of the Basin Plan will be to:

- set and enforce environmentally sustainable limits on the quantities of surface water and groundwater that may be taken from Basin water resources
- set Basin-wide environmental objectives, and water quality and salinity objectives
- develop efficient water trading regimes across the Basin
- set requirements that must be met by state water resource plans
- improve water security for all uses of the Basin water resources.

The Basin Plan will provide the new foundation for managing the Basin's water resources in accordance with any rules and plan accreditation criteria established by the MDBA.

At the heart of the Basin Plan will be limits on the quantities of surface water and groundwater that can be taken from Basin water resources. These are known as 'sustainable diversion limits' (SDLs). As the SDLs come into effect, they will replace the current Cap on diversions in the Basin. At the time of publishing this document, NSW was still engaged in negotiations with the MDBA regarding the implementation of SDLs.

Further details can be found on the MDBA website www.mdba.gov.au in the Basin Plan section.

Natural Resource Commission targets

The Natural Resource Commission (NRC) was established in 2003 to provide the NSW Government with independent advice on natural resource management issues. To achieve this, the NRC has developed a Standard for Quality Natural Resource Management, along with 13 state-wide targets for natural resource management which have been embedded in the NSW State Plan. The Standard is designed to apply to natural resource management at all scales including at the state, regional, catchment and local level.

The NRC's Standard requires the use of the best available knowledge, appropriate information management systems, delivery of integrated outcomes, engagement of the community and regular monitoring, measuring, evaluation and reporting to specify how delivery of the targets are progressing. The NRC reviews water sharing plans against this standard and its associated targets. In 2013 the NRC reviewed 31 water sharing plans that were due to expire in 2014 and provided advice to the Minister for Primary Industries.

In 2012 the NRC reviewed the state-wide standard and targets, including monitoring, evaluation and reporting arrangements in NSW. They recommended five new state-wide targets that provide a sharper focus on the key long-term issues of concern to the Government and community and revised the monitoring, evaluation and reporting strategy to support the implementation of the new targets.

Table 8 lists the state targets and how these are met within the Water Sharing Plan.

Table 8: Contribution of the plan to the relevant NRC state wide targets

Relevant statewide target	Plan's contribution
By 2015 there is an improvement in the condition of riverine ecosystems (Target 5)	<ul style="list-style-type: none"> - sets a defined share of water for riverine ecosystems - protection of very low flows - trading rules to maintain or reduce entitlement in high value streams - adaptive management, giving the ability to adjust rules once information becomes available or at the end of plan period.
By 2015 there is an improvement in the ability of groundwater systems to support their groundwater dependent ecosystems and designated beneficial uses (Target 6)	<ul style="list-style-type: none"> - sets distance rules to GDEs for new bores - extractions from alluvial aquifers managed using connected surface water rules - trading rules designed to protect groundwater sources - local area impact management rules
By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained (Target 8)	<ul style="list-style-type: none"> - trading rules to maintain or reduce entitlement in high conservation value water sources - protection of very low flows
Natural resource decisions contribute to improving or maintaining economic sustainability and social well-being (Target 12)	<ul style="list-style-type: none"> - plans provide a defined share to water and defined certainty of access - separation of land and water enhances trading and value of licences - establishment of perpetual and compensable water access licences provides security for business investment - water markets encourage movement of water licences to high value uses - rules developed which consider community dependence on water extraction

Catchment Action Plans

Catchment action plans are statutory, non-regulatory plans that were previously prepared by the state's catchment management authorities under the *Catchment Management Authorities Act 2003* (now repealed). In January 2014 the NSW Government established Local Land Services (LLS) and transferred the functions of catchment management authorities into this new organisation to provide agricultural support, natural resource management and emergency management to rural communities through a single organisation. The Central West Riverina Local Land Services will be responsible for continuing the delivery of natural resource management programs within the Castlereagh valley, including catchment management plans.

NSW water planning policies and considerations

A number of policies and guidelines have been developed since commencement of the WMA 2000. These policies have arisen in response to specific water management issues that need to be considered during the development of water sharing plans. These policies directly influence the planning process and the formulation of water sharing rules.

Protecting pools, lagoons and lakes

Pools in NSW can provide an important source of water for licence holders, landholders and communities. Pools also have a key ecological function as a critical refuge and habitat for flora and fauna. For the purpose of this policy a pool refers to any lentic water bodies (standing water) within or associated with unregulated rivers in NSW, including water bodies that fall within the definition of a lake according to the Dictionary of the WMA 2000 (the exception is tidal pools and estuaries).

The policy document *Macro water sharing plans – the approach for unregulated rivers. Access and trading rules for pools* can be found on the DPI Water website www.water.nsw.gov.au. This document provides guidance for Interagency Regional Panels in setting water access and trading rules for pools that are covered by unregulated river water sharing plans.

The general approach is to establish a default access rule where no draw down is allowed below full pool capacity for the majority of pools. This default rule may be reviewed where it is justifiable and feasible to do so, to allow limited access to pools based on local hydrological, environmental and socio-economic considerations.

Default rules vary depending on the pool type. Generally the default rule for artificial pools is to adopt the existing licence conditions; however in some circumstances where this may not be appropriate, alternate rules will need to be developed. For natural pools, the default rule requires users to stop pumping when the pool is less than its full capacity (approximated by the greatest pool volume at which there is no visible flow leaving the pool).

The plan process does allow for more lenient access rules to be set if the default rules would significantly impact on current irrigation operations.

Protecting environmental values

Plans are required to reserve water for the overall health of the river and aquifers and to protect specific ecosystems that depend on river flows, such as wetlands, lakes, estuaries and floodplains and groundwater dependent ecosystems. This share of water reserved for the environment, is also intended to sustain the river and groundwater system's aquatic fauna and flora.

The freshwater environment of the Castlereagh catchment is comprised of a range of aquatic habitats that are mostly associated with the extensive instream sand beds, including pool habitats, small flood runners, anabranches, in-stream benches, sand bars and terraces.

Pools and backwaters provide an important role in the provision of habitat, breeding areas and food source, providing a critical refuge for aquatic organisms such as native fish, invertebrates and mammals such as platypus and water rats, during low flow periods.

Baker and Raisin (2000) conducted an assessment of riverine health and found that much of the Castlereagh River exhibited poor bed and bar stability due to high sediment loads derived from Pilliga sandstone. In the Castlereagh headwaters Weeping Willows (*Salix babylonica*) have an additional detrimental effect on stability. Downstream of Binnaway, the

riparian overstorey is dominated by River Red Gums (*Eucalyptus camuldulensis*) and River She-oak (*Casuarina cunninghamiana*). The natural bed mobility in the catchment is difficult to assess due to the lack of knowledge of the river prior to major land use changes.

Riparian understory and groundcover has also been greatly affected by noxious species; with species such as Noogoora Burr (*Xanthium occidentale*) and African Boxthorn (*Lycium ferocissimum*) commonly noted.

Baker and Raisin found that most of the tributaries of the Castlereagh River had moderate or poor aquatic habitat. Of the river itself, only the headwaters above Coonabarabran were identified as very good aquatic habitat, and only two stretches were identified as having good aquatic habitat; between Coonabarabran and Binnaway, and between Coonamble and the Teridgerie Creek confluence. The latter section of the river is of particular interest due to its connectivity to the 'Wingadee' wetlands. This connectivity increases habitat availability and is significant in terms of bird breeding grounds.

There are very few other wetlands within the Castlereagh catchment. The upper catchment is too steep and hilly for the development of wetlands, and many of the floodplain wetlands of the lower catchment have been cleared for agriculture. Kingsford *et al.* (2003) mapped 17,000 hectares of wetlands within the catchment, with most of this area representing two large areas of floodplain woodland and shallow swamps that are associated with Nedgera and Mowlma Creeks on the lower floodplain.

The Castlereagh catchment provides aquatic and terrestrial habitats for a range of threatened species and ecological communities that are protected under the *Threatened Species Conservation Act 1995*.

An endangered ecological community (EEC) is an assemblage of species occupying a particular area (plant or animal communities) that is in danger of becoming extinct. These EECs are listed in schedules to the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994*. Four endangered ecological communities occur within the Castlereagh catchment.

Brigalow community is a low open semi-arid woodland which is dominated by brigalow (an acacia species), with occasional stands of belah and poplar box.

Coolibah – black box woodlands is an ecological community found on the grey clays of floodplains, ephemeral wetlands, and along watercourses. The structure of the community varies from tall riparian woodlands to very open grassy woodlands. Remnants of the community occur on the Castlereagh floodplain in the Coonamble area.

Myall woodland is a low open woodland that occurs on the alluvial plains of the Murray-Darling Basin and is known to occur in the Coonamble area. The community varies from low woodland to open shrubland, depending on the site and its degree of disturbance. The dominant tree species is *Acacia pendula* (weeping myall) with an understory of chenopod shrubs, woody shrubs, grasses and herbs.

The aquatic community of the Castlereagh River forms part of the endangered ecological community known as the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River*. This includes 21 native fish species and hundreds of native invertebrate species that are found within the Darling River and its associated streams, wetlands and anabranches within NSW, including the Castlereagh River.

Five fish species that previously occurred within the Macquarie-Bogan-Castlereagh catchments are listed as threatened under the *NSW Fisheries Management Act 1994*. These are trout cod, river snail, silver perch, purple spotted gudgeon and olive perchlet.

Threatened species likely to be dependent on water resources in the Castlereagh Valley, are included in Appendix 2.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and natural ecological processes determined to some extent by the availability of groundwater. GDEs can include cave systems, springs, wetlands and groundwater dependent endangered ecological communities.

The methodology utilised for the identification and scheduling of high-priority GDEs in the macro planning process involves two stages consistent with the NSW State Groundwater-Dependent Ecosystem Policy (DLWC 2002).

Managing surface water and groundwater connectivity

A key objective of the National Water Initiative is 'recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource'. Most alluvial aquifers have a relatively high degree of connectivity with their associated surface water sources. Accordingly, most alluvial water sources are included in a water sharing plan that covers both surface water and its connected alluvial groundwater. Conversely, most porous rock, fractured rock and coastal sands aquifers are considered to have a lesser degree of connectivity and are included in groundwater-specific plans.

In the Basin, it is generally not practical for groundwater and surface water to be treated as one water source due to the MDBMC Cap, as the Cap does not apply to groundwater sources within the Basin.

Consistent with the state-wide approach, extraction from highly connected aquifer access licences that relate more closely to the regulated river will be managed annually, via AWDs, whilst highly connected aquifer access licences that related more closely to unregulated water sources will be managed via unregulated river cease-to-pump rules.

The document *Macro water sharing plans – the approach for groundwater. A report to assist community consultation* provides further information about the principles used to develop water sharing rules for groundwater sources.

Maintaining ecosystem functions

In 1997, the NSW Government undertook a public process of developing water quality and river flow objectives for NSW unregulated river catchments. The seven objectives applicable to the Castlereagh catchment, including "to protect pools in dry times" and "to protect natural low flows", have been an important consideration in the various stages of developing the plan.

The *Stressed Rivers Assessment* (DLWC 1998) looked at environmental and hydrological stress of a river at a sub-catchment level, the boundaries of which were determined by hydrology, infrastructure, social and other factors. The assessment was designed as a rapid desk-top appraisal and meant as a guide, thus the need for additional data, evaluation and monitoring is taken as a given. The assessment report for the Macquarie catchment, which included the Castlereagh catchment, revealed that at that time, all of the Castlereagh's water sources were classed as being in a high or medium degree of environmental stress, with all

the water sources including the main arm of the river also considered to be in a high or medium degree of hydrological stress.

In the report *An assessment of riverine health in the Macquarie, Castlereagh and Bogan river catchments* (Baker and Raisin 2000) the authors elaborate on the initial work of the *Stressed Rivers Assessment*. The report, which took a 'snapshot' of riparian condition at sub-catchment sites based on a range of biological and physical indicators, found that riparian vegetation was severely degraded across most catchments. This was characterised by low levels of native regeneration, high degradation of understory species and small tree layers. The authors assigned unrestricted stock access as the main culprit. It also found severe bank and bed instability on first and second order streams with the tributaries of the Castlereagh River considered to be particularly badly eroded.

These studies and reports have provided a foundation to assist in the formulation of appropriate rules for the Castlereagh plan.

Protecting basic landholder rights

As defined under the WMA 2000, basic landholder rights (BLR) consist of domestic and stock rights, harvestable rights and native title rights. Water may be extracted under these rights without the need for a water access licence; although where groundwater is accessed under a domestic and stock right, the bore must still be approved by DPI Water.

The WMA 2000 requires that water sharing must protect BLR. The plan does this by identifying the requirements for domestic, stock and native title rights at the start of the plan and considering these requirements when designing the rules for licensed water extraction. The access rules for licensed water extractions do not apply to water extracted under BLR, thus affording priority to BLR users.

The requirements of harvestable rights have been inherently considered in the water sharing process, as access rules are based on river flows that result after harvestable rights extractions have occurred. There are currently no extractions for native title rights, however the plan allows for these rights should they be activated during the plan's ten year term.

The Castlereagh River Unregulated water sharing plan provides an estimate of the water requirements for BLR within each water source, noting that these rights may increase during the life of the plan. The water sharing plan cannot limit or restrict these rights, but the WMA 2000 provides for restrictions on BLR through the development of mandatory guidelines.

Protecting town water supply access

Under the WMA 2000, extractions for town water supply are afforded a higher priority than extractions for commercial purposes such as irrigation. Water sharing plans recognise this priority by ensuring that a full share of water is allocated for annual town water supplies except where exceptional drought conditions prevent this. Local water utilities such as local councils are issued with local water utility access licences. The WMA 2000 allows for annual trade but not permanent trade of entitlement between local water utility access licences.

Any development of new water storages in the plan area must be undertaken within the bounds of the plan. The plan is not prescriptive in endorsing any particular option since economic considerations vary over time. Instead, the plan sets a framework within which development of future water supplies can occur in a sustainable manner.

With the population of the three local government areas that cover the Castlereagh catchment (Warrumbungle, Gilgandra and Coonamble Shires) projected to decline in the

period to 2036 by around 12 per cent from the 2006 population, there is no pressure for local water utilities to increase their bulk water supplies.

However, should any utility wish to undertake town water supply augmentations within the plan area, then they must be undertaken within the bounds of the plan. At a minimum, a local water utility will need to meet conditions specified in the plan to ensure enough water is flowing to protect the environment in accordance with the plan. Furthermore, a new significant town water dam would likely require assessment under the *Environmental Planning and Assessment Act 1979*.

Protecting Aboriginal values

Aboriginal people have a spiritual, customary and economic relationship with land and water that provides an important insight into natural resource management. Aboriginal cultural values may be affected by water extraction from aquifers and surface waters and most of the information about flow-related Aboriginal values resides with the Indigenous communities.

The NSW Government established the Aboriginal Water Initiative in 2012 to facilitate effective engagement with Aboriginal communities in the water sharing process and ensure that measurable Aboriginal water outcomes are achieved. The Initiative aims to build Aboriginal peoples' capacity to participate as water users, protect their rights to water, maintain a healthy environment, and take full advantage of economic opportunities.

Water sharing plans recognise the importance of rivers and groundwater to Aboriginal culture. The plans will allow Aboriginal communities to apply for water access licences for cultural purposes such as manufacturing traditional artefacts, hunting, fishing, gathering, recreation and for cultural and ceremonial purposes. Aboriginal cultural licences can also be used for drinking, food preparation, washing and watering domestic gardens. These cultural licences are limited to 10 ML/yr per application. Opportunity for granting licences for Aboriginal cultural purposes throughout the Castlereagh Unregulated catchment is included in the water sharing plan.

For further information refer to *Our Water Our Country. An information manual for Aboriginal people and communities about the water reform process* which is available from the DPI Water website www.water.nsw.gov.au

Water interception activities

Changes in land use activities can potentially result in the interception of significant quantities of surface runoff and throughflow. Activities that can impact on water quantity include increased farm dam capacity or the development of significant areas of new forestry plantations in a catchment. Under the National Water Initiative, significant interception activities should be accounted for within a plan's extraction limit.

Floodplain harvesting activities

Floodplain harvesting is the collection, extraction or impoundment of water flowing across floodplains, excluding the following types of water extraction:

- taking of water under any other type of water access licence that is not a floodplain harvesting access licence or an applicable water access licence exemption
- taking of water under a basic landholder right, including the harvesting of rainwater runoff

- runoff of irrigation water and stormwater which is subsequently captured in tailwater return systems or other means in accordance with licence conditions or methods which have been approved by DPI Water.

Floodplain harvesting works can generally be put into two categories:

- Purpose-built works specifically built to facilitate floodplain harvesting, including pumps, structures or other works that divert water into or from storages, supply channels, depressions or otherwise impound flows.
- Works built for multiple purposes that have the effect of facilitating floodplain harvesting, such as:
 - levees, conveying works and off-river storages constructed in billabongs or depressions
 - below-ground level channels from which the water is delivered into storages.

Floodplain flows can originate from local runoff that has not yet entered the main channel of a river, or from water that has overflowed from the main channel of a stream during a flood.

In unregulated river water sources, floodplain harvesting has generally already been recognised and licensed during the conversion of area based water licences to volume based licences. However, further volumetric entitlements, measurement and long-term limits for floodplain harvesting may be established in the future under the NSW Floodplain Harvesting Policy which is currently under development.

Instream dams

Farm dams currently require an access licence when:

- they are located on a third order (or greater) river, irrespective of capacity or purpose;
- they exceed the maximum harvestable right dam capacity for the property, which enables the capture of ten per cent of the mean annual run-off from the property, or
- they are on a permanent (spring fed) first or second order stream.

Unlicensed extraction from farm dams that doesn't match any of the above criteria may be permitted under "harvestable rights", a component of the basic landholder rights. The full activation of harvestable rights within the area of the plan is considered highly unlikely.

Water sharing plans cannot restrict the volume of water collected under harvestable rights³ but can place restrictions on instream dams – dams that are located on streams of third order or higher. Under state-wide policy the construction of new instream dams is prohibited in those water sources in which high instream values have been identified.

Risk of interception through forestry expansion

In its report *Water Availability in the Murray-Darling Basin* (CSIRO 2008) the CSIRO has not allowed for any additional surface water use as it does not consider the Castlereagh catchment suitable for commercial plantation forestry.

³ The maximum harvestable right dam capacity is calculated based on providing the ability to harvest 10% of the mean annual runoff from the landholder's property. It is determined using a calculator provided on the DPI Water website, with input parameters being property location and property size.

Developing the plan

DPI Water is responsible for implementing the WMA 2000, including developing water sharing plans for the state's water resources. DPI Water established several interagency panels to assist with the development of water planning policies and water sharing plans.

The Castlereagh River Unregulated water sharing plan was prepared based on:

- indicative rules generated by a risk and values classification,
- the deliberations of the Regional Panel, and
- feedback from stakeholders during targeted consultation and public exhibition.

This section describes the various panels and outlines the process of developing the Castlereagh River Unregulated water sharing plan including the risks and values classification, refinement of the indicative rules based on panel deliberations, and targeted consultation and exhibition of the draft plan.

Role of the panels

State Interagency Panel

The State Interagency Panel (SIP) has overall responsibility for the statewide strategic direction of water sharing planning, to make certain that adequate resources are available from each agency and to ensure that the varying policy and statutory requirements of the relevant NSW Government agencies are met. The SIP also has the role of making water sharing decisions in cases where the Interagency Regional Panel (IRP), see below, cannot reach agreement or where the issue has statewide significance.

The SIP is chaired by the NSW DPI Water and comprises representatives from DPI Water, the NSW Office of Environment and Heritage (OEH), Local Land Services (formerly catchment management authorities), and agriculture, fisheries and aquaculture specialists from the NSW Department of Primary Industries. DPI Water is responsible for the overall project management.

Interagency Regional Panel

Interagency Regional Panels (IRPs) were established to develop water sharing plans. Regional panels consist of two representatives from DPI (one from DPI Water and another representing agricultural and fisheries interests), and one representative from OEH. A representative from Local Land Services attends meetings as an observer to provide advice on consultation issues and other matters within their areas of expertise.

Appendix 3 lists the names of Castlereagh panel representatives and their areas of expertise, and also lists their colleagues who they had access to for specific technical and scientific information.

The key responsibilities of the IRP are to:

- ensure water sharing rules are consistent with state policy
- review the hydrological (water management) units provided by DPI Water
- review economic, social and environmental values and undertake risk and value assessments to classify each unregulated water source

- review existing and generic water sharing rules as to their applicability⁴
- make recommendations on the water access and dealing (trading) rules for each water source
- assist with consultation on the proposed rules
- review submissions, from targeted consultation and public exhibition, and make changes where necessary to the water sharing rules.

The Castlereagh IRP used local knowledge and expertise in developing and recommending the water sharing rules through a consensus decision-making approach.

Consultation

The rules recommended by the Interagency Regional Panel underwent targeted consultation with water users⁵ before the plan was drafted. Formal public exhibition⁶ of the draft plan was then undertaken to ensure wider public consultation.

Targeted consultation on the draft rules

Targeted consultation on the proposed rules for the draft plan was undertaken in mid-2010. The objectives of this consultation were:

- to provide background as to why the plan was being developed, how it was developed, what rules were proposed in the various areas and how stakeholders could provide feedback
- to provide a 'first opportunity' to informally consult with key stakeholders to test the suitability of the proposed water sources and management zones, flow reference points and access and trading rules.

Public exhibition of the draft water sharing plan

Public exhibition of the draft water sharing plan was held in the plan area, at Coonamble and Gilgandra. The objectives of this consultation were:

- to provide background to stakeholders as to why the water sharing plan was being developed, how it has been developed to date, what rules were proposed in the various areas and how stakeholders could provide feedback
- to formally consult with a broad range of stakeholders to explain the proposed water sharing rules and how they will be implemented
- to seek feedback from stakeholders and the general community about the proposed water sharing rules.

⁴ This includes reviewing water access conditions imposed on users through announcements or orders under the *Water Act 1912* during low flow conditions.

⁵ Targeted consultation refers to informal consultation held with key stakeholders to test the suitability of the proposed water sharing rules and provide feedback on the rules potential impacts.

⁶ Public exhibition is the formal exhibition of a draft Plan where the Minister invites submissions on the draft Plan and in particular will seek comment on a range of key issues.

The Central West CMA managed the public consultation process, ensuring that all stakeholders and interested parties had an opportunity to examine and comment on the proposed water sharing rules. In particular, the CMA was looking for stakeholders to provide:

- local knowledge and expertise – for example, there may be other natural or socio-economic values that have not yet been considered by the Interagency Regional Panel
- feedback on the practical elements of the proposed water sharing rules - to make certain they are easily implemented by the licence holders
- confirmation that there are no unintended outcomes from the plan – it is essential that this be given due consideration before the plan is finalised
- specific comments on any Minister's notes included in the draft plan.

Submissions were required to be made in writing on the applicable form. Comments and enquiries made at the public meeting were also noted.

Targeted consultation for replacement plan

Public submissions regarding the Castlereagh above Binnaway water sharing plan were called for in 2012. Any submissions and additional information was collated and reviewed in 2013. A report was submitted to the Minister recommending that the plan be replaced.

Due to the minor changes proposed and the expected associated minimal impact, there was no formal public consultation process undertaken. However in 2015 all affected water users received a letter with a phone contact for inquiries and an address for the submission of any written comments. Included with this correspondence was an information package comprising a Report Card, a fact sheet detailing the proposed changes and a map of the area affected.

Water sharing rules for unregulated water sources

The 'macro planning' process is the current approach of DPI Water to developing plans for unregulated rivers and is described in "*Macro water sharing plans - the approach for unregulated rivers*"⁷. The application of the macro planning process has proven problematic for unregulated catchments, particularly in northern NSW, where many unregulated rivers have only intermittent flows. The variable flow, coupled with the opportunistic nature of unregulated diversions in this part of the state, has warranted a refined approach.

The refined approach has been used to guide the Interagency Regional Panel in its development of water sharing rules that consist of:

- access rules – which determine at what river flow level, gauge height, proportion of full capacity of a pool, and/or times extraction can occur
- dealing rules – which control the trade of water (both permanent transfer of access licence entitlements and temporary assignment of water allocation between access licences).

Classification method

In developing water sharing plans for unregulated rivers, DPI Water classifies each water source based on the risks and values of water extraction.

Specifically the classification process involves assessing:

- instream values (such as threatened fish species) and the risk to these values posed by existing or increased extraction
- hydrologic stress, based on the demands for licensed extraction relative to river flows
- the risk to instream values posed by extractions
- extraction value, a qualitative assessment of the economic value of the agriculture which relies on the water licensed for extraction
- the economic dependence of the local community on activities requiring licensed water extraction

Exceptions to the classification approach

It is important to note that the macro planning approach is an indicative tool to develop initial classifications. While these classifications guide the water sharing rules, a major role of the Interagency Regional Panel is to use the local knowledge of panel members to check whether these classifications are realistic. Any amendments to either the classifications or the proposed management rules are to be based on local and technical knowledge of the water sources.

⁷ the document is available on the DPI Water website www.water.nsw.gov.au in the Water sharing plan section

Developing the access and dealings rules

Access rules for rivers and creeks

Under the macro planning process, generic access rules are determined by balancing the risk to instream values (a product of instream value and hydrologic stress) and the community dependence on extraction. The assumption under the refined approach for inland unregulated catchments is that hydrologic stress in each water source is 'high', which is considered to be a reasonable assumption given that:

- most inland unregulated streams have been embargoed since the early 1990's
- the Stressed River Assessments⁸ show consistent scores of 'high' stress across the inland unregulated streams.

Under the refined approach, each unregulated water source is classified as having either high, medium or low instream values and either a high, medium or low community dependence on extraction, using the same method as is outlined in the manual. Indicative access rules balance instream values against community dependence as per Table 9.

Table 9: Indicative access rules for rivers and creeks under the refined approach

Rule level	Indicative cease-to-pump rule	Indicative environmental rule	Instream value	Community dependence
1	No pumping unless flows exceed a specified level at the reference point	Consider commence-to-pump rule	High	Low
2	No pumping unless there is a visible flow at the reference point	Consider commence-to-pump rule	↑	↓
3	No pumping if it draws down the pool	Consider commence-to-pump rule		
4	Exception to no drawing down pools rule for example allow pool drawdown to a specified level		Low	High

The Interagency Regional Panel recommended draft access and trading rules for all the unregulated water sources based on the macro classification approach and indicative rules. It found that for the majority of rivers and creeks no rule, other than a cease to pump when there is no visible flow in the vicinity of the pump site, could be recommended due to:

- many existing licences having no access rules; therefore any change to access should be incremental to allow irrigators time to adjust
- the lack of appropriate reference points (e.g. river gauges) other than the pump site
- if there was a suitable river gauge within the water source, a flow rule using the gauge would be quite stringent and would impact significantly on current irrigation operations, given that many streams only flow intermittently.

⁸ "Stressed River Assessment Report" for various catchments, NSW Department of Land and Water Conservation. Sydney 1999

Other management rules that were considered in the development of the plan include:

- extraction limits – which set the total volume of water that can be extracted on a long-term average annual basis from the water source or water management zone
- rules for granting new entitlement – what types of access licences may be granted
- rules for granting works approvals – what types of setback conditions are required.

Existing rules

Some of the licences within the plan area currently have an existing cease to pump condition (mostly no visible flow at the pump site). However, in most water sources there has been no previous history of a ‘cease to pump’ condition during low flow periods. This applies especially to the water sources that contain the sandy reaches of the river, generally between Mendooran and Coonamble. These water sources have a significant number of users and limited water during low flows.

Proposed rules

When the plan commences, surface water licences in all unregulated water sources will be subject to cease to pump rules (excluding licences held by local water utilities, town water supplies, licensed stock and domestic users, and licences used for food safety and essential dairy care). For the licensed stock users, the State Interagency Panel in November 2008 decided to provide an exemption from the cease to pump rules for the first five years of the plan. Therefore, after that period, the cease to pump rules will also apply to that category of licence.

In instances where the existing cease to pump rule under the Water Act 1912 is based on a higher flow rate than the rule proposed by the plan, the existing cease to pump rule will take precedence.

Access rules for sand beds

The implications of the ‘high stress everywhere’ assumption means that for the majority of water sources, no rule other than a cease to pump when there is no visible flow in the vicinity of the pump site could be recommended. This approach is also due to the absence of a gauging station within or nearby to the water sources and the recognition that installing a station in these water sources was not a priority. This means that for most of the Castlereagh’s water sources the access rule for rivers and creeks is:

*no pumping unless there is a visible flow at the reference point
(water supply work e.g. pump, diversion pipe).*

This approach however was not suitable for dealing with the extraction by spearpoint from a large reach of the main arm of the Castlereagh River, which is contained within one water source and one management zone. The majority of this length of the Castlereagh between Binnaway and Coonamble, a distance of 210 kilometres, is noted for its extensive in-river sand beds. The Castlereagh River is described by residents as the “upside-down” river because for most of the time it flows little, or not at all, and yet yields ample supplies of water from within the sand forming its bed (Rankine and Hill 1983).

In this situation, even though there is no evidence of flow, water is available from these in river sand beds though it is difficult and costly (dollars and time) to extract due to the intensive management required, high set up costs and low returns. Current extractions are not limited by licensed access conditions. However management procedures are based around a physical and temporal cease to pump limitation, with anecdotal advice being that

there seems to be only a short term localised draw down effect due to waters transmission times through the sand and the nature of the undulating clay streambed (for more details see section Water extraction in the unregulated water sources).

Dealing with this issue was also further complicated by the fact that the existing river gauges are not suitable for determination of flow related access within the sand beds and, in addition, the potential for new gauges in this sandy reach of the Castlereagh is negligible, as shown by the deactivation of previously installed gauges because of the nature of this system.

A rule built around this temporal limitation and compliance requirements was devised by the IRP while acknowledging that the depth limitation for extraction by spearpoint ensured that a base environmental flow would continue to remain.

As a no visible flow rule was impracticable to manage extraction by spearpoint of flow moving through these sand beds, the Panel recommended that the water sharing plan contain alternate day cease to pump provisions from the Castlereagh River sand beds between Binnaway and Coonamble (i.e. the Castlereagh River Binnaway to Gilgandra Management Zone of the Binnaway to Gilgandra Water Source and the Castlereagh River Gilgandra to Coonamble Water Source).

Testing of this rule with major spear point extractors prior to public exhibition of the draft plan showed general acceptance to the proposal. While there were no formal submission made on this issue, two suggestions (by phone, and in person) were made that it would be preferable to ensure that the pumping occurred at night to enable the use of off peak electricity and to minimise water loss due to evaporation. Accordingly a minor amendment to the file design of the rule was made.

All these access rules were reviewed by the panel against a large range of reference material while utilising the general knowledge of the IRP members and technical support staff within agencies. The reference material is listed in Appendix 4.

Access rules for pools, lagoons and lakes

The indicative rule for all instream natural pools where visible flow at the pump site is the only access rule in the water source or management zone is “no drawdown below full capacity”. For water sources where the indicative access rule is set at a reference point other than the pump site (for example a road bridge, or gauging station), the no drawdown rule for instream pools described above does not apply, and the access rule for the water source or management zone does apply.

This access rule provides, at a minimum, protection of natural pools which are important for drought refuge, as well as domestic and stock water supplies.

Dealings (trading) rules

Trading rules under the macro planning process for inland catchments are guided by the following principles:

- Where instream values are considered high, trades are either not permitted or only allowed into high flows.
- Where a water source is under high hydrologic stress no trades are permitted into the water source.
- Trades into downstream water sources are permitted regardless of stress or instream value, as long as the water sources have a direct hydrologic connection.

- Trades through a regulated river are not permitted, for example a licence cannot be traded from an unregulated water source upstream of the regulated reach to a water source downstream of the regulated reach.
- Trading within water sources is generally permitted, however in some areas trading may be restricted to protect high value areas or to limit demand in areas where competition for water is already high.

As a result of these principles, trades are not permitted into many unregulated water sources across the plan area. High instream value water sources are protected by prohibiting trades or limiting trades into only higher volume flows. Trades are allowed into some water sources with lower value in order to encourage the movement of extraction from high to lower environmental value areas.

Refining water sharing rules as a result of public exhibition

The Interagency Regional Panel reviewed all the submissions and the matters raised at the meetings and, consequently made some minor changes to the draft water sharing rules proposed for extractions from the in-river sandbeds. During this review process, if updated flow data and water use data became available, it was incorporated into the assessment process. Table 10 outlines the changes to the proposed rules as a result of this consultative process, or the inclusion of new data.

Table 10: Changes to water sharing rules as a result of public exhibition

Water source	Change to water sharing rules	Justification
Binnaway to Gilgandra Water Source (Castlereagh River Binnaway to Gilgandra Management Zone)	Amend 24 hr alternate day pumping rule from sand beds by 6 hr to commence from 18:00	The change would not affect the impact of the rule, i.e. 24 hours on, 24 hours off. However this approach would result in an unbroken 12 hour night time period during which pumping could occur which would improve water use efficiency, reduce power usage and be more workable for irrigators. Ensuring compliance would remain unchanged as the allowable 24hr pumping period would still be clearly defined.
Gilgandra to Coonamble Water Source	Amend 24 hr alternate day pumping rule from sand beds by 6 hr to commence from 18:00	The change would not affect the impact of the rule, i.e. 24 hours on, 24 hours off. However this approach would result in an unbroken 12 hour night time period during which pumping could occur which would improve water use efficiency, reduce power usage and be more workable for irrigators. Ensuring compliance would remain unchanged as the allowable 24hr pumping period would still be clearly defined

Managing extraction in unregulated water sources

Access to very low flow

The water sharing plan permits access to the very low flow (i.e. below the cease to pump defined in the access rules) for those activities that are considered critical to human needs or for animal health requirements. Although the level of extraction is small relative to entitlement, it is in direct competition for environmental water requirements at its most critical time. Licences with access to very low flows include:

- domestic supply
- town water supply, until major augmentation of the schemes infrastructure occurs
- fruit washing
- cleaning of dairy plant and processing equipment for the purpose of hygiene
- poultry washing and misting
- cleaning of enclosures used for intensive animal production for the purposes of hygiene.

The plan provides an estimate of the water requirements for domestic and stock rights within each of the water sources, noting that these rights may increase during the life of the plan. The plan cannot limit or restrict these rights, but the WMA 2000 itself provides for restrictions on basic landholders rights, through the draft Mandatory guidelines for take and use of water under domestic and stock rights that are currently under development.

Construction of rainfall runoff harvesting dams

Capture of water in a rainfall runoff harvesting dam requires no licence if the dam is within the maximum harvestable right dam capacity for the property on which it is located (see *Instream Dams*). Capture of water in a rainfall runoff harvesting dam beyond the permissible harvestable right requires a water supply works approval and a licence nominating this work that has a share component (entitlement), with a volume equal to or greater than the capacity of the dam. Extraction from these dams is not subject to the cease to pump for the water source or management zone.

Trading of access entitlement

The water market is an effective and equitable way to reallocate water between users. The National Water Initiative (NWI) sets out guidelines for water trading. Trading can occur either on a permanent or temporary basis. Trading of water entitlement needs to be addressed in the plan within a framework that maximises the flexibility for users to be able to use water to its highest value but does not adversely impact on water sources or existing users.

Accordingly, the Interagency Regional Panel recommended that, based on high hydrologic stress, the level of existing commitment in each water source and the potential third party impacts, there would be no trading between unregulated water sources permitted in the Castlereagh water sharing plan.

Trading within each water source is permitted except where management zones exist.

Available water determination

Each year, an available water determination (AWD) will be made defining how much of the share component will be available under each category of licence. Specific purpose access

licences such as domestic and stock or local water utility access licences, will generally receive 100 per cent of their share component, although in years of exceptional drought the daily access rules may limit extraction to the extent that annual entitlement cannot be fully realised.

Generally the AWD for unregulated river, unregulated river high flow and aquifer access licences will be 1 ML per unit share. However for the first year of the plan, a one-off announcement of 2 ML per share will be made. This, combined with the carryover rules (see next section), will enable licence holders to use up to twice their water allocation in a year provided that over a consecutive three year period they do not exceed the sum of their water allocations for those three years.

An AWD for unregulated river access licences of less than 1 ML per unit share may be made if the extractions are assessed as exceeding the LTAAEL and a growth-in-use response is required. This will mean that general purpose access licences may in the future, if there is significant growth in water use, receive fewer megalitres in their water account than they have shares. This is unlikely as the limit is based on the level of existing entitlements plus the granting of specific new access licences.

Carryover and water allocation accounts

A water allocation account will be established for each water access licence. Water is credited to the account when an AWD is made, and debited when water is extracted.

Unregulated rivers have enormous variation in annual flow volumes between years. As such unregulated river/ unregulated river high flow access licence account management will operate under three year accounting rules, subject to compliance with the daily access rules. Available water determinations combined with the carryover provisions will enable licence holders to use up to twice their water allocation in a year provided that over a consecutive three year period they do not exceed the sum of their water allocations for those three years. The maximum amount of unused water allocation that can be carried over from one water year to the next in unregulated river/ unregulated high flow access licence accounts will be 100 per cent of the share component (where this is expressed in ML), or 1 ML per unit share (where share component is expressed in unit shares).

A licence holder's account cannot go into debit, and the volume taken over any three consecutive years in not to exceed 300 per cent of annual entitlement.

Water sharing rules for alluvial groundwater sources

Background

The Castlereagh Alluvial groundwater source, which extends from Binnaway downstream to Gilgandra, is mainly recharged by rainfall, side slope run-on and partly by Castlereagh River flow. While the groundwater quality is high, the aquifer yields only a small to moderate volume (generally the yield is less than 5 litres per second) which is unsuitable for high intensity irrigation. As such, there are only seven licensed production bores in the alluvial aquifer and 103 basic right bore licences, which are estimated to extract 630 ML per year or 25 per cent of the annual recharge.

The Interagency Regional Panel has developed water sharing rules for the alluvial aquifer to address:

- limits to the availability of water – based on management to a long-term average annual extraction limit through assessment of average annual extraction
- managing surface water and groundwater connectivity – in consideration of degree of connectivity and amount of carryover allowable
- granting new works approvals – what types of setback conditions are required.

For the purposes of setting access rules in the macro water sharing plans, a groundwater source is considered to be highly connected if 70 per cent of the volume of groundwater pumped during one irrigation season is derived from the surface water source.

Developing the water sharing rules

Defining connectivity

The alluvial sediments upstream of Mendooran are considered highly connected to the Castlereagh River (see section *Managing surface water and groundwater connectivity*), but it is a very small portion in regard to the whole Castlereagh Alluvial groundwater source. As the number of licences (and associated small volume of water extracted) from the Castlereagh Alluvial as a whole is small, it was decided that there was no need for the portion upstream of Mendooran to be managed separately under highly connected rules. Therefore the Castlereagh Alluvial is managed as being less highly connected to the Castlereagh River.

Protecting environmental values

The water sharing plan protects environmental values in the alluvial groundwater source by reserving the long term average volume of water stored in the aquifer and a proportion of recharge to the groundwater source as planned environmental water. Estimates of rainfall recharge have been derived using the macro method⁹, but the groundwater source also has significant recharge from other sources, e.g. river recharge. All of the recharge from these other sources is therefore reserved as planned environmental water. Exact figures for the total recharge volume (and therefore the environmental water component) in these highly

⁹ The macro method for groundwater is outlined in *Macro water sharing plans - the approach for groundwater. A report to assist community consultation*. See www.water.nsw.gov.au for the most recent version of the report.

dynamic systems are not possible as the amount of recharge will depend on the amount of groundwater pumped.

Hydrogeological modelling of connected groundwater sources acknowledges that significant volumes of recharge to the groundwater source are either accessed and removed by vegetation through evapotranspiration or are discharged as baseflows to rivers. Setting the LTAAEL at current average usage protects and maintains environmental water for these functions.

Water sharing rules for groundwater dependent ecosystems

The plan sets out rules that will apply to any high priority (high conservation value) GDEs listed in the schedule. Their location will be mapped and the specified distance rules will apply to new or replacement bores which will not be permitted within a buffer zone around the GDE. Existing bores will not be affected by the proposed buffer zones and are able to continue operating (i.e. within the existing conditions of their access licences). The GDE schedule may be updated after gazettal of the plan. Updating of the schedule is considered to be an amendment to the plan, and as such would require the concurrence of the Minister for the Environment in addition to the approval of the Minister for Primary Industries.

Existing rules

Access licences for groundwater extraction have been subject to annual limits rather than daily management.

Proposed rules

In the Castlereagh Alluvial Groundwater Source, 100 per cent of groundwater storage is reserved as planned environmental water.

Recharge to the alluvial groundwater source is shared between the environment and extractive users. The proportion of recharge reserved for the environment is intended to reduce the risk of unsustainable groundwater extraction in the long term. Planned environmental water for the recharge component is defined as the volume of recharge in excess of the long-term average annual extraction limit (LTAAEL), which is based on current usage.

The Castlereagh Alluvial Groundwater Source has been classified as less highly connected and thus will be managed by groundwater rules only.

The plan also includes rules on the location of new works and extraction from existing works to protect high-priority groundwater dependent ecosystems (GDEs), high-priority karst systems and other environmentally sensitive areas such as rivers or streams.

Managing extraction

NSW has resolved that the long-term average annual extraction limit (LTAAEL) for highly connected and alluvial water resources within the NSW portion of the Murray-Darling Basin shall be set equal to current average usage. Any extraction beyond this level will result in additional impact on groundwater dependent ecosystems and other users of these connected water resources.

In highly connected and alluvial water systems, extraction in one water resource area can reduce water availability in the other. The surface waters of alluvial and highly connected groundwater systems tend to be groundwater dependent and are most vulnerable during dry periods. Surface waters within the NSW portion of the Murray-Darling Basin have been capped at 1993/94 levels of development, following the Murray-Darling Basin Ministerial

Council Agreement, in 1995. The Murray-Darling Basin Ministerial Council Cap does not apply to groundwater.

Extractions are to be managed to the long-term average annual extraction limit (LTAAEL). Should growth in extraction above the LTAAEL be assessed to have occurred, an appropriate growth in use response will be taken. The LTAAEL for the Castlereagh Alluvial groundwater source is equal to 630 megalitres per year, defined by the sum of:

- an estimate of annual extraction (usage) of water for those entitlements issued under Part 5 of the *Water Act 1912* in this water source (545 megalitres per year)
- an estimate of annual water requirements for domestic and stock rights and native title rights in this water source (85 megalitres per year).

Water supply works approvals

In accordance with the principles of the WMA 2000, the plan sets rules to minimise the cumulative impacts resulting from groundwater extraction. To do this, the plan specifies rules which prohibit new/amended works from extracting water within certain distances of other water users, contaminated sites, GDEs and groundwater dependent culturally significant sites. This is to prevent unacceptable or damaging levels of drawdown of water occurring in the local vicinity of these users and sites.

Standard distance rules were developed for the macro plans through internal meetings of regional and State panels consisting of regional groundwater experts and representation from the NSW Department of Primary Industries and Office of Environment and Heritage to incorporate a socio-economic and environmental perspective. These panels compiled sets of distance criteria based on previous studies, substantial local knowledge and experience. This experience included knowledge of analytical and numerical models and their results, such as those used in dryland salinity studies until the late 1990's. A consistent set of rules for common groundwater aquifer types (for example fractured rock, alluvium, coastal sands and porous rock) was then produced by comparing the various rules proposed by the regional panels based on what has worked in the past in similar geological provinces.

Groundwater flow modelling with representative aquifer parameters was used to calculate water balances and also provided water table drawdowns at different distances under a 24 hour/day pumping regime for one year. The modelling was undertaken to test the distance criteria produced by the IRPs to protect regulated stream flow and base flow in the unregulated systems. The modelling indicated that the water table fluctuation due to pumping was not above natural variations if the access rules in the plan are implemented. For high priority GDEs such as Karst GDEs, the distances were set so that overall ecosystem health would remain the same and resulting impacts on drawdown would be within seasonal water level movements. For other GDEs, water users and significant sites, only a minimal level of impact was permitted.

The standard set of distance criteria then went to the State Groundwater Panel for approval. The panel, when negotiating the final rules, weighed the social, environmental and economic impacts of extraction on groundwater sources to set an acceptable level of drawdown near critical sites and other water users. Since then, the standard rules have been further tailored for the macro plans through the development of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources*.

As the distances are based on a combination of experience and modelled estimates of drawdown, the macro plans allow for these distances to be altered in some cases. For example, the distances to minimise interference with other works may be reduced if a proponent can demonstrate in a hydrogeological study that no more than minimal impact will

occur on existing extraction at a lesser distance. The distances to protect GDEs may be reduced if the proponent provides hydrological evidence that no drawdown of water will occur at the outside edge of the perimeter of any high priority GDE listed in the plan.

This process has resulted in consistent rules across aquifer types considered the most current thinking in terms of managing local impacts of extraction and protecting GDEs. However, the plan development process allows for changes to the rules to cater for local conditions. The distance criteria may be altered due to a number of different factors, such as lot size where property sizes may lead to different interference distance criteria, aspects of the local hydrology and groundwater dependence of town water.

For the Castlereagh Alluvial groundwater source, the IRP adopted the standard distance criteria as applicable to the various locational rules.

For new/ replacement works there are rules to:

- minimise interference between neighbouring works
- locate works away from contaminated sites
- protect water levels near high priority groundwater dependent ecosystems (GDEs)
- protect groundwater dependent culturally significant sites
- manage surface and groundwater connectivity
- manage temporary local impacts that may affect water levels, water quality and aquifer integrity.

For existing works there are also rules to:

- protect water levels near groundwater dependent ecosystems (GDEs)
- manage surface and groundwater connectivity
- manage works near contaminated sites
- manage temporary local impacts that may affect water levels, water quality and aquifer integrity.

Access rules

Daily flow access conditions will not apply to licences in the Castlereagh Alluvial groundwater source. As the aquifer has been classified as less highly connected, long-term management is deemed more appropriate than daily access management.

Trading of access entitlement

The water market is an effective and equitable way to reallocate water between users. The National Water Initiative (NWI) sets out guidelines for water trading. Trading can occur either on a permanent or temporary basis. Trading of water entitlement needs to be addressed in the plan within a framework that maximises the flexibility for users to be able to use water to its highest value but does not adversely impact on water sources or existing users.

The Minister's Access Licence Dealing Principles Order 2002, currently prohibits the trade of entitlement from a groundwater source to a surface water source. Trades are only permitted between sources where there is a hydrologic connection; hence trades are not permitted into or out of the Castlereagh Alluvial water source.

Trades are permitted within the groundwater source subject to assessment of potential impacts on other users and the environment.

Carryover and water accounts

The Castlereagh Alluvial groundwater source has a relatively small storage volume. As such, for licence holders extracting from the Castlereagh Alluvial no carryover of entitlement from one year to the next is allowed and the maximum amount of water permitted to be taken from this groundwater source in any one water year is equal to the water allocation accrued in the water access licence account, for that water year.

Available water determination

The maximum available water determination (AWD) for a water source is used to manage growth in extractions above the LTAAEL. AWDs will be made at commencement of each water year for:

- Specific purpose access licences – 100 per cent of share component
- Aquifer access licences – 1ML/unit of share component or lower amount as result of a growth in extractions response.

Growth in extractions will be assessed against the LTAAEL over a five year period with a five per cent tolerance

Amendments to the Plan

In 2016, the *Water Sharing Plan for the Castlereagh Unregulated and Alluvial Water Sources (2011)* was amended to incorporate the water source previously regulated by the *Water Sharing Plan for the Castlereagh River (above Binnaway) Water Source (2003)*.

Although the existing plan for the Castlereagh River above Binnaway had been through its own development process prior to 2004, some changes were made to the access and trading rules for this water source to reflect current management practices prior to its incorporation into the Castlereagh Unregulated and Alluvial water sharing plan. The Castlereagh IRP provided advice to guide these amendments and changes were communicated with key stakeholders to ensure that the amendments did not result in any unintended outcomes.

Refining the access rules for the Castlereagh River above Binnaway

Management zones

The former *Water Sharing Plan for the Castlereagh River above Binnaway Water Source 2003*, established and defined six management zones, together with the trading (dealing) rules to:

- Protect threatened species (zone 1) and Shawns Creek (within zone 6)
- Protect Coonabarabran town water supply (TWS) (zone 1) and Binnaway TWS (zone 4) from pressure due to increased development
- Provide certainty for existing users across all zones.
- Prevent further trade into Belar Creek (zone 5) which was known to be highly committed and often has to implement odds/evens pumping during drought periods

These six management zones have been retained to support the rationale behind their initial establishment with respect to trading and providing certainty to users.

Removal of daily and individual extraction limits

The former *Water Sharing Plan for the Castlereagh River above Binnaway Water Source 2003* contained detailed rules that specify flow classes and total and individual daily extraction limits for the individual management zones.

These provisions are not included in the amended WSP because

- they have yet to be implemented under the 2003 WSP
- there is a lack of both an effective gauging network and the implementation of a metering requirement,
- the presence of large and mobile sandbeds within the system significantly impacts on the ability to apply gauge based access rules
- it will provide consistency in management across the catchment as the 2011 Castlereagh River Unregulated and Alluvial plan does not contain similar detailed provisions).

The new plan does however include an amendment clause enabling the establishment, amendment, removal or reinstatement of flow classes, total daily limits and individual daily

limits at a future time if required. The detail on these rules will remain in the superseded plan to inform any future consideration of reintroduction.

Amendment of access rules

For the Castlereagh River above Binnaway water source it seems that the continuation of the pre 2003 management regime is acceptable and manageable for water users. In management zones 1-5 the application of a detailed cease to pump (CTP) has not been implemented due to the lack of an effective gauging network and therefore the 'no visible flow' CTP has been maintained. In management zone 6 (the majority of the plan area) there has been no change in practice from the pre-2003 access rule of CTP at 'no visible flow'. During the past 10 years DPI Water has not received any comments or objections regarding the access limits or requests to remove or modify the zones to which they apply

Accordingly, it is proposed that the cease to pump limits as currently defined for management zones 1 – 5 be removed and a cease to pump limit, including a pool rule, be applied to all six management zones.

Other changes

Some other minor amendments have been made to clarify existing rules and to simplify the overall plan. These amendments do not change the intent of any rules and are simply for the purposes of making the legislation clearer for licensing staff and water users. These changes include:

- standardising clauses to make them consistent with the latest water sharing plans and legislative framework
- incorporating policy developments since 2004

Adaptive management

Adaptive management is an important part of a water sharing plan. Adaptive management refers to the process of ongoing data collection monitoring, evaluation and review during the life of the plan that either enables plan amendment or remaking of a better plan after ten years. Adaptive management is a requirement of both the WMA 2000 and the National Water Initiative, and has been allowed for during the life of the plan through amending provisions and establishment of “limits of change” to the plan.

Where adaptive management is identified further studies may be undertaken within agencies or by external organisations which may assist in informing the review of plan provisions.

Amendment provisions

Standard amendments that apply to all water sharing plans include:

- amending water sources, management zones or EMUs
- establishing new or additional flow classes in any water source where management zones are added or amended
- amending water sources for which dams on third order streams or higher will not be granted
- amending requirements for metering or record keeping in relation to licensed access works
- updating information in Schedules or deleting them if no longer required.

The Castlereagh Unregulated and Alluvial plan also includes a number of specific amendments that may be made to the plan during its 10 year period of operation. These amendment provisions were part of the rule development process undertaken by the Regional Panel and are defined in Part 12 of the plan.

Monitoring, evaluation and reporting

DPI Water has developed a Monitoring, Evaluation and Reporting Framework in collaboration with key stakeholders. The framework conforms to NSW and Commonwealth government guidelines for monitoring, evaluation and reporting, and demonstrates an adaptive management approach to water planning required under the principles of the WMA 2000. The evaluation framework aims to inform the community of the outcomes of water sharing plans, and to collate the results of various legislatively required evaluations and relevant knowledge to inform the review of the water sharing plans. The framework will assess the inputs, outputs and outcomes of the water sharing plans and their operations. The assessment will consider:

- the process of plan development (appropriateness)
- the performance of the plan during operation (efficiency)
- the socio-economic, environmental and cultural outcomes of the plan (effectiveness).

The main strategies in place to assist in evaluating water sharing plans include:

- assessment of performance indicators (using an Environmental Flows Monitoring and Modelling program)
- an audit of plans and
- review of each plan at the end of its ten year term.

Performance indicators

Part 2 of the water sharing plan includes a number of standard performance indicators that will be monitored over the life of the water sharing plan. It is not practical to monitor all issues in all water sources. The performance indicators identify that monitoring will be undertaken for specific issues in key water sources. The actual procedure for monitoring each indicator may change over the period of the water sharing plan as improved methods are developed.

In order to assess performance indicators, DPI Water has established an Environmental Flows Monitoring and Modelling program which is designed to make the results of environmental flow studies more transferable between water sources and to develop more generic relationships between flow, hydraulics and ecological responses. This will enable a more efficient and effective evidence based approach to support monitoring and evaluation of water sharing plans in NSW.

Audit

The WMA 2000 requires that water sharing plans be audited regularly, at intervals of not more than five years, to determine whether the provisions of the plan are being implemented. Under section 44 of the Act the Minister for Lands and Water must appoint an Audit Panel to undertake this review.

The Audit Panel reflects the membership of the State Interagency Panel for Water Sharing and comprises representatives from DPI Water, OEH, DPI and LLS. Representatives from the NSW Natural Resources Commission and NSW Fisheries are invited to participate in the audit process as observers.

Reflecting the requirements of the WMA 2000 the focus of the audit is on the extent to which the provisions in the plan have been implemented. The audit does not attempt to assess the outcomes or effectiveness of the plan in achieving its objectives (this is considered by DPI Water through its monitoring and evaluation process).

Plan review

At the end of the water sharing plan's 10 year life the Minister may, on recommendation by the NRC (under Section 43A of the WMA 2000), extend a water sharing plan for another 10 years or replace the plan. An extension does not allow for any changes to the water sharing plan. If any changes are proposed, then a replacement water sharing plan needs to be prepared.

The WMA 2000 requires that when deciding whether to extend or replace an existing plan, the Minister must consider

- the most recent audit of water sharing plans conducted under section 44
- a report from the NRC prepared within the previous five years, on the extent to which the water sharing plan has contributed to relevant state-wide natural resource management standards and targets of the relevant LLS catchment action plan.

Under the WMA 2000 a water sharing plan may be extended for 12 months past the expiry date of the plan to allow for a replacement plan to be prepared.

Glossary

Many of the terms in this document are defined in the WMA 2000 and are therefore not redefined here. However, there are some terms that are not and have therefore been defined below to assist with understanding the water sharing plan.

Account water: The balance in an access licence water allocation account at a particular time. An access licence water allocation account records water allocations accrued under the licence as well as water allocations taken, assigned or re-credited. The operation of the account is also governed by rules for the carrying over of credits from one accounting period to the next and rules for the maximum credit that may be allowed to accumulate in the account as established in a water sharing plan.

Alluvial, alluvium: Sediment deposited by a stream of running water, in particular along river beds or flood plains.

Aquifer: An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be usefully extracted. The volume of water stored in an aquifer, the rate at which water can recharge, the volume of water extracted from it, and the rate at which water can move through the aquifer are all controlled by the geologic nature of the aquifer.

Critical habitat: Areas of habitat (land or water) that are crucial to the survival of particular threatened species, populations or communities.

Cumulative impact: The combined impact of all surface water extraction.

Ecological values: The intrinsic or core attributes associated with naturalness, diversity, rarity and special features, but excluding representativeness used to classify water sources for apportioning water management rules.

Endangered ecological communities: Ecological communities listed in Schedule 1 of the *Threatened Species Conservation Act 1995* or Schedule 4 of the *Fisheries Management Act 1994*.

Ephemeral: Temporary or intermittent; for instance, a creek or wetland which dries up periodically.

Extraction of water: Removal of water from a river for off-stream storage or consumptive use.

Extraction management unit (EMU): A group of water sources; defined for the purpose of managing long-term annual average extraction.

Flow classes: The range of daily flow rates in a river which provides the framework for sharing water on a daily basis.

Flow duration curve: A plot that shows the percentage of time that flow in a stream is likely to equal or exceed some specified value of interest.

Flow gauging station: A device used to measure the height of a river, from which the flow in the river can be calculated.

Flow reference point (FRP): The site from which the flow data is calculated to determine the rates associated with a flow class and then to implement the daily access rules during the life of the plan.

Full capacity: The volume of water that is impounded in the pool, lagoon or lake when the level of water in the pool, lagoon or lake is at the high water mark.

Groundwater: The water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated.

Groundwater dependent ecosystems (GDEs): Ecosystems that rely on groundwater for their species composition and their natural ecological processes.

Individual daily extraction limit (IDEL): The daily volume limit that may apply for a particular licence holder for each flow class. The IDEL will be specified as part of the extraction component on the access licence. It establishes a share of the TDEL for that flow class.

Long-term average annual extraction limit (LTAAEL): The target for total extractions (under all water access licences plus an estimate of basic landholder rights within an EMU) which is used to assess whether growth-in-use has occurred. The actual annual extractions (metered plus estimated) are averaged over a fixed period of time defined by the water sharing plan when comparing with the LTAAEL. If the fixed period of time is greater than one water year, then in any one water year, extractions can exceed the LTAAEL without triggering a growth-in-use response.

Macro water sharing plans: Plans which apply to a number of water sources across catchments or different types of aquifers. The macro planning process is designed to develop broader-scale plans covering most of the remaining water sources in NSW.

Management zone (MZ): An area within a water source used for defining the location of applicability of water sharing rules, but secondary to the water source. A management zone (MZ) is more likely to be designated where local dealing restrictions are in place or where 'Cease to Pump' (CtP) rules for works approvals apply.

Pools: Lentic water bodies (standing water), including anything falling within the definition of a "lake" found in the Dictionary of the *Water Management Act 2000*, except for tidal pools and estuaries.

Reliability: The frequency with which water allocated under a water access entitlement is able to be supplied in full (referred to in some jurisdictions as 'high security' and 'general security'). Alternately, reliability can also sometimes be measured in terms of long-term average water availability relative to entitlement.

Riparian: Relating to or living or located on the bank of a natural watercourse, such as a river or stream.

Security: The legal status and tenure of a right to access water. This includes the level and assurance that a water access entitlement will provide that which it specifies. Security thus includes the reliability of supply. The range of water access entitlement characteristics detailed in the NWI contributes to the security of a water access entitlement.

Schedule 2: Refers to those licence holders, as identified in Schedule 2 of the plan, that may continue to access water during periods of very low flows for fruit washing, cleaning of dairy plant and equipment for the purposes of hygiene, poultry watering and misting or cleaning of enclosures used for intensive animal production for of hygiene.

Supplementary water event: A continuous period during which the taking of water from uncontrolled flows under supplementary water access licences or as no-debit access under a Regulated River (general security) access licence is permitted in all or part of a River Water source

Total daily extraction limit (TDEL): The total limit on the daily volume of water that access licence holders in a particular category can take from a flow class. It is the sum of all the IDELs in that flow class.

Uncontrolled flow: is flow, in excess of that needed to meet the environmental provisions of the plan, basic landholder rights and water orders placed by Regulated River (general security) access licences and higher priority access licences in a water source. These flows originate from tributary inflows or dam spills.

Visible flow: The continuous downstream movement of water that is perceptible to the eye.

Water sharing plan (plan): A plan made under the WMA 2000, which sets out the rules for sharing water between the environment and water users within whole or part of a water management area or water source.

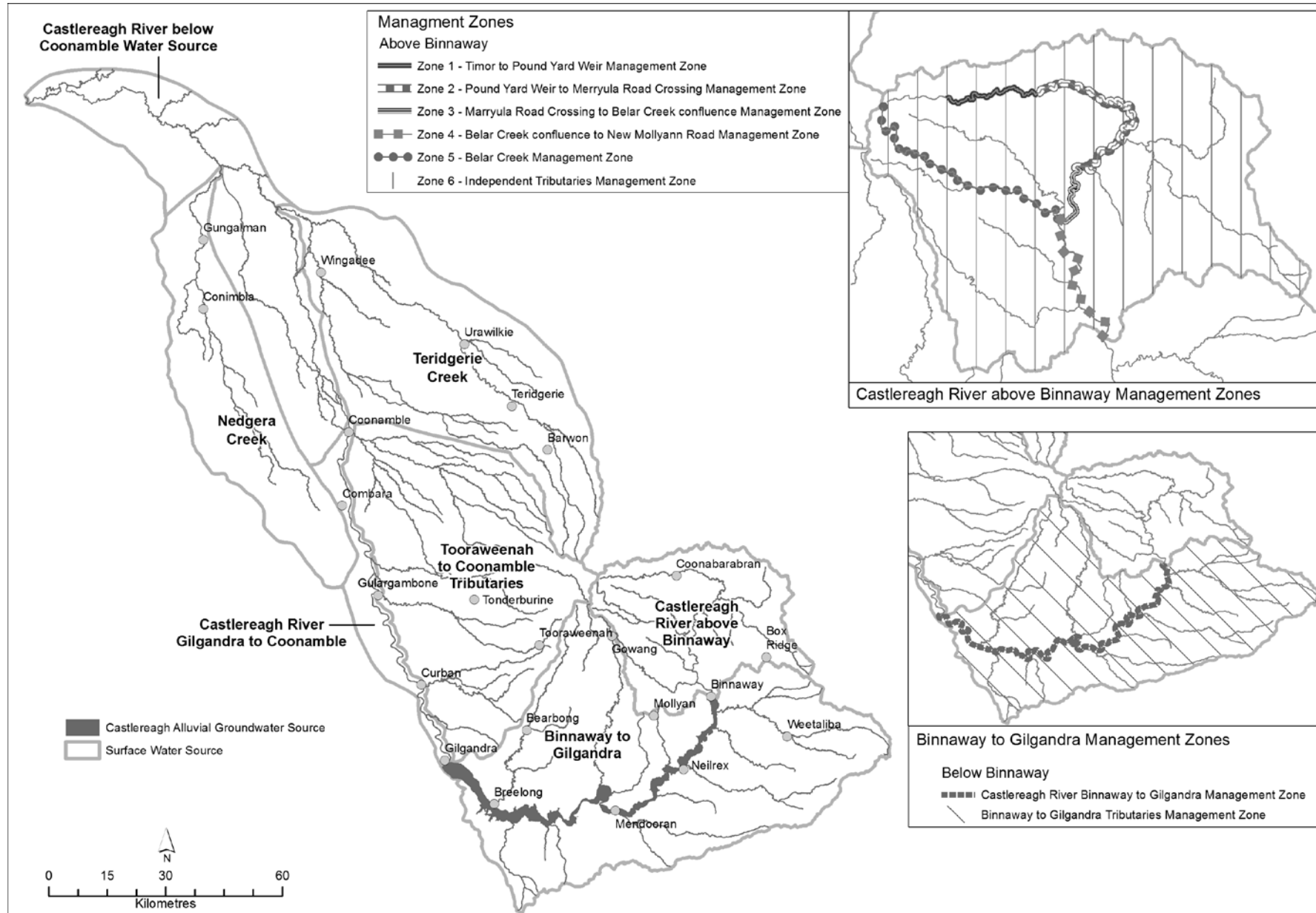
Water year: The 12 months running from 1 July to 30 June

References

- Baker T and Raisin G 2000, *An assessment of riverine health in the Macquarie, Castlereagh and Bogan River catchments*, Department of Land and Water Conservation, Central West region.
- Christison, R 2009, *Thematic history of Gilgandra Shire*, High Ground Consulting.
- CSIRO 2008, *Water availability in the Murray-Darling Basin*, a report by CSIRO to the Australian Government, November 2008.
- DLWC 1998, *Stressed rivers assessment report*, NSW Department of Land and Water Conservation, Sydney.
- DLWC 2001, *Water Management Act 2000 – What It Means for NSW*, Department of Land and Water Conservation, Sydney, February 2001, HO/03/01.
- DLWC 2002, *NSW Groundwater Dependent Ecosystems Policy*, Department of Land and Water Conservation, available online at www.water.nsw.gov.au/ArticleDocuments/34/groundwater_dependent_ecosystem_policy_300402.pdf.aspx
- Department of Environment Climate Change and Water 2010, *Warrumbungle National Park. Native vegetation*. Accessed online 09/02/2010, <http://www.environment.nsw.gov.au/NationalParks/parkVegetation.aspx?id=N0035>
- Kingsford R.T., Brandis K., Thomas R., Chriton P., Knowles E. and Gale E. 2003, *The Distribution of Wetlands in New South Wales*. NSW National Parks and Wildlife Service, Hurstville.
- National Parks and Wildlife Service 1997, *Warrumbungle National Park New Plan of Management*. NSW National Parks and Wildlife Service, Sydney. Accessed online 09/02/1010, <http://www.environment.nsw.gov.au/parkmanagement/ParkManagementPlans.htm>
- Rankine & Hill 1983, *Castlereagh Valley: summary report, March 1983*. Rankine & Hill Pty. Ltd for Water Resource Commission, NSW.

Appendices

Appendix 1: Water sharing plan map



Appendix 2: Identified threatened species

It is important to note that the macro water sharing plan process is concerned with protecting instream water values that relate to extraction. Therefore, only threatened species that are likely to be sensitive to extraction have been considered when assessing the water source values.

It should also be noted that some threatened species are highly sensitive to low flow extraction, whilst other threatened species, such as plants that occur in the riparian zone, are less sensitive.

Accordingly, threatened species considered to be highly sensitive to low flows are given a highly priority for protection.

The table below shows threatened species that are known (K) or expected (E) to occur in each water source.

	Castlereagh above Binneway	Binneway to Gilgandra	Tooraweenah to Coonamble Tributaries	Teridgerie Creek	Castlereagh River Gilgandra to Coonamble	Castlereagh River below Coonamble	Nedgera Creek
Fish species							
Olive Perchlet			E	E	E	E	E
Macquarie Perch	E	E	E	E	E	E	E
Silver Perch			E	E	E	E	E
Frog species							
Red-crowned Toadlet		E					
Bird species							
Australasian Bittern	K	E	K	K	K	K	K
Black-necked Stork	K	K	K	K	K	K	K
Black-tailed Godwit	E	E	K	K	K	K	K
Blue-billed Duck	E	E	K	K	K	K	K
Brolga	K	K	K	K	K	K	K
Freckled Duck	E	E	K	K	K	K	K
Magpie Goose	K	K	K	K	K	K	K
Painted Snipe	E	E	K	K	K	K	K
Regent Honeyeater	K	K	K	K	K		
Other fauna							
Greater Broad-nosed Bat	E	E	E	E	E		

Disclaimer

The Office of Environment and Heritage (OEH) has provided assessments on the presence of threatened species and their sensitivity to extraction to inform the classification of water sources through the Macro Water Sharing Planning process. The assessments were undertaken for the specific purpose of developing an initial classification of water sources. They were based on the most accurate and relevant data/ information sourced and analysed at the time.

Initial classifications were a first step to inform panel deliberations. Panels considered a range of information and used local knowledge in determining a final classification. The assessments are not absolute – for example the absence of threatened species for an assessment does not necessarily mean the threatened species are not present.

These assessments should not be used for any purpose other than classification of catchment management units as part of the Macro Water Sharing Planning process.

Appendix 3: Interagency Regional Panel and support staff

Name	Agency	Role	Expertise
Interagency Regional Panel			
Dave Miller	DPI Water	Agency Representative	Water planning/administration/policy. Geomorphology. Riparian management. Stream ecology/restoration.
Greg Markwick	DPI (formerly I&I NSW)	Agency Representative	Regional experience in water reform programs, water quality problems, inland agricultural industries, catchment management and interagency coordination.
Debbie Love	OEH (formerly DECCW)	Agency Representative	Regional input to water reforms, catchment plans and investments, biodiversity and threatened species management planning.
Jessica Brown / Laura McKinley	NRCMA	CMA Observer	Catchment management, program development and implementation, project management, soil conservation, land management and riparian restoration. Community liaison and engagement.
Support Staff			
Tim Rabbidge	DPI Water	Plan coordinator	Water policy and planning, plan development and implementation, facilitation and project management.
Jeanette Nestor / Richard Wheatley	DPI Water	Technical Support (licensing)	Licensing officer, local knowledge of water users, local access arrangements and reference points.
Hari S Haridharan	DPI Water	Technical Support (groundwater)	Hydrogeology, local knowledge of water users, local access arrangements and reference points.

Appendix 4: Interagency Regional Panel reference materials

Office data sets

Licensing Administrator System (LAS) – DPI Water statewide database holding the licence details including volume of entitlement, location details and stream orders.

Hydsys – Hydsys is an Office of Water statewide database that holds all flow record data. Flow records are available for most water sources in the Northern Rivers area.

Regional Groundwater Monitoring Network – DPI Water is developing a regional groundwater monitoring network to be used to monitor alluvial groundwater levels and assess stream / surface water connectivity.

Volumetric Conversion Database (VOLCON) – used to help determine the Peak Daily Demand (PDD) for each water source.

Regional Geographic Information Systems – DPI Water Land use and topographic information

Central data sets

Stressed rivers reports – used as the basis for identifying where there are in-stream barriers.

Threatened species (fish) – Data supplied by the former I&I NSW.

Threatened species (other) – Data supplied by the former DECCW.

Index of Social Disadvantage – Australian Bureau of Statistics.

Employment in Agriculture - Australian Bureau of Statistics

Other agency data

National Parks and Wildlife (within the former DECCW) statewide atlas – State-wide flora and fauna database

NSW Fisheries (within the former I&I NSW) modelled data sets (Fish Community Index, Fish Community Vulnerability).

NSW Fisheries (within the former I&I NSW) freshwater and saltwater recreational fishing database.

Other projects/reference material

Australian Greenhouse Office (March 2004 version). *NSW Forest Extent 1972-2002*. Australian Greenhouse Office, Canberra. Data set used to determine per cent cover and width of riparian zones.

NSW DPI Agriculture web site for crop gross margins:
<http://www.agric.nsw.gov.au/reader/budget>.

Trewin, D. (2001), *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA)*. Australian Bureau of Statistics, Canberra.

Central West Catchment Management Authority (2007), *Central West Catchment Action Plan 2006 - 2016*

- Deverell, C (2008), *Where Community Matters*, Country Careers Coordinator. Gilgandra,
- Christison, R (2009), *Thematic history of Gilgandra Shire*, High Ground Consulting.
- NSW Office of Water (draft 2010), *Castlereagh catchment - General purpose water accounts contextual statement*
- NSW Department of Planning (2008), *New South Wales State and Regional Population Projections, 2006-2036*:
- New South Wales Department of Land and Water Conservation (1998), *Stressed rivers assessment report*, NSW Department of Land and Water Conservation, Sydney.
- Baker, T & Raisin, G (2000), *An assessment of riverine health in the Macquarie, Castlereagh and Bogan River catchments*, Department of Land and Water Conservation, Central West region.