Department of Primary Industries
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Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources

Background document

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More information

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Introduction

Water sharing plans (plans) are being progressively developed for rivers and groundwater systems across New South Wales following the introduction of the *Water Management Act 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 plans commenced in NSW, bringing these water sources and some 80 per cent of water extracted in NSW under the management and licensing provisions of the *Water Management Act 2000*.

In recent years, plans for the unregulated[1] rivers and groundwater systems have been completed using a 'macro' or broader-scale river catchment or aquifer[2] system approach. Over 95 per cent of the water extracted in NSW is now covered by the *Water Management Act 2000.* The macro planning process is 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 river basin or aquifer macro plans will generally apply to catchments or aquifers where there is less intensive water use.

The *Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources* (the Plan) covers 22 unregulated surface water sources that are grouped into one extraction management unit (EMU) and four alluvial groundwater sources (refer Appendix 1).

This document provides background to the development of the rules in the plan and includes:

- the purpose of the statutory plan
- a physical description of the Namoi catchment including land and water use
- the process of plan development including scope, history and basis for decisions
- the activities associated with implementation, monitoring and review of the plan

This document is part of a range of material available specifically on the plan including:

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

In addition, general information on the macro planning process is available in the Water sharing plans section of the NSW Office of Water website www.water.nsw.gov.au. Information available for download or viewing 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. Setting access and trading rules for pools* – explains the method used to set water sharing rules for pools in unregulated water sources across the state

[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.

[2] An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be usefully extracted.

- *Macro water sharing plans – the approach for groundwater. A report to assist community consultation* – explains the method used to classify and set water sharing rules for groundwater across the state
- *Setting rules for water sharing plans* – information outlining the key steps for developing the rules.

Purpose of the plan

Why are water sharing plans being prepared?

Expansion of water extraction across NSW in the 20th 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.

Under the *Water Management Act 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 rights. 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 provide a legal basis for sharing water between the environment and consumptive purposes.

Plans also recognise the economic benefits that commercial users such as irrigation and industry can bring to a region. Upon a plan's commencement, access licences held under the *Water Act 1912* are converted to access licences under the *Water Management Act 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 *Water Management Act 2000*, plans also set rules so that commercial users can also continue to operate productively. In general, commercial licences under the *Water Management Act 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

With the introduction of the plan, a number of benefits will flow to water users including:

- greater certainty for water users – the plan sets out the water sharing arrangements for a 10 year period
- clear trading and access rules – the plan specifies where and how trading can occur
- automatic conversion of licences in the plan area to perpetual water access licences providing greater security for water users – meaning the volumetric water access licences do not have to be renewed, however approvals for the works used to extract water under these access licences will need to be renewed.

Environmental considerations

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

To be healthy and reproduce successfully, the plants and animals that live in rivers and streams need floods (very high flows), freshes (high flows) and dry spells (low and very flows). The plan's environmental flow rules are designed to ensure the plants and animals in streams continue to experience this full range of flow events.

There is evidence to suggest that low flows are essential for maintaining water quality, allowing passage over riffles for fish and other fauna to pools used for drought refuge, and maintaining those parts of aquatic ecosystems that are most productive. For example, the faster flowing riffle areas between pools usually contain the highest abundance and diversity of aquatic fauna.

In order to protect a proportion of these low flows for the benefit of the environment, the plan imposes water access rules in the form of new access restrictions on days when flows are low. These 'cease-to-pump' (CtP) rules 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 CtP rules (excluding licences held by town water suppliers, local water utilities, licensed stock and domestic users, and licences used for food safety and essential dairy care[3]).

In water sources where there is a history of flow data and automatic telemetered gauges are currently installed, CtP rules have been established after reviewing the flow patterns or hydrology of the stream, taking into considering the protection of in-stream environmental assets and processes but also equity of access and economic impact on water users. In many water sources existing conditions on some licences were more restrictive than the CtP rules, as a result of specific conditions applicable to that stream or to minimise impacts on other water users. These licences have been identified and these 'higher' conditions have been transferred across to the equivalent new access licences issued under the *Water Management Act 2000* to ensure there is no worsening of instream health or equity of access for other water users.

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 protected by the plan not allowing any licences to trade into the water source.

Alluvial groundwater sources

An aquifer is an 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; this is referred to as 'storage'.

The volume of water in storage is recharged in a number of ways depending on the type of the groundwater system. Recharge usually comes from rainfall, surface water bodies such as rivers, or via flow from adjacent aquifers. Under the plan, only a proportion of recharge is available for extraction. The remainder of recharge is reserved for the environment. Limiting the volume of use to a proportion of recharge is intended to reduce the risk of unsustainable groundwater extraction in the long term.

[3] 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*"

Some groundwater sources, such as alluvial aquifers, are highly connected to surface water flows meaning that a large proportion of recharge comes from the adjacent river. Taking water from one source can affect the other. Where low river flows are protected by CtP access rules for environmental purposes, similar restrictions may also be applied to 'highly connected' groundwater systems. That is, environmental water may also be protected through linked CtP rules to ensure taking groundwater does not adversely affect surface water flows.

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

Scope of the plan

The plan covers both surface water and some groundwater resources within what is known as the Namoi water management area. The surface water resources comprise the mostly unregulated tributary streams and off-stream water bodies (such as lagoons and the large ephemeral water body Lake Goran) in the Namoi water management area that are not already covered by the following existing water sharing plans:

- *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources (2004)*
- *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources (2004)*
- *Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources (2010)*

A number of smaller groundwater sources that comprise alluvial aquifers hydrologically connected to stream flows are also included in the plan. These will be managed in an integrated way, by the development of water sharing rules that are consistent with rules for adjacent surface water users. These aquifers are the Manilla, Currabubula, Quipolly and Quirindi alluvial groundwater sources. The remainder of groundwater resources in the Namoi water management area are already covered by existing plans, namely the:

- *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources (2006)*
- *Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources (2008)*
- *Water Sharing Plan for the NSW Great Artesian Basin Shallow Groundwater Sources (2011)*
- *Water Sharing Plan for the NSW Murray-Darling Basin Porous Rock Groundwater Sources (2011)*
- *Water Sharing Plan for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources (2012)*
- *Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources (2012)*

Water management units

Where appropriate, an **extraction management unit** (EMU), consisting of one or a number of unregulated surface water sources, is specified for the purpose of establishing a geographic area over which the long-term average annual extraction limit (LTAAEL) applies.

This plan refers to one EMU, the **Namoi Extraction Management Unit**, which covers all the 22 unregulated surface water sources included in this plan, but which also includes 9 unregulated surface water sources in the existing plans:

- *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources (2004)*
- *Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvium and Fractured Rock Water Sources (2010)*

Unregulated surface **water sources** are used to define where water access rules apply. As specified above there are a total of 26 water sources within the plan area, 22 of surface water and 4 of groundwater.

Water sources can be further subdivided into **management zones** where finer resolution of water access rules is required. Within this plan there are 26 unregulated river management zones, and 3 groundwater management zones.

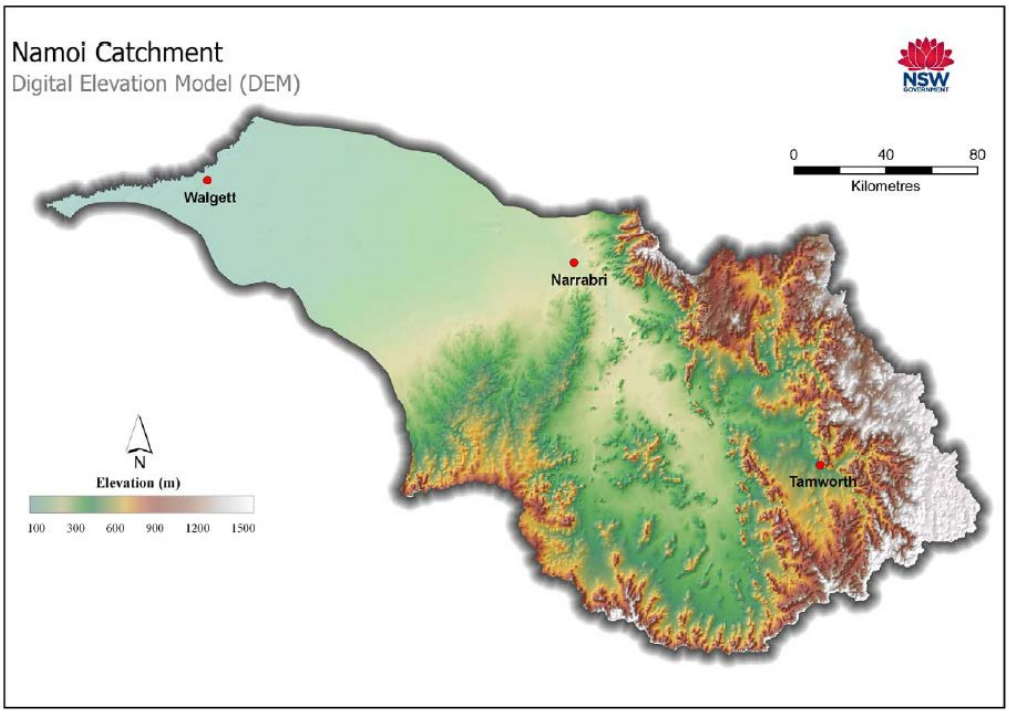
In some water sources where water access rules are consistent but limits are imposed on the trading of entitlements, **trading zones** may also be established. Within this plan there are 5 trading zones.

The location of management zones and trading zones in the Plan area are shown in Appendix 1. For more information about water management units refer to Water Sharing Rules section of this document.

Description of the plan area

The Namoi River catchment covers an area of approximately 42,000 km^2 and represents about 3.8 percent of the Murray-Darling Basin. It lies between the Gwydir and Castlereagh catchments, and its headwaters arise in the Great Dividing Range in the east, the Liverpool Ranges to the south east, the Warrumbungle Ranges to the south, and the Nandewar Ranges and Mount Kaputar to the north. Elevations range from over 1,500 m in the south and east to just 100 m on the floodplain of the lower catchment west of Narrabri (Figure 1). Stretching from Bendemeer in the east to Walgett on the western boundary, the Namoi catchment is over 350 km long, covering 3 distinctive landform types – tablelands, slopes and plains.

Figure 1 Topography and elevation of the Namoi catchment



The main watercourse draining the catchment is the Namoi River on which is located Keepit Dam downstream from Manilla. From here to its confluence with the Barwon River, the Namoi is a regulated river. Split Rock Dam is located higher in the catchment on the Manilla River, and the Manilla and Namoi Rivers between the 2 dams are also regulated. The Peel River sub-catchment, containing Chaffey Dam, whilst a substantial portion of the Namoi catchment, is not part of this plan, being covered by an existing water sharing plan. Similarly the majority of the Mooki River catchment, embracing much of the Liverpool Plains is also not part of this plan, being also covered by an existing plan.

The major unregulated tributaries covered by this plan are the Macdonald and Upper Namoi Rivers, Halls Creek upstream of Manilla, the Manilla River above Split Rock Dam, Bundella and Coxs Creeks which flow into the Namoi at Boggabri, Maules Creek, and the out-flowing streams from the Pilliga scrub including Bohena, Bundock, Brigalow and Baradine Creeks. The lower section of Pian Creek west of Burren Junction is also unregulated, as is the catchment of Lake Goran.

Many of these tributaries are ephemeral streams, more so in the western parts of the catchment where flow is much more variable. A number of streams are underlain by alluvial aquifers and often lose substantial flows.

The majority of unregulated water use in the catchment occurs in central and western parts of the catchment where fertile grey clay plains are suitable for large scale irrigation development for broad area crops such as cotton, cereals and oilseeds. Also many farms with unregulated surface water entitlement have access to alluvial groundwater supplies, which are more reliable in low rainfall seasons. Where unregulated entitlements are held on small or highly ephemeral streams where alternative sources such as groundwater are unavailable, irrigation is carried out on an opportunistic basis and varies greatly from season to season. In ephemeral streams the ability to store water in on-farm dams is critical to be able to effectively utilise the limited periods of accessible flows.

High environmental value areas

The Namoi region has one wetland of national significance, the ephemeral Lake Goran, located on the Liverpool Plains. Lake Goran is the terminus of a large internal drainage basin with a catchment of over 1,700 km^2. When full it has a surface area of over 50 km^2. It is recognised as an important habitat for water-birds, particularly migratory birds protected under international migratory bird agreements. The Lake Goran catchment is not a regular contributor to Namoi River flows (CSIRO, 2007). Only during major floods does the lake or catchment overflow into the Mooki River and contribute to Namoi River flows.

There are no other wetlands classified as being highly significant. However there are many water related features providing high environmental or habitat value. Many upland catchment areas are located in national parks or forests, or have high native vegetation value, and are associated with healthy streams and good biodiversity. On the Namoi floodplain from Gunnedah to Walgett there are many off-river lagoons, stream anabranches and water bodies in good condition which act as refuge areas particularly in dry times. The limited number of perennial or more reliable tributaries are particularly important for fish habitat and breeding, as are watercourses with healthy riparian native vegetation.

Seven of the 22 unregulated surface water sources covered by the plan were identified as having high instream values. Water sources identified as having high instream value tend to be those water sources where threatened species are present. The instream value of all 22 unregulated river water sources is listed in Appendix 2.

Land use history

Prior to European settlement, the Namoi catchment was part of the territory of the Kamilaroi nation which extended from around Singleton in the Hunter Valley to the Warrumbungle Mountains in the west and through the north-west plains into south-west Queensland. The land and waters of the Namoi catchment contain places of deep significance to Aboriginal people, central to their spiritual and religious belief systems, and are often celebrated in ritual, ceremony, story, dance and art work.

Present information indicates that Aboriginal occupation of the area dates back at least 3,600 years and possibly to more than 20,000 years. The various Kamilaroi communities were loosely bound by a common language spoken in different dialects throughout their area. Estimates of the Aboriginal population prior to European settlement vary, but by the late 1820s there were probably around 10,000 to 12,000 indigenous occupants in the area from the Peel River (Tamworth area) to the Barwon River (Tamworth Regional Council, 2005). Much of Aboriginal life revolved around locations in proximity to water resources such as rivers and billabongs where good biodiversity provided more reliable food supplies and materials for daily life.

Much of the region prior to European settlement was characterised by the now threatened grassy box woodlands (Kalaitzis, 1996 in NSW Office of Water, 2010). This included white box grassy woodlands with yellow box and Blakely's red gum on lower slopes. In the 1820s, the increasing expansion of European settlement in the Hunter Valley began to push over the ranges onto the Liverpool Plains and beyond. The grazing potential of the Liverpool Plains and the Peel Valley had been well described on the earlier explorations of John Oxley in 1817-18. Graziers and squatters gradually spread across the fertile plains from the 1820s through to the 1850s. By the 1840s much of the better grazing land was under the control of large grazing stations, with access to water for stock being a critical aspect. During this period the indigenous population suffered and declined greatly due to the effects of introduced disease epidemics, increasing exclusion from traditional hunting grounds by the expansion of sheep and cattle grazing, and general cultural alienation. During the early period of grazing expansion, settlers learnt from experience of the unreliable nature of water supplies from ephemeral streams, and of the severe impact of floods on the alluvial plains.

European settlement was hastened significantly by the discovery of gold in inland areas of NSW from the 1850s. Urban settlements, such as Tamworth, Gunnedah, Narrabri and Wee Waa, grew and developed as towns during the 1850 to 1880 period. Tamworth was proclaimed a borough in 1876, and Narrabri a municipality in 1883. Wee Waa had been the early centre for police and law in the western part of the catchment with a court house opened in 1847. The extension of rail across the north west from the 1870s also greatly boosted settlement and commerce. Rail reached over the range to Quirindi in 1877, Tamworth in 1878, Gunnedah in 1879, Narrabri in 1883, Wee Waa in 1901, and Walgett by 1908.

While sheep and cattle grazing was the predominant land use up until the Second World War, small scale cropping and dairy farming for local consumption was important for the expanding population. Wheat farming occurred mainly on the lighter, more easily cultivated soils and expanded in the 20th century, assisted by government support through the Department of Agriculture, and improvements in plant breeding. The uncertainty of drought also encouraged some small scale irrigation development in proximity to rivers from the 1900s, and began the push for large dam construction. The rapid spread of mechanised farming after World War 2 allowed cropping to expand onto the heavy grey clays of the Liverpool and north west plains and from the 1950s wheat and later summer cropping became major industries focused on export income.

Work commenced on Keepit Dam on the Namoi River in 1938 but was interrupted by war and only recommenced in 1946, with completion finally in 1960. Subsequently the 1960s saw a rapid expansion in irrigation development on the plains downstream of Gunnedah and particularly in the

Narrabri - Wee Waa area. The introduction of cotton and Californian farming systems on the heavy grey clays resulted in a steadily expanding cotton industry based on regulated water supply from the Namoi River. Also in the1960s, American water drilling methods were introduced, allowing steady growth of irrigation from the extensive areas of alluvial groundwater in the Namoi Valley, and across the Liverpool Plains. The expansion of irrigation eventually stretched available water supplies, particularly during the early 1980s drought, and increasing regulation by government was required to adequately share both surface and groundwater resources. Chaffey Dam on the Peel River was completed in 1979 to supply irrigation water to local dairy and fodder producers and to augment Tamworth's town water supply. A second storage for supplying irrigation water to the lower Namoi, Split Rock Dam on the Manilla River, was completed in 1987. Several smaller dams in the catchment are operated by Councils for town water supply purposes. Meanwhile, the number of water licences on unregulated streams in the catchment had also been increasing.

From the 1980s, there was a growing concern that the increasing extraction of water, expanding area of land developed for irrigation, and alteration of natural river flow patterns may be affecting the ecological health of the river system and its dependent vegetation and wildlife. Furthermore, concerns about reduced flows to water reliant communities downstream along the Darling and Murray Rivers prompted calls for a 'basin wide' approach. In the mid 1990s the Murray-Darling Basin 'cap' was introduced in order to minimise further expansion of irrigation and extractions, and a greater focus on the water requirements of the 'environment'. In NSW, the *Water Management Act 2000* was introduced to provide a better mechanism for sharing water between users and the environment. The first Water Sharing Plans (WSP) for the Namoi Valley commenced in 2004, covering the unregulated streams of the Mooki River catchment which flows into the Namoi near Gunnedah, as well as the regulated Namoi River, for the major Namoi groundwater sources in 2006, and for the Peel River catchment in 2010.

Current land use activities in the Namoi catchment include sheep and cattle grazing which accounts for 61 percent of land use by area (Table 1) (NOW 2012). Wheat, cotton and other broad acre crops such as grain and hay are grown along the alluvial floodplains with cotton being the major irrigated crop (Figure 2). In the year 2000, over 70 percent (more than 80,000 ha) of the 112,000 ha irrigated area was used for cotton production in the Lower Namoi catchment (CSIRO 2007). Irrigation water is predominantly sourced from the regulated Namoi River, with alluvial groundwater also an important source.

Table 1 Land use statistics for the Namoi catchment

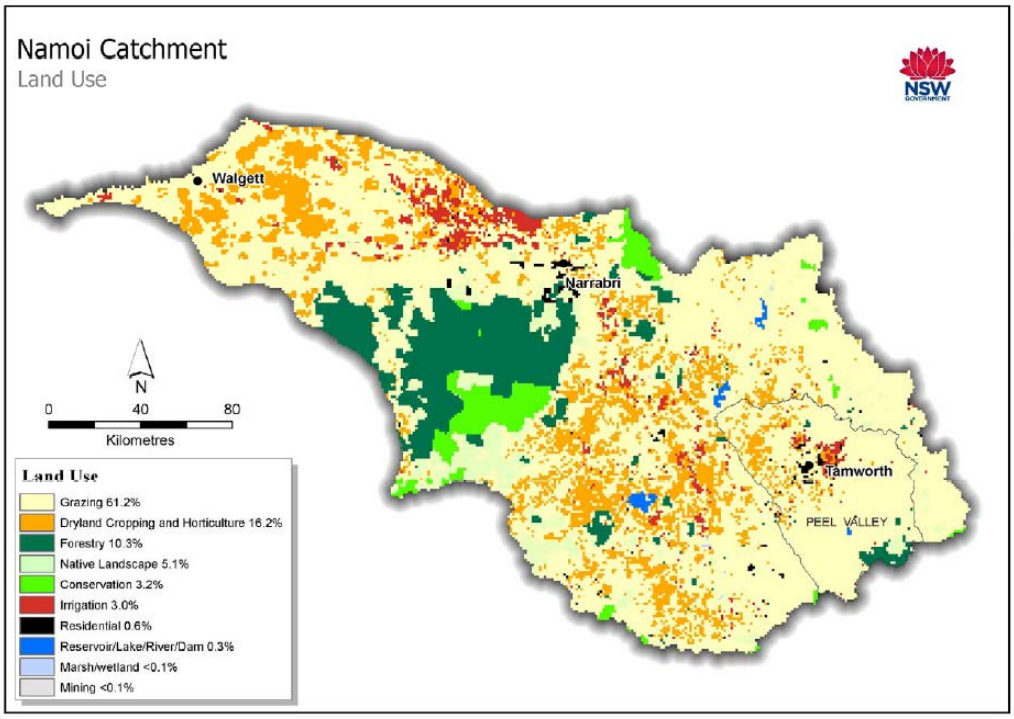
Land use type	Extent (km^2)	Proportion of catchment (%)
Grazing	25,727	61.2
Dryland cropping and horticulture	6,810	16.2
Forestry	4,339	10.3
Native landscapes	2,136	5.1
Conservation	1,351	3.2
Irrigation	1,259	3.0
Residential	256	0.6
Lakes, rivers, dams	139	0.3
Wetland	12	<0.1
Mining	7	<0.1

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

Extensive areas of land for conservation and forestry occur in the middle of the catchment to the south of Narrabri. Together with other native landscapes such as National Parks, smaller Nature Reserves, and State Forests, these land uses account for over 18 percent of the Namoi catchment. Much of this area comprises the Pilliga Scrub, a significant area of remnant dry sclerophyll forest west of the Great Dividing Range in NSW. The Pilliga Nature Reserve and Pilliga State Conservation Area together protect over 1,800 square kilometres of this semi-arid woodland.

There are approximately 100,000 people within the Namoi catchment, mostly along the Namoi River and its tributaries between Tamworth and Narrabri. Tamworth, located on the Peel River, is the largest urban centre in the catchment with a population of nearly 33,500 people (ABS, 2006). Gunnedah, on the Namoi River, has a population of 7,500 people, and Narrabri, also on the Namoi, has a population of 6,100 people (ABS, 2006). A number of smaller towns throughout the catchment, such as Barraba, Manilla, Quirindi, Walgett, Wee Waa and Werris Creek, support between 1,000 and 3,000 people (ABS, 2006).

Figure 2 Land use the Namoi catchment



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

Climate

The climate has been classified as a temperate climate (Tomlinson, 2008).

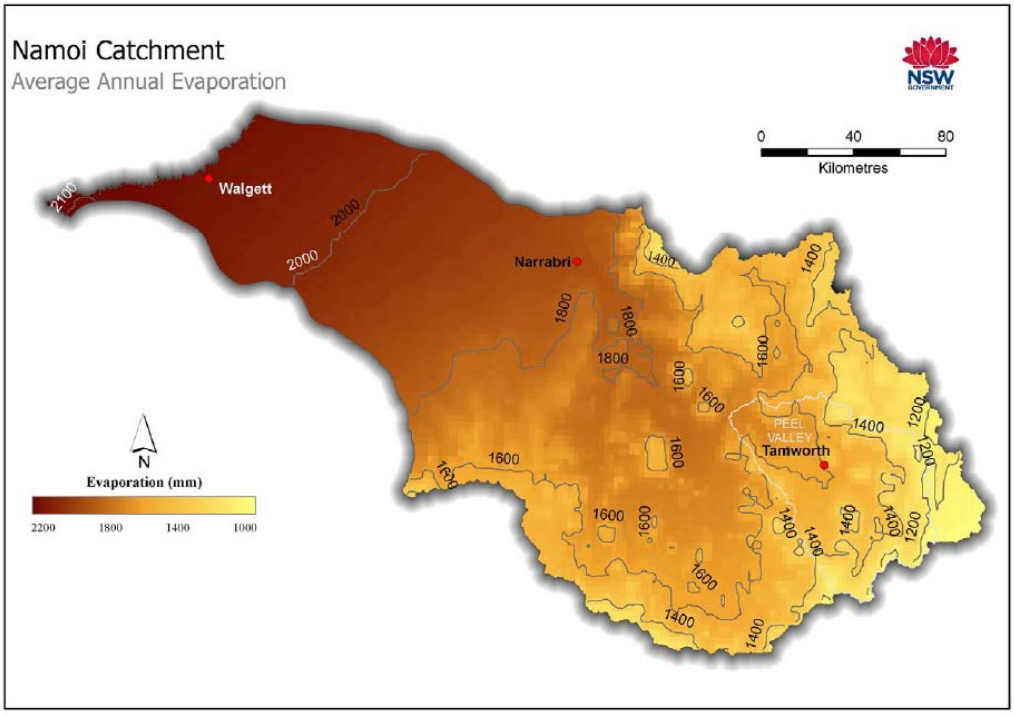
Temperatures are warm to hot in summer with relatively low humidity, mild in autumn and spring, and cool to mild in winter. The annual evaporation potential (as determined by pan evaporation) has a strong east-west gradient and varies from around 1,000 mm per year in the south-east, to over 2,200 mm per year in the north-west (Figure 3). Pan evaporation is also strongly seasonal, varying from around 2 mm per day in June and July at Gunnedah, to around 8 mm per day during December and January (Figure 4).

Total average annual rainfall varies over the catchment, from a maximum of 1,300 mm over the ranges in the east to around 400 mm near Walgett (Figure 5). The pattern of rainfall varies throughout the year with the highest monthly rainfall at Gunnedah occurring in summer, and the lowest rainfall occurring from April through September. Although rain falls throughout the year, there is a marked wet

season in summer through to early autumn. Rainfall in summer months averages twice to four times the rainfall in winter months. Continually high rainfall over these summer months can trigger flood events.

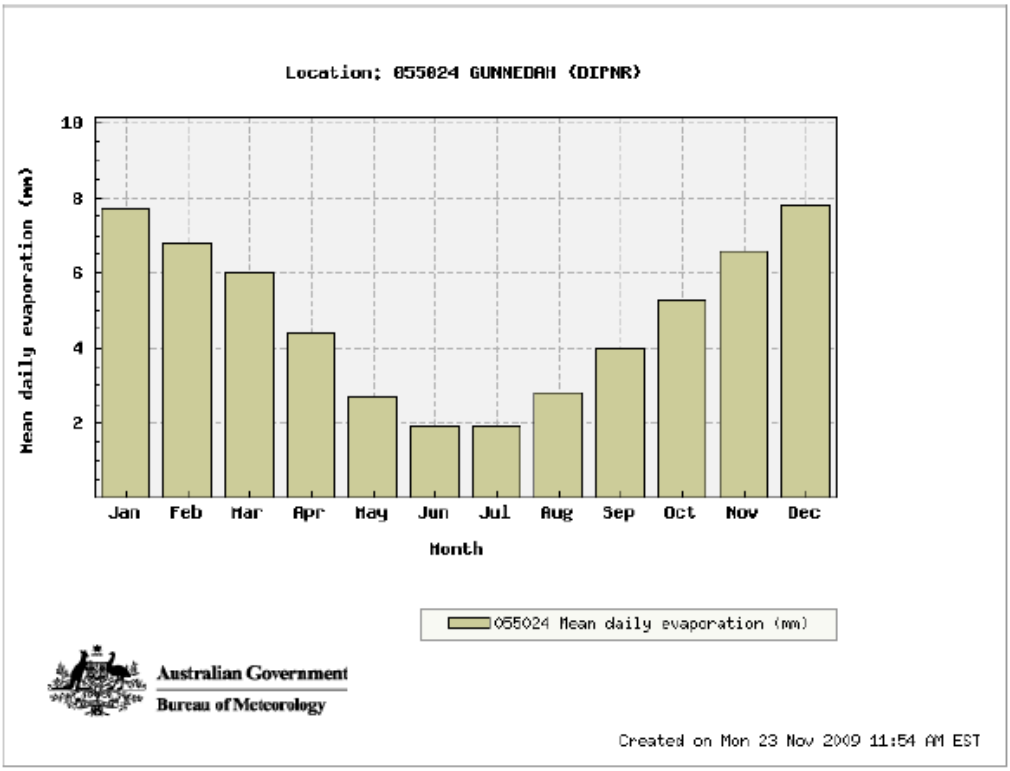
Average annual maximum temperatures vary from 18 degrees Celsius to 36 degrees Celsius in Gunnedah. Refer to the Australian Government website www.bom.gov.au/climate climate statistics page for additional information on rainfall and temperature in the catchment.

Figure 3 Pan average annual evaporation in the Namoi catchment



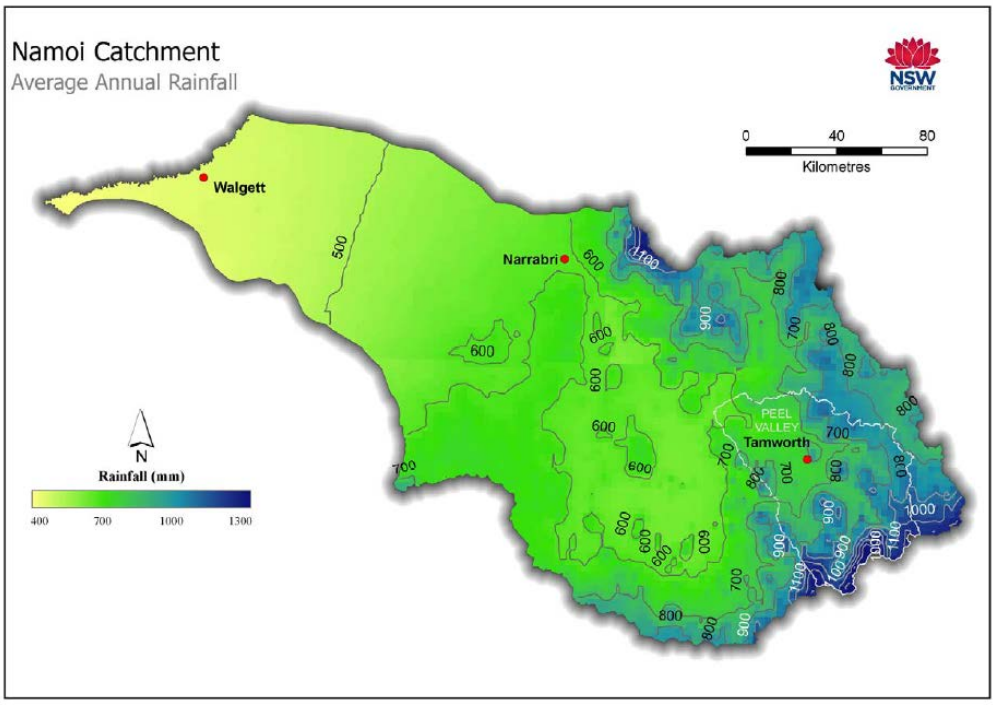
Source: Hutchinson and Kesteven 1998

Figure 4 Mean daily pan evaporation at Gunnedah



Source: Bureau of Meteorology Climate Data Online

Figure 5 Average annual rainfall in the Namoi catchment



Water resources and hydrology

Stream flows

The Namoi catchment is characterised by high variability in stream flows, that is, huge differences between maximum and minimum flows, and unpredictability in any particular year, typical of most inland river systems. Flows in the regulated rivers in the catchment tend to be more reliable over summer months due to the release of water for irrigation from the major storages. A number of tributaries in the eastern section of the catchment, draining the tablelands, are very reliable and are considered perennial streams but the majority of tributaries are non-perennial, with longer periods of no flow for those in the western parts of the catchment, such as those that drain the plains or Pilliga Scrub areas. Generally, reliability of stream flow declines from east to west. Natural flows are often highest from November to January when seasonal rainfall is greatest, while May to July is often a period of low flows. However, weather patterns and stream flow is highly unpredictable and floods can occur at any time.

The average annual discharge for the catchment is estimated to be around 1 million Megalitres. With an average annual rainfall for the catchment of 610 mm, this equates to around 23 mm of average annual runoff or around 3.8% of rainfall (Green *et. al*., 2011).

There are numerous flow gauging sites along the regulated rivers in the Namoi catchment which assist in the estimation of flows and the delivery of water from the major dams. The data from these is used to support a Flow Model for the regulated Namoi River which is used for planning and management purposes. On the unregulated rivers covered by this Plan, there are flow gauging sites on some of the more important tributaries which contribute either to the filling of dams, maintaining lower catchment flows or exacerbating floods. Many gauging sites on the unregulated streams have reasonably long periods of record, useful for making decisions on access rules, while others are more recent or have not been maintained, where data must be used with caution. Many of the smaller ephemeral or non-perennial streams have no gauge sites and only basic access rules can be applied.
Table 2 shows the automatic telemetered stream gauging sites located in the unregulated rivers covered by this Plan. Daily information from these sites is available on the Office of Water's web site at www.water.nsw.gov.au. Of the 19 gauges listed, 12 have been used as a reference point for defining access rules in the Plan. In addition, the Hokey Pokey height gauge at Lake Goran and the Manilla Weir on the Namoi River, have been used as reference points for the Lake Goran and Upper Namoi water sources, respectively. Records from these telemetered gauges and other gauges with limited data were used to assist with the development of the Plan.

Table 2 Stream gauging stations in the Plan area

Station name	Water source	Station no.	Approximate catchment area (km^2)	Period of flow records
Macdonald River at Woolbrook	Mid Macdonald River	419 010	890	83
Macdonald River at Retreat	Mid Macdonald River	419 028	890	45
Namoi River at North Cuerindi	Upper Namoi	419 005	1,551	90
Halls Creek at Ukolan	Upper Namoi	419 029	1,551	41
Manilla River at Barraba	Upper Manilla	419 107	1,388	3
Manilla River at Black Springs	Upper Manilla	419 053	1,388	41
Ironbark Creek at Woodsreef	Upper Manilla	419 047	1,388	43
Yarraman Creek at Spring Ridge	Lake Goran	419 093	1,871	14

Station name	Water source	Station no.	Approximate catchment area (km^2)	Period of flow records
Bundella Creek at Bundella	Coxs Creek	419 086	3,855	18
Bomera Creek at Tambar Road	Coxs Creek	419 085	3,855	18
Coxs Creek at Tambar Springs	Coxs Creek	419 033	3,855	41
Coxs Creek at Tourable (replaces old Mullaley Gauge)	Coxs Creek	419 102	3,855	3
Coxs Creek at Boggabri	Coxs Creek	419 032	3,855	41
Maules Creek at Avoca East	Maules Creek	419 051	1,095	38
Bohena Creek at Newell Highway	Bohena Creek	419 905	2,310	12
Brigalow Creek at Tharlane	Brigalow Creek	419 083	344	18
Pian Creek at Dempsey's Bridge	Pian Creek	419 089	2,733	8
Pian Creek at Waminda	Pian Creek	419 049	2,733	33
Baradine Creek at Gwabegar (replaces old Kenebri gauge)	Baradine Creek	419 105	4,883	2

Groundwater

NOW Hydrogeologist, M. O'Rouke (pers. comm., October 2010), has provided the specific detail in this groundwater section.

Discrete alluvial aquifers that are deemed to be connected to and recharged from adjacent rivers should be managed in a consistent manner to those rivers. In the Namoi catchment there are 4 discrete aquifers that have been included in this Plan as specific alluvial groundwater water sources: Manilla, Currabubula, Quipolly and Quirindi. Their location is shown in Appendix 1, Map 1.

The Manilla alluvial aquifer underlies a section of the unregulated Namoi River, a section of the unregulated Halls Creek, a section of the regulated Namoi River, and a section of the regulated Manilla River. This aquifer has been divided into 3 management zones to allow specific access and trading rules that are consistent with the nature of the adjacent streams. The alluvium comprises coarse sand, gravel, silt and clay deposits, and is between 200 meters to 1.3 kilometers wide. The thickness of the alluvial deposits reaches a maximum of 20 meters. The aquifers contained within the alluvium are recharged by rainfall, some side slope run on, and stream flow infiltration. The aquifer water quality is good and is suitable for most purposes.

The Currabubula alluvial aquifer underlies Currabubula Creek and comprises gravel, sand, silt and clay sediments, from between 125 to 2.9 kilometers wide. The thickness varies from 6 to 20 meters but is commonly around 10 meters. The aquifer is recharged by rainfall, some side slope run on, and stream flow infiltration. The aquifer water quality is reasonable and is suitable for most purposes. There are no management zones in this water source.

The Quipolly alluvial aquifer underlies Quipolly Creek and comprises gravel, sand silt and clay sediments, from 100 to 2 kilometers wide. The thickness varies from 2 to 12 meters but is commonly around 8 meters. The aquifer is recharged by rainfall, some side slope run on, and stream flow infiltration. The aquifer water quality is good, and is suitable for most purposes. There are no management zones in this water source.

The Quirindi alluvial aquifer underlies Quirindi Creek and the Jacob and Joseph Creek and comprises gravel, sand silt and clay sediments, from 125 to 4,700 meters wide. The thickness varies from 3 to 8 meters thick but is commonly around 5 meters thick. The aquifer is recharged by rainfall, some side

slope run on, and stream flow infiltration. Aquifer water quality is reasonable and is suitable for most purposes. There are no management zones in this water source.

Groundwater in these areas is generally used for irrigation of pasture, fodder crops, and some grain crops, and for stock and domestic supply. In the Manilla area, where stream flow is more reliable or regulated, groundwater often supplements surface water sources. In Quipolly and Quirindi areas, streams are non-perennial and more reliance is placed on groundwater. There is very little use of groundwater for irrigation from the Currabubula groundwater source.

Entitlement and use

At the commencement of the Plan there were approximately 314 surface water and 58 ground water licence holders in the Plan area. There was approximately 114,000 ML of surface water entitlement on the unregulated streams covered by this Plan and 7,340 ML of groundwater entitlement. The majority of licences are used for irrigation, with a small proportion also used for town water supply and minor use for domestic and stock purposes. There has been an embargo on granting new surface water licences in both the unregulated and regulated systems of the Namoi catchment since 1982. Alluvial aquifers were embargoed in 2008.

Estimates of water entitlement at the commencement of the Plan by water source are listed in Table 3.

Table 3 Total entitlement* and licence numbers in each water source (approximate)

Water source	Entitlement (ML/year)	Number of licences
Unregulated river		
Upper Macdonald River	30	1
Mid Macdonald River	5,332.5	31
Upper Namoi	10,333.5	82
Werris Creek	1,344	12
Keepit	750	15
Split Rock	0	0
Upper Manilla	21,10.5	38
Rangira Creek	1,479	1
Bluevale	1,640	6
Lake Goran	32,259	9
Coxs Creek	17,628.5	25
Maules Creek	1,413	7
Eulah Creek	3,493.8	8
Bohena Creek	995.5	16
Bundock Creek	6,142.5	13
Brigalow Creek	1,257	3
Coghill Creek	600	1
Etoo and Talluba Creeks	1,407	6
Spring and Bobbiwaa Creeks	753	2

Water source	Entitlement (ML/year)	Number of licences
Pian Creek	2,080	16
Lower Namoi	3,412	9
Baradine Creek	19,480.5	13
Total	113,941.3	314
Alluvial		
Manilla	3,585	18
Currabubula	327	6
Quipolly	737	8
Quirindi	2,690	26
Total	7,339	58

* Surface water entitlement figures are based on the total of unregulated river access licences, domestic and stock licences, and local water utility licences. Groundwater entitlement figures are based on the total of aquifer and aquifer (general security) access licences. Entitlement figures are approximate and may vary following the determination of a number of licensing anomalies or currently unresolved cases, and due to very recent licence dealings (trade) or cancellations.

Water is also extracted from watercourses within the Plan area according to basic landholder rights (BLR). These extractions do not require an access licence, but it should be noted that, for groundwater extraction, a works approval is required for the bore or well being used.

Water extraction in the unregulated water sources

In the unregulated surface water sources covered by this Plan there has not been a compulsory requirement for the fitting of flow meters on extraction works and the collection and reporting of data. Therefore, water extraction can only be estimated. Extraction is highly variable, depending on seasonal conditions, market influences and cropping opportunities. Those water users who have made a significant investment in infrastructure and equipment are more likely to be regulated or groundwater water users.

Usage is more consistent on perennial rivers and streams in the eastern part of the catchment with better rainfall and lower crop requirements, such as above Keepit and Split Rock dams, where irrigation can be relied upon to a greater extent. Maximum water use in these areas tends to be limited by topographic constraints such as limited area of river flats, and in wetter years by reduced crop demand and limited sites suitable for construction of on-farm water storages. As spray irrigation is typically used in these areas, pumping costs is also a factor in moderating usage.

In unregulated rivers on the plains and in western areas, flow is more unpredictable, with a more limited number of pumping days available over the year. The ability to utilise entitlement often requires on-farm storage and larger pumps, the economics of which may be doubtful if no other sources of water is available. Where other more reliable sources are available, such as regulated flow or groundwater, unregulated flow can be an important supplementary source. This is the case along much of Coxs Creek, on Maules Creek and some other streams on the Liverpool Plains, and also on large irrigation farms in the western parts of the catchment along the lower end of tributaries near the regulated river. These areas are also more flood prone and floodplain water harvesting is significant in some parts of the catchment. The WSP accounts for floodplain harvesting in the Long Term Annual Average Extraction Limit, and work is planned for 2014/15 by the Office of Water to verify floodplain harvesting works and finalise licensing arrangements.

In the Lake Goran water source on the Liverpool Plains, there are several large developments which can plan on a reliable seasonal supply of water when the lake is substantially full. However the lake is ephemeral and, although low levels are protected by access restrictions, evaporation eventually dries the lake in extended drought periods.

Diversion of flow into on-farm storage is an important aspect of usage in western parts of the catchment. However such flows generally need to be utilised over the immediate season as evaporation can take a significant toll.

Water extraction in the alluvial groundwater sources

There are no monitoring bores located in any of the four alluvial groundwater source areas covered by the Plan. Furthermore, the majority of bores and wells have not been fitted with meters. Consequently there is no reliable record of water extraction from the aquifers. Anecdotal local reports indicate that water tables have not declined and remain within the normal historical range as affected by seasonal conditions. An estimate of water usage based on field inspection and survey has been made and it is apparent that water use in recent years is well below the full entitlement volume. The predominant forms of irrigation in these areas are pressurised spray systems, and increasing costs of energy for groundwater pumping and the cost of re-equipping aging bores and pumps is likely to have resulted in a reduction in water use from these alluvial areas over the last decade. In developing extraction limits for groundwater sources in this Plan, the assumption has been made that current levels of extraction are sustainable, as there is no evidence of a long term decline in water tables.

In the Manilla groundwater source, there is a moderate usage of groundwater for irrigation by a number of licence holders, while many use groundwater only for domestic and stock purposes, or are inactive. Many groundwater licence holders also have access to surface water supply. Usage varies with seasonal conditions as rainfall can contribute significantly to crop water requirements in some years. It is estimated that average usage in recent years has been no more than about 1230 ML.

In the Currabubula groundwater source, there are only a small number of entitlements, most of which are either inactive or used solely for domestic and stock purposes. Average usage in recent years is estimated at no more than 60 ML.

In the Quipolly groundwater source, there are a small number of active users who rely heavily on irrigation as a component of their mixed farming enterprises, and who have been utilising their entitlements more fully. However, anecdotal evidence and some data from monitoring bores installed by a local mining company indicate that the water tables have been reasonably stable in recent years. Average usage is estimated at no more than 475 ML.

In the Quirindi groundwater source, anecdotal feedback indicates there is no decline in water tables. The majority of licence holders have used their entitlement sparingly or have been inactive in recent years. However, there are a small number of very active users involved in intensive fodder production and livestock fattening who are highly dependent on groundwater. Inspection and survey of the area suggests that average usage is no more than 1230 ML.

Local water utility requirements

A number of licences for the purpose of town water supply are covered by this Plan. Towns and villages that are dependent or partially dependent on unregulated surface water sources in the plan include Walcha (Walcha Shire Council), Bendemeer, Manilla and Barraba (Tamworth Regional Council). Towns or villages that have access to alluvial groundwater, mainly as reserve supply, are Currabubula and Quirindi (Liverpool Plains Shire Council), and Manilla (Tamworth Regional Council).

At Manilla, Tamworth Regional Council also has licensed entitlement from the regulated Manilla River but utilises unregulated flow impounded by Manilla Weir as its primary water source. At Barraba unregulated surface water supply has been a serious problem during recent drought years, prompting a search for additional groundwater sources, and now the construction of a pipeline to Split Rock dam to access regulated supply. The dependence on unregulated flows is expected to ease once this pipeline is fully operational.

Unregulated flow in the Macdonald River for Walcha and Bendemeer water supply is quite reliable.

At Currabubula and Quirindi, the alluvial groundwater licences covered by this Plan are not used heavily by Local Water Utilities, and are generally seen as a contingency for emergency supply, or used on occasion for watering of Council land.

Table 4 Town water supplies, location and entitlement volume

Water source	Water supply	Council	Entitlement (ML/ year)
Mid Macdonald River	Walcha	Walcha Shire	379
	Bendemeer	Tamworth Regional	84
Upper Namoi	Manilla	Tamworth Regional	564
Upper Manilla	Barraba	Tamworth Regional	421
Manilla Alluvial	Manilla	Tamworth Regional	60
Currabubula Alluvial	Currabubula	Liverpool Plains Shire	25
Quirindi Alluvial	Quirindi	Liverpool Plains Shire	200

Policy framework

The NSW Office of Water is responsible for implementing the *Water Management Act 2000*, including developing water sharing plans for the state's water resources. The Office of Water has established several interagency panels to assist with the development of water planning policies and the preparation of water sharing plans.

State Interagency Panel

The State Interagency Panel (SIP) has overall responsibility for the statewide policy development for water sharing plans, to ensure that adequate resources are available from each agency and 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 an Interagency Regional Panel (IRP) cannot reach agreement or where the issue has statewide significance.

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

State Groundwater Panel

The State Groundwater Panel (SGP) was established to oversee the development of policy for the macro water sharing planning process for groundwater. The Panel has members from the Office of

Water, the OEH and from the DPI. CMAs are also represented by an inland and coastal representative.

The Panel provides a senior level forum for discussing and resolving a wide range of water planning and policy issues specific to groundwater. In particular the SGP has developed statewide distance criteria which IRPs use as a starting point when considering distance rules for groundwater sources.

The SGP is a subcommittee of the SIP.

Interagency Regional Panel

Interagency Regional Panels (IRP) were established to assist in the development water sharing plans. IRPs consist of representatives from the Office of Water, DPI (representative covering both agricultural and fisheries interest), and one representative from OEH.

A representative from the Namoi CMA also attended meetings, so that they can provide advice on consultation issues and other matters within their areas of expertise.

Appendix 3 lists the names of the Namoi IRP representatives and their areas of expertise and also lists their colleagues who provided specific technical and scientific information.

The key responsibilities of the IRP are to:

- consider relevant policy matters and ensure water sharing rules are consistent with state policy
- review the hydrological (water management) units provided by the Office of Water
- assign 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 applicability[4]
- 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.

IRPs use local knowledge and expertise in developing and recommending the water sharing rules through a consensus decision-making approach.

Key policies

There are a number of legislative and policy documents that impact on and direct the development of plans. These include:

- National Water Initiative
- *Water Management Act 2000*
- *Access Licence Dealing Principles Order 2004*
- Murray Darling Basin Cap Agreement
- Basin Plan (*Commonwealth Water Act 2007*)
- Natural Resource Commission's statewide targets
- Namoi Catchment Action Plan.

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

National Water Initiative

The NSW Government is a partner to the National Water Initiative (NWI) which was signed by the Council of Australian Governments (COAG) in June 2004. The NWI recognises the continuing imperative to increase the productivity and efficiency of Australia's water use, the need to service rural and urban communities, and to ensure the health of river and groundwater systems by establishing clear pathways to return all systems to environmentally sustainable levels of extraction.

The NWI sets out guidelines, outcomes and timelines for water plans and planning processes. The National Water Commission is an independent statutory body responsible for providing advice to COAG on the implementation of the NWI and national water issues and undertakes a biennial assessment of each state's progress with implementing the NWI for this purpose.

Water Management Act 2000

The object of the *Water Management Act 2000* is the sustainable and integrated management of the state's water for the benefit of both present and future generations.

The *Water Management Act 2000* was passed by the NSW Parliament in December 2000, establishing a completely new statutory framework for managing water in NSW. For the first time NSW had comprehensive water legislation to guide its water management activities.

The *Water Management Act 2000* is based on the concept of ecologically sustainable development – development which aims to meet the needs of today, while conserving our ecosystems for the benefit of future generations.

Because of the major changes required by the legislation, the Act has been progressively implemented. Since 1 July 2004 the new licensing and approvals system has been in effect in those areas of NSW covered by operational water sharing plans – these areas cover most of the State's major regulated river systems and therefore the largest areas of water extraction. As water sharing plans are finalised and commenced for the rest of the state, the licensing provisions of the Act are introduced extending the benefits for the environment of defined environmental rules and for licence holders of perpetual water licences and greater opportunities for water trading.

The latest copy of the *Water Management Act 2000* is available from the NSW government legislation site.

Access licence Dealing Principles Order 2004

The Access Licence Dealing Principles Order (commonly referred to as the Ministers Dealing Principles) commenced in 2004. It draws on the objects and water management principles of the *Water Management Act 2000* and provides State-wide guidance and rules for applications to undertake water dealings including trade.

The Minister's 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.

Rules for specific types of access licence dealings (such as conversion to a new category, subdivision, consolidation, assignment or rights or allocation, changing water sources, amending extraction components and interstate dealings) are also included. The Minister's Dealing Principles specify when a dealing is prohibited and what requirements must be met in order for a dealing to be permitted.

Water sharing plans must be consistent to the Minister's Dealing Principles. Water sharing plans can also put additional restrictions in place such as restricting trade into a particular area due to it's environmental value or hydrological stress.

Murray-Darling Basin Cap Agreement

In 1994, the Murray-Darling Basin Ministerial Council (MDBMC) undertook an assessment of water diversions across the Basin. This found that the levels of diversions at that time were 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 – the Cap – in 1995.

Schedule F of the Murray-Darling Basin Agreement (the Agreement) was then 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. There is no MDBMC Cap on 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 were volume based and diversions were metered with good records of past use for establishing the Cap. In unregulated water sources, licences were area based and not metered so the assessment of Cap is more difficult. As part of a volumetric conversion 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 Cap for unregulated surface water in the Namoi is assessed and reported on at the whole Namoi catchment scale which includes the Peel River subcatchment and the Mooki River subcatchment and any growth management actions required will also be applied at this scale.

The Basin Plan (Commonwealth Water Act 2007)

The Commonwealth *Water Act 2007* requires the Murray-Darling Basin Authority (MDBA) to prepare and oversee a Basin Plan. This plan is 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 Murray-Darling Basin Ministerial Council Cap on diversions in the Basin. They will set limits on the taking of both groundwater and surface water from the Basin. At the time of publishing this document, NSW was still engaged in negotiations with the MDBA in regard to bringing the SDLs into effect.

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

Natural Resource Commission's statewide targets

Water sharing plans also comply with the Natural Resources Commission's (NRC) Strategic Plan 2011 – 2014 and contribute to the relevant statewide targets such as Targets 5 and 6 (see www.nrc.nsw.gov.au for details) which is a requirement under Goal 22 of NSW 2021 (see www.2021.nsw.gov.au for details).

The NRC was established in 2003 to provide the NSW Government with independent advice on natural resource management issues. To achieve this it has developed and recommended a Standard for Quality Natural Resource Management and 13 statewide targets for natural resource management in NSW, which have been embedded in the NSW 2021. As with the NWI, the components of the State Standard focus on the use of the best available knowledge, use of 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 is progressing. The NRC reviews plans against this Standard and its associated targets.

Namoi Catchment Action Plan

This plan is consistent with and contributes to the Namoi Catchment Action Plan 2010-1020 (CAP). The CAP can be found on the Namoi CMA website at www.namoi.cma.nsw.gov.au. The Namoi CAP water theme includes three catchment targets:

- **Catchment Target Water 1** - By 2020 there is an improvement in the condition of those riverine ecosystems that have not crossed the defined geomorphic thresholds as at the 2010 baseline.
- **Catchment Target Water 2** - By 2020 there is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses.
- **Catchment Target Water 3** - By 2020 there is an improvement in the condition of regionally important wetlands and the extent of those wetlands is maintained.

Actions relevant to these targets include supporting water planning and implementation, especially where extraction is over 33% of natural flow on a subcatchment basis which may be impacting on wetlands or aquatic health, and supporting the improved management of semi-connected alluvial aquifers.

The WSP will contribute to achieving the water catchment targets by:

- setting a defined share of water for riverine ecosystems
- protecting very low flows
- stabilising sustainable extraction from several connected alluvial groundwater systems
- implementing trading rules to maintain or reduce entitlement in high conservation value streams
- adopting an adaptive management approach, giving the Minister the ability to adjust rules once information becomes available, or upon remake of the next plan.

One of the CMA's responsibilities, as observer, is to provide the IRP with advice on the alignment of the proposed classification and extraction limits and rules with the priorities in the CAP.

Other considerations

There are a number of state policy issues that require consideration with the development of this plan and the associated 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.

Pools include lentic water bodies (standing water) in or associated with unregulated rivers, 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.

'*Macro water sharing plans – the approach for unregulated rivers. Access and trading rules for pools*' can be found on the Office of Water website www.water.nsw.gov.au. This document has been developed to provide additional guidance for IRPs in setting water access and trading rules for pools that are covered by unregulated river water sharing plans.

The approach uses an assessment of the environmental values of the pools to select rules that adequately protect these values while not having a disproportionate effect on water availability for extraction. Because it is not practical to identify and create site-specific rules for every natural pool in a water sharing plan area, the focus of the approach adopted is to establish a default access rule of no draw down below full pool capacity for the majority of natural pools. 'Full capacity' can be approximated by the greatest pool volume where there is no visible flow out of that pool The default rule may then be modified by IRPs in specific circumstances if it is justifiable and feasible to do so to allow limited access to pools based on local hydrological, environmental and socio-economic considerations. In relation to in-steam pools, there are no drawdown allowances in this plan. However, 20% drawdown is allowed on Gulligal Lagoon in Bluevale water source and Wee Waa Lagoon in Bundock Creek water source.

Different default rules apply depending on the pool type. Artificial pools created by structures are treated differently to natural pools. Generally the default rule for artificial pools is to adopt the existing licence conditions, however there may be some circumstances where the default rule may not be appropriate and alternate rules will need to be developed.

Managing surface water and groundwater connectivity

Most alluvial aquifers have some level 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 covered by groundwater-specific plans.

Consistent with the statewide approach, extraction from highly connected aquifer access licences that relate more closely to the regulated river will be managed annually, via AWDs. This is the case for the Manilla alluvial water source, where 15% of the AWD is derived from the regulated river (general security) AWD.

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

Protecting basic landholder rights

Under the *Water Management Act 2000*, basic landholder rights (BLR) are made up 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 in the case of accessing groundwater under a domestic and stock right, the bore must still be approved by the Office of Water.

The principles of the *Water Management Act 2000* require that water sharing must protect BLR. The plan does this by identifying the water requirements for domestic and stock and native title rights at the start of the plan and taking these requirements into consideration when designing rules for licensed water extractions. As the access rules for water access licences do not apply to BLR users this provides BLR users with a higher level priority of water access. The requirements of harvestable rights have been inherently considered as the design of access rules is also based on river flows that result after harvestable rights extractions have occurred. There are currently no extractions for native title rights. However, these rights may be activated during the plan's ten year term.

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 *Water Management Act 2000* itself provides for restrictions on basic landholders rights, through the development of mandatory guidelines.

Protecting town water supply access

Towns have a higher priority for access to water than commercial licences. 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. The annual share for every town water supply will be specified on the town's licence. Towns may be able to sell part of their annual account water to other towns but, unlike commercial users, will not be able to sell the licence outright.

In unregulated surface water and groundwater sources, towns will not need to change their existing water access arrangements unless their infrastructure is upgraded. In this case, when a major augmentation of works occurs, town water utilities will need to meet access conditions specified in the plan.

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.

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. The NSW Government is determined to ensure that Aboriginal culture is maintained across the state and that Aboriginal communities benefit from the new opportunities that the water market will bring.

Macro plans recognise the importance of rivers and groundwater to Aboriginal culture. The plans will allow Aboriginal communities to apply for a water access licence for cultural purposes such as manufacturing traditional artifacts, hunting, fishing, gathering, recreation, and for cultural and ceremonial purposes. An Aboriginal cultural licence can also be used for drinking, food preparation, washing, and watering domestic gardens. These cultural licences are limited to 10 megalitres per year per application.

Further input is sought from the Aboriginal community during the development of the plan to identify water dependent cultural assets which may be relevant for consideration in the development of the plan, or to determine the level of interest in licences for cultural use. For more information, see the fact sheet *Macro water sharing plans - Information for Aboriginal water users*, which is available on the Office of Water website www.water.nsw.gov.au.

Water interception activities

A change in land use activities can potentially result in the interception of significant quantities of water. Examples of 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 (NWI), significant interception activities should be accounted for within a plan's extraction limit.

Acknowledgement of 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 storm-water which is subsequently captured in tail-water return systems or other means in accordance with licence conditions or methods which have been approved by the Office of 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 as part of the process that converted 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 was under development at the time of publishing.

Risk of interception through forestry expansion

The projected growth in commercial forestry plantations in the Namoi is considered negligible (CSIRO, 2007).

In-river dams

Under the NSW weirs policy on-river dams on third order streams or greater are permitted subject to:

- the Farm Dams Policy (harvestable rights)

- the NSW Weirs Policy
- a minimal harm test under the *Water Management Act 2000*.

Under the Farm Dams Policy, a farm dam that is less than the maximum harvestable rights dam capacity is considered a basic landholder right and can be built on a first or second order stream without the need for a water access licence.

Under the NSW Weirs Policy, the construction of new weirs is discouraged, but can be done where "it can be demonstrated that the primary component of the proposal is necessary to maintaining the essential social and economic needs of the affected community" (DLWC, 1997).

Assuming the instream storage can meet these criteria then an application could be made and these would be assessed against the minimal harm test under the *Water Management Act 2000*.

The plan will not permit applications for dams in water sources with high instream values. See appendix 2.

Exemptions for farm dams

Farm dams currently require an access licence when:

- they are located on a third order (or greater) river, irrespective of the dam 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
- 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 is permitted as a component of the basic landholder rights, called the harvestable right. The full activation of harvestable rights within the area of the plan is considered highly unlikely. The plan cannot actually limit these rights. The provisions relating to harvestable rights are unaffected by any of the rules identified in the plan.

Developing the plan

The first unregulated Watering Sharing Plan in the Namoi catchment was developed for the Mooki River catchment, using an intensive consultative committee process and commenced in 2004. Work on the remainder of the unregulated Namoi catchment began as a pilot project in 2005 with the intent to develop a more streamlined approach. In 2007, work on the Namoi plan was postponed due to competing priorities and stretched resources. When work recommenced in the Namoi, the focus was an integrated water sharing plan for the Peel River subcatchment which included groundwater, regulated and unregulated water sources. This Peel WSP commenced in 2010. As work on the Peel plan came to a conclusion, work on the remainder of the Namoi catchment recommenced, including the remaining significant connected alluvial groundwater systems.

The plan rules were developed by the Namoi IRP based on consensus decision making. The approach used for setting the plan rules involved the consideration of government policy and then rule refinement according to local knowledge and expertise.

Different methods were used to develop water sharing rules for surface water and groundwater sources. Information about how rules were developed for surface water and groundwater systems is provided below, as well as how these rules were modified by the IRP or changed as result of consultation.

Consultation to inform rule development

In late 2010, the Namoi IRP met to consider unregulated river water sharing rules. Feedback from earlier consultation, as well as recent policy updates, and the adoption of the 'Macro' approach, draft water sharing rules were developed. In some cases and on some issues additional information was requested and the IRP reconvened several times to progress the draft plan.

The public exhibition process was developed with guidance and support from the Namoi CMA, to ensure that all stakeholders and interested parties would have an opportunity to examine and comment on the proposed water sharing rules. In particular, stakeholders were encouraged 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 IRP
- 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 the Minister's notes included in the draft plan.

Public exhibition of the draft water sharing plan

Public exhibition of the draft water sharing plan was initially held from 24 September to 2 December 2011, with public meetings held at key locations, Boggabri, Manilla, Wee Waa and Quirindi. At the request of several water user groups the closing date for submissions was extended until 20 January 2012. 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 in writing from stakeholders and the general community about the proposed water sharing rules.

34 written submissions were received from a range of stakeholders. In some cases, the Plan Coordinator undertook additional consultation in order to better understand local concerns. The IRP reviewed all the submissions and consequently made changes to some of the draft water sharing rules, particularly where legitimate concerns had been raised about likely impacts. During this review process, if updated data became available, it was also incorporated into the planning process, and some additional data was requested. Information about how the rules were refined is detailed in 'Refining the rules for local circumstances' below.

Water sharing rules for unregulated surface water sources

Water sharing rules that the IRP focused on:

- access rules – which determine at what flow levels, river heights, proportion of full capacity of a pool or times extraction is allowed
- dealing rules – which control the trade of water (both permanent transfer of access licence entitlements and temporary assignment of water allocation between access licences, the change of water sources and the location for extraction)

- rules for the protection of specific environmental assets, including protection of pools and lagoons, and requirements for fish passage.

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 unregulated surface water resource, and from each alluvial groundwater source
- assessing growth – how growth in diversions are assessed.

These rules form the basis of mandatory conditions on water access licences and approvals.

Classification method

The 'macro planning' process is the approach of the Office of Water to developing plans for unregulated rivers and is described in *Macro water sharing plans – the approach for unregulated rivers. A report to assist community consultation* [5] (the manual).

The process for the development of the water sharing rules involves weighing up the risk to instream natural values against community dependence on irrigated agriculture for each water source. The assessment also included hydrologic stress, which is the amount of water extracted relative to river flow.

The macro approach has been used to guide the IRP in its development of water sharing rules that consist of:

- access rules – which determine at what flow levels, river heights, proportion of full capacity of a pool 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).

There are 22 unregulated water sources in the plan area. Initial classification of the unregulated water sources was undertaken by reviewing earlier work undertaken in 2006 and subsequently adjusting it in line with the macro classification process. Based on this classification and the indicative rules, the Namoi IRP recommended draft access and trading rules for each of the 22 unregulated water sources.

Protecting high instream values

The plan area contains one water feature listed as being of national significance, the ephemeral Lake Goran, which from time to time, serves as important habitat for migratory and other water birds. Access rules for extraction from the lake are already well embedded in licences and these conditions have been carried over into the plan. Trading rules have been tightened to prevent any further growth in entitlement drawing from the lake.

Pools and lagoons are seen as important refuge areas for wildlife and aquatic species throughout the catchment but especially on the floodplains where farming is predominant. The NSW Pools Policy has been applied in the plan to minimise water extraction from such features, and all but 2 lagoon features are largely protected from extraction. For Gulligal and Wee Waa lagoons, some limited access has been permitted in recognition that existing licence holders are currently extracting from these water bodies, but the majority of water is reserved for the environment. Trading rules in the plan prevent the addition of new entitlement onto off-river lagoons.

Along the upper tributaries of many sub catchments riparian vegetation is often in good condition. Many of these originate in forested or well vegetated areas or national parks which support good

[5] the document is available on the NSW Office of Water website www.water.nsw.gov.au in the macro water sharing plan section

biodiversity. Water licences are usually limited and the IRP considered that water extraction had not significantly impacted on these tributaries. Trading rules have been designed in most of these 'tributary' zones to prevent any increase in entitlement, but often allowing for 'trade out' where downstream conditions are adequate. This will assist the protection of the aquatic health of these upstream areas and contribute to the maintenance of flows and water quality discharging from them.

On the unregulated Namoi River above Manilla, access rules and fish passage over the fish-way at Manilla Weir were significant issues for local water users. The IRP considered this matter in detail. The access rules in the plan carry over and clarify the existing conditions applying at the weir, and this will allow the continuation of a small degree of self regulation by the local water user group to ensure compliance with the rules. The Office of Water has also installed a telemetered observation camera at the weir to assist in the implementation of the rules.

In the Coxs Creek water source, the IRP had investigated the merits of a 'first flush' flow rule in the system to improve connectivity with the Namoi River. However, more detailed analysis of available data indicated that existing licence conditions are achieving this outcome and that further tightening would have economic impacts on access for unspecified environmental benefits. The plan consolidates current access rules and a new telemetered gauge has been installed near Mullaley to provide better flow information for compliance.

Access rules

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 macro approach for inland unregulated catchments is that hydrologic stress in each water source is 'high', unless specific information indicates otherwise. This is a reasonable assumption given that:

- most inland unregulated streams have been embargoed since the early 1990's and
- Stressed River Assessments[6] show consistent scores of 'high' stress across the inland unregulated streams.

Table 5 Generic access rules for rivers and creeks under the macro approach

Rule level	Indicative CtP 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

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

For all water sources, pumping is not permitted from natural pools when the water level in the pool is lower than its full capacity. This basic rule could only be recommended due to:

- many existing licences have no access rules; therefore any change to access should be incremental to allow irrigators time to adjust.
- lack of appropriate reference points (for example river gauges) other than the pump site.

This access rule provides protection of natural pools, which are important for drought refuge, as well as domestic and stock water supplies. For water licences drawing water from in-stream pools the rule is equivalent to 'visible flow' at the pump site, the level 3 rule above when there is no suitable gauged reference point on the particular stream.

Dealings rules

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

- Where instream values are considered high, no trades are permitted into that water source.
- Where a water source is under high hydrologic stress (which is a default assumption, because of the lack of flow and usage data available) 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 Namoi plan area. In most of the others, trade into the water sources is limited by a cap on the total entitlement in the water source equivalent to the level at the commencement of the plan, which effectively prevents most trades.

The lack of any metered extraction data in unregulated streams, and the absence of gauging in many subcatchments, made assessment of impacts on various levels of stream flow difficult. The Namoi IRP decisions on trade were generally conservative, based on concerns for impacts on the environment or for protecting the security of existing water users. Also, as inactive entitlement from unregulated streams generally results in flows into the regulated Namoi system, the likely impacts of unfettered trade from one side of the regulated river to the other on particular sections of the regulated river are unclear. Furthermore, the IRP was of the view that an opening up of trade across the catchment may result in increased extraction of entitlements, which may put pressure on the Namoi 'cap' via exceeding the Long Term Average Annual Extraction Limit for the unregulated system.

Consequently, in response to the feedback from many water users keen to see better opportunities for trade, the plan makes provision for a complete review of trade rules after the first 2 years when time and resources will allow a more detailed understanding of impacts.

Refining the rules for local circumstances

Many water sources have particular features or circumstances that require the generic macro approach to be tailored to achieve an appropriate balance between environmental protection and sustainable resource access. Often water sources are split into management or trading zones to allow rules to be better focused on particular streams or features.

The following sections indicate how the rules and plan provisions have been implemented in each water source. In some cases these rules were developed by the IRP, sometimes they reflect current licence conditions which are working well, and sometimes they include changes as a result of feedback. Often existing licences (under the *Water Act 1912*) have access conditions that are more stringent or more specific than the general rules in the plan, sometimes developed in consultation with local water users, and occasionally as a result of Land Board inquiries. In these cases, the plan specifies that these 'higher of' conditions will be transferred across to the replacement access licences issued under the *Water Management Act 2000*.

Upper Macdonald River

There is only 1 small existing licence in this water source with a site specific access rule that will be maintained. The water source is relatively unaffected by water extraction and the key aspect of the plan is that trade into the water source is not permitted, in order to maintain the largely natural flow regime and healthy aquatic environment.

Mid Macdonald River

This water source has several telemetered gauges on the Macdonald River which allow the establishment of access rules to protect low flows for the environment. There are some important environmental attributes in this water source, including habitat for platypus. Two management zones have been specified to allow the rules for upstream and downstream sections to relate to the nearest river gauge. The cease to pump triggers, which are between the 90th and 95th percentiles of daily flow, are very close to those on some existing licences, and will now apply as a basic rule to all licences. Trading is permitted within management zones, and between management zones in a downstream direction only, to maintain or improve upstream conditions.

Upper Namoi

This water source has a significant number of water licences (82), mostly along the Namoi River and on Halls Creek. The IRP looked at using the North Cuerindi gauge on the Namoi River, in addition to flow at Manilla Weir, as a reference point for specifying cease to pump rules in the Namoi and Macdonald Rivers Management Zone. The IRPs aim was to ensure adequate flows over the Manilla Weir fish-way for fish passage and to safeguard town water supply security and water quality. This raised concerns with the local water users regarding impacts on access. Water users maintained they had been managing the river well on a voluntary cooperative basis which allowed local flexibility in complying with existing access rules. On further analysis of flow data and impacts on access, the IRP agreed the inclusion of North Cuerindi gauge as a reference point was unnecessary, deeming flow over the weir as a simpler and adequate reference point which would allow the continuation of the cooperative management scheme ie water users can cooperatively share flows, as long as flows remain above the cease to pump level.

A telemetered camera has been installed at the weir to assist management and the nature of 'flow over the weir' has been clarified to indicate flow over the weir crest, not through the adjacent fish-way. This will ensure that the fish-way flows at full capacity (over 20 ML/d) for as long as possible. Those existing licences with more stringent cease to pump conditions than flow at the weir, will have such conditions carried over into new water access licences. On Halls Creek, the cease to pump trigger relates to the local Ukolan gauge and approximates the 90th percentile of daily flow.

Due to the number of licences and reliance on water access during drier seasons, the IRP determined that trades into the water source should not be permitted, to safeguard existing access. Within the water source, trading into the Halls Creek Management Zone is also not permitted due to the smaller

size of the stream and the number of existing licences. Trading can occur into the Namoi and Macdonald Rivers Management Zone from elsewhere in the water source. It should be noted that this water source discharges into the regulated river system and thus trading downstream below Keepit Dam is against current policy.

Werris Creek

This water source discharges onto the Mooki River floodplain and has a small number of licences, many located on Currabubula Creek. Stream flow is highly ephemeral and there are no suitable flow gauges for reference points. Basic cease to pump rules of 'no visible flow at the pump site' apply. Trade into the water source is restricted by an entitlement limit based on the level at the commencement of the plan.

Keepit

This water source consists of smaller ephemeral tributary streams flowing into the regulated Manilla and Namoi Rivers. Greenhatch Creek has the largest number of licences. No suitable gauging sites exist on any of the streams. Basic access rules apply of 'no drawdown from in-stream pools' to ensure extraction only occurs when streams are flowing. No trading is permitted into the water source to minimise environmental impacts and to protect existing users on ephemeral streams.

Split Rock

There are currently no water licences in this water source, which surrounds the foreshores of Split Rock Dam. The IRP determined that no new licences should be issued in this water source to preserve its undeveloped condition, noting that it is a catchment area for the dam. Consequently trading into this water source is not permitted. It should also be noted, however, that impounded water in the dam is part of the Upper Namoi regulated system, and that access to such regulated water is covered by a separate water sharing plan.

Upper Manilla

Suitable gauge sites are located on both the Manilla River and Ironbark Creek to serve as reference points for cease to pump (CTP) rules for these 2 Management Zones, and the triggers correspond approximately to the 80^{th} and 57^{th} percentile of daily flow respectively. Most irrigation development (29 licences) is located on the Manilla River while there is only 1 licence on Ironbark Creek which is in relatively better environmental health. The 3 ML/d CTP trigger in the Manilla River Management Zone is a compromise between those many existing licences which have access conditions of 7.5 ML/d and those licences which have no access conditions. The existing higher access conditions will be carried over into new water access licences.

Town water supply for Barraba is drawn from the Manilla River, and also from Barraba and Connors Creeks, and supply during drought seasons is a critical issue. The 3 ML/d CTP rule on the Manilla River will assist in maintaining town water supply which is exempt from CTP conditions. The relatively more stringent access rule for Ironbark Creek is designed to protect a larger percentage of low flows for the environment.

The trading rules prevent trading into the 2 Tributaries Zones to protect environmental values along smaller streams. Because of the current density of licences in the Manilla River Management Zone, trade into this zone is only permissible from the immediate catchment (Manilla River Tributaries Zone) while licences can be traded out into the Ironbark Creek Management Zone to reduce competition. Furthermore, within the Manilla River Management Zone, trade from licences located downstream of the town water supply point to locations upstream is not permitted. The plan contains provisions to

review access and trading rules in the Manilla River Management Zone in the event that an alternative water supply for Barraba is secured, such as the proposed pipeline from Split Rock Dam.

Rangira Creek

Rangira Creek, the main stream in this water source, discharges onto the Namoi River floodplain near Gunnedah and is highly ephemeral. There is only 1 licence which is attached to a large water storage in the upper reaches of the catchment. There are no gauging sites and no known water dependent environmental assets. Basic cease to pump rules of 'no drawdown of pools' which is equivalent to 'no visible flow at the pump site' apply. Trade into the water source is restricted by an entitlement limit based on the level at the commencement of the plan.

Bluevale

This water source spans the regulated Namoi River and contains 6 licences on ephemeral watercourses and on Gulligal Lagoon. The lagoon is an important environmental asset providing valuable habitat for fish and other aquatic species, and has benefitted from investments in environmental enhancement projects. The Commonwealth Environmental Water Holder has indicated that the lagoon may receive environmental flows in the future to maintain its excellent condition, if required. The IRP considered that some drawdown of the lagoon would be permitted to provide some access for the 2 licences located there, and established the cease to pump at 80% of the full volume of the lagoon.

The lagoon has been surveyed to quantify the full volume and a suitable height gauge installed as a reference point. Elsewhere in the water source basic access rules apply. Trade into the water source is restricted by an entitlement limit based on the level at the commencement of the plan. A number of other smaller lagoons of environmental value in the water source will be protected by the 'no trade onto off-river lagoons' rule.

Lake Goran

This water source contains a large ephemeral terminal lake holding over 120,000 ML when full after wet seasons (Bewsher Consulting, 1995). Only after major floods does the lake overflow into the Mooki River catchment and contribute to the Namoi River, although some of the tributary streams flow to the Mooki after lesser rainfall events. The lake is nationally listed as a significant wetland for migratory bird habitat. There are 3 licences drawing from the lake with entitlement approaching 25,000 ML.

Existing licence conditions have a cease to pump rule to prevent complete drying out of the lake and this access rule has been carried over into the plan. The remaining licences in the water source mostly draw from Yarraman Creek (over 7,000 ML of entitlement). To ensure extraction from the lake does not increase, no trading is allowed into the Lake Goran Management Zone. Similarly, due to the pressure on Yarraman Creek, and the desire to maintain flow into the lake, no trading is permitted into the Tributaries Management Zone.

Coxs Creek

The Coxs Creek catchment, with a licence entitlement of over 17,500 ML, was initially split into 2 water sources, with the upper water source titled Bundella Creek. Feedback from earlier consultation in 2006 and again in 2011 returned the view that the 2 water sources should be combined. The upper and lower sections of Coxs Creek have now been formed into 2 management zones, with rules referring to 3 gauges near Tambar Springs, Mullaley and Boggabri.

The exhibited draft plan included a proposal for a significantly higher commence to pump rule than exists at present to protect 'first flush' flows to encourage better connection into the Namoi River. Following major concerns raised by water users about likely impacts, the IRP reviewed the available flow data and the effectiveness of existing access conditions. Because of the long travel time for flow peaks, particularly in the mid Coxs reaches, it became evident that the proposal would have significant impacts on water users and be difficult to monitor, while not necessarily guaranteeing a significant improvement in connectivity for unspecified environmental benefits. It was also noted that flow patterns in the upper reaches were not necessarily replicated in the lower reaches below Mullaley. Recharge to the Coxs Creek alluvial groundwater source may be one factor at play.

The IRP considered the existing access conditions, which applied to most licences, were effective, and these will now be applied to all unregulated licences, except for a number with more stringent conditions which will be carried over. These large licences with more stringent conditions are already delivering a first flush outcome in the lower reaches. Trade into the Mid Coxs Creek and Lower Coxs Creek Management Zones is restricted by an entitlement limit based on the level at the commencement of the plan, to safeguard current access levels and prevent further pressure on flows.

Maules Creek

This water source has a relatively small licensed entitlement of around 1,400 ML, mostly located on Maules Creek itself. Current access conditions for these licences vary. The creek is connected with the underlying alluvial groundwater system which is the main source of water for irrigation in the area. In the past pumping restrictions have been imposed on groundwater users during dry seasons to reduce impacts on creek flows.

The IRP agreed that surface water access rules should be consistent with past practice in the area, and adopted the same CTP level (1 ML/d at Avoca East gauge), to protect low flows. The more stringent access conditions applying to several licences will be carried over. Trade into the Maules and Horsearm Creeks Management Zone is restricted by an entitlement limit based on the level at the commencement of the plan, to prevent further pressure on the resource. Trade into the Tributaries Management Zone is not permitted, to protect upstream areas which are in good environmental condition, many originating in forested areas or national park. Trade rules also protect several lagoons on the Namoi floodplain from the potential impacts of water extraction.

Eulah Creek

The water spans both sides of the regulated Namoi River and has a modest entitlement (around 3,500 ML) located on ephemeral streams. Around 2,000 ML of this is concentrated in 2 licences on Tullen Mullen Creek near Baan Baa. There are no gauging sites in the water source so basic access rules apply. Trading into the water source is restricted by an entitlement limit based on the level at the commencement of the plan.

Bohena Creek

This water has a small level of entitlement (around 1,000 ML) spread over 16 licences. The majority are located along the Namoi River anabranch which, due to siltation in the past, now only receives flows at higher river levels. There is only 1 gauging site in the water source, upstream on Bohena Creek which is too distant to be useful for establishing access rules for the 3 licences on the creek, so only basic access rules apply. Because of the highly ephemeral nature of flow, trading into the water source is not permitted to prevent further competition for limited flows, and to ensure the relatively good environmental conditions in the upstream catchment areas of the Pilliga scrub are not impacted

by extraction. Internal trade onto the weir pool behind Mollee Weir on the regulated river is also not permitted.

Bundock Creek

The water source has a modest level of entitlement (around 6,000 ML) mostly utilising flows in watercourses emanating from the Pilliga scrub as they spread onto the Namoi floodpain which is well developed for irrigation and cotton farming. There are no gauging sites so basic access rules apply. The cease to pump trigger for 3 small licences on Wee Waa Lagoon has been set at 80% of the full volume to provide some access, and the lagoon has been surveyed to establish its volume and a height gauge. Trading into the water source is not permitted to prevent further intensification of extraction on the floodplain, and to ensure the relatively good environmental conditions in the upstream catchment areas of the Pilliga scrub are not impacted by extraction. The trade rules also protect a number of other natural lagoons with environmental attributes from the potential impacts of extraction.

Brigalow Creek

This small subcatchment has two moderate sized licences with 1250 ML of entitlement on Brigalow Creek. Access rules on Brigalow Creek are based on the Tharlane gauge with a moderately stringent cease to pump rule set at approximately the 15th percentile of daily flow in this highly ephemeral stream to ensure the flows connect through to the Namoi River. Trade into the water source is not permitted but is not restricted between the 2 management zones within the water source.

Coghill Creek

This water source contains 1 licence of 600 ML entitlement on the ephemeral Coghill Creek. There are no gauging sites in the water source so basic access rules apply. Trade into the water source is restricted by an entitlement limit based on the level at the commencement of the plan.

Etoo and Talluba Creeks

This water source contains 2 licences with entitlement of around 1,400 ML on Turagulla Creek. A small number of domestic and stock licences are scattered across the remainder. There are no gauging sites and basic access rules apply. Trade into the Turragulla Creek Trading Zone is restricted by an entitlement limit based on the level **in the trading zone** at the commencement of the plan to protect access to ephemeral flows and avoid further extraction impacts on environmental flows for riparian vegetation and wetlands in the lower reaches of the meandering creek towards the Namoi River. Trade into the Tributaries Trading Zone is restricted by an entitlement limit based on the level **in the water source** at the commencement of the plan. This allows for trade out of Turragulla Creek if such options arise. The trade rules also protect any floodplain lagoons from extraction.

Spring and Bobbiwaa Creeks

This water source of highly ephemeral streams draining from the Nandewar Range has only 2 licences, with a total entitlement around 750 ML. There are no gauging sites so only basic access rules apply. Trade into the water source is restricted by an entitlement limit based on the level at the commencement of the plan. The trade rules also protect several off-river lagoons along the Namoi River floodplain from future water extraction.

Pian Creek

This water source covers the floodplain and catchment of the Pian Creek, an anabranch of the Namoi River, from its effluence near Wee Waa to its confluence towards Walgett. It also covers Pagan Creek which runs parallel to the Barwon River. The mid section of Pian Creek is a regulated river, from Merah North where the Gunidgera cutting enters, downstream to Dundee weir. There are 2 gauging sites on Pian Creek downstream of the weir, which are used to establish access rules in this reach, the Lower Pian Creek Management Zone.

The access rules are consistent with the conditions on most of the current licences, and are designed to ensure that low flows, when available, reach to the lower end of the creek for environmental and basic rights purposes. The remainder of the water source, the Tributaries Management Zone, including the upstream section of Pian Creek, is ungauged and only basic access rules apply. Trade into the water source is restricted by an entitlement limit based on the level at the commencement of the plan. Trade between the 2 management zones is not restricted. The trade rules also protect off-river lagoons and billabongs from future water extraction. It should be noted that licences extracting water from the Barwon River for irrigation adjacent to Pagan Creek are not covered by this plan.

Lower Namoi

This water source covers the lower uregulated section of Gunidgera Creek and the floodplain between Pian Creek and the Namoi River. The main water bodies are warrambools (ie overflow channels which have water only during flood times) and watercourses which are highly ephemeral, only flowing after heavy rains and floods but which often evaporate into a series of pools and lagoons in dry periods. It contains 4 irrigation licences with entitlement of over 3,300 ML, one of which is designated a *special additional high flow* licence to which more stringent conditions apply.

As there are no gauging sites in the watercourse, only basic access rules apply, unless licences have site specific conditions that need to be carried over. Due to the entitlement volume, the ephemeral nature of watercourses, and environmental values of some lagoons, trade into the water source is not permitted to prevent further competition for limited flows. The trade rules also protect off-river lagoons from future extraction.

Baradine Creek

This water source covers the Baradine Creek subcatchment from its headwaters in the Warrumbungle Ranges, as well as the floodplain between the lower Namoi, Barwon and Castlereagh Rivers where a number of watercourses break out from the Namoi in high flows and flow in a south west direction. Of the total licensed entitlement of almost 19,500 ML, over 19,000 ML is located on Turragulla and Gil Gil Creeks which receive high flow breakouts from the Namoi River, mostly in 3 large licences. The remaining small irrigation and domestic and stock licences are scattered along Baradine Creek and tributaries.

The only gauging sites in the water source occur upstream along Baradine Creek and these are not suitable for establishing access rules, so only basic access rules apply. The special conditions applying to several large licences will be carried over. Because of the very large entitlement located on Turragulla and Gil Gil Creeks, these streams have been placed in a separate Trading Zone, with no further trading into the zone permitted to prevent additional extractive pressure on flows. The remainder of the water source has been split into two more zones, the Baradine Creek and Tributaries Trading Zone, and the Namoi Effluents and Barwon Trading Zone, for both of which trading in is not permitted. The ‘no trade in’ rule for the tributaries zone is to minimise further extractive impacts on limited catchment flows. The effluents zone currently has no licences and flow in watercourses in this zone is largely natural. The ‘no trade in’ rule is designed to prevent extractive development on these

floodplain watercourses. Floodplain developments drawing water from the Barwon River are covered by a separate water sharing plan. Trade within trading zones is permissible but natural off-river pools or lagoons are protected.

Special additional High Flow Licences (SALs)

Traditionally SALs were issued with access restricted to only higher unregulated river flows. This was done by more restrictive conditions being placed on the licence. The Office of Water policy for managing SALs requires management rules that recognises the lesser right of this licence category.

Because there is only 1 SAL covered by this plan, the Namoi IRP did not consider that restrictions imposed on this licence would significantly affect patterns of water use in the catchment or contribute excessively to exceeding the extraction limits. As there was no submission on the matter during public exhibition, the IRP considered that there was no reason why this licence should not be treated according to existing policy.

The rules for this licence adopted in the plan are in accord with policy, namely that:

1. the SAL is not tradeable, having been created for a site or circumstance specific situation
2. there is no carry over of unused allocation from one water year to the next
3. any reduction in the available water determination to address exceeding the LTAAEL (growth in use response) is twice that of other unregulated water access licences.

Exemptions to access rules

Access to very low flow

Those activities that are considered to be essential for critical human needs or animal health requirements are permitted to continue to access water when the CtP access rule applies. Licences with access to very low flows include:

- domestic water supply
- stock water supply for at least the first 5 years of the plan (after which a review of the exemption may result in its extension)
- town water supply
- fruit washing
- cleaning of dairy plant and processing equipment for the purpose of hygiene
- poultry watering and misting
- cleaning of enclosures used for intensive animal production for the purposes of hygiene.

Users of basic landholders rights are also exempt from the CtP rule.

Managing extraction

Long Term Average Annual Extraction Limit

The Namoi Unregulated Rivers Extraction Management Unit (EMU) includes the 22 unregulated surface water sources covered by this plan, as well as 5 in the Peel River subcatchment, and 4 in the Mooki River subcatchment. The EMU for the Namoi was defined in earlier water sharing plans for these latter two subcatchments. Extractions from all unregulated water sources within the EMU are managed collectively under a long-term average annual extraction limit (LTAAEL).

For surface water in inland NSW, the LTAAEL is based on the Murray-Darling Basin Ministerial Council (MDBMC) Cap which was introduced in 1995 to halt growth in extractions across the basin.

The LTAAEL for the Namoi Unregulated Rivers EMU is equal to the total of the estimated annual licensed extraction of water averaged over the period from July 1993 to June 1999; plus an estimate of annual extraction of water under domestic and stock rights and native title rights in this EMU at the commencement of this plan, plus extraction by floodplain harvesting activities averaged over the period from July 1993 to June 1999. The licensing and assessment of historical extraction by floodplain harvesting activities is still in progress.

Growth in use

To protect the water set aside for the environment and the supply to existing users, it is important to control any growth in water used over time that is above the limit specified in the plan, that is, growth in extractions above the LTAAEL. If growth does occur, the mechanism used to bring water extraction back under the average is a reduction in the Available Water Determination each year until extraction declines sufficiently. This is called a Growth in Use (GIU) response. The Namoi IRP had some discretion in determining how growth was assessed across the plan area, such as the length of the averaging period for extractions, and the amount of tolerance permitted in order to allow for climatic variations. The IRP could also make recommendations on whether one Extraction Management Unit was appropriate for the whole Namoi catchment, or whether the catchment should be divided into two or more EMUs.

The averaging period established in earlier water sharing plans for the Namoi EMU was 3 years, with a 5% tolerance before a response would be triggered. During public exhibition, many submissions expressed concern about the potential impacts and fairness of a GIU response where excessive growth in particular parts of the catchment could affect water users in other areas, particularly in the absence of quantitative data on unregulated extraction. There was also concern that the averaging period of 3 years was too short, and that the tolerance should be increased, perhaps to 10% or more.

In finalising its decision, the IRP was mindful that much of the concern about the LTAAEL and GIU response was conjecture due the lack of metering of unregulated water use across the catchment, and that any changes should be informed by better data. The averaging period for the LTAAEL remains at 3 years with a 5% tolerance. However, the IRP has included amendment provisions in the plan which allow for

1. addition or modification of EMUs based upon a review of geographic distributions of actual or potential growth in extractions, and the potential for disproportionate growth, and exceeding the LTAAEL
2. after year 5 of the plan, a possible increase in the averaging period and/or the tolerance before a GIU response is required, following a review which demonstrates that the current GIU trigger is being caused by a short term change in extractions rather than long term growth.

It should be noted that before a GIU response is triggered, comprehensive extraction data will be required for at least 3 years after metering of unregulated licences is introduced.

Available water determination (AWD)

AWDs are primarily used to credit water into a water allocation account. 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. These types of licence are not subject to AWD reductions due to a GIU response.

The AWD for unregulated river access licences will be 1 megalitre per unit share, unless a GIU response is required. That is, if average extractions total more than 5% above the LTAAEL, then the maximum AWD will be reduced to less than 1 megalitre per unit share until the 3 year average returns under the limit. However for the first year of the plan, a one-off announcement of two megalitres per unit share will be made to allow the effective introduction of three year accounting rules described below.

If a GIU response is required, the AWD for the Special Additional (High Flow) Licence will be reduced by twice that of ordinary unregulated access licences, recognising the lesser right of this licence category.

Carryover and water 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. A licence holder's account is not permitted to go into debit.

Unregulated rivers have enormous variation in annual flows between years. It is therefore important to allow this variability to be reflected in accounting practices. Unregulated river access licence account management will operate under three year accounting rules. Available water determinations combined with the carryover allowance will enable licence holders to use up to twice their water allocation in a year (200% account limit) provided that over a consecutive three year period they do not exceed the sum of their water allocations for those three years.

For the first three years of the plan, this maximum volume that may be taken may not exceed a volume equal to three times the access licence share component (where this is expressed in megalitres), or 3 megalitres per unit share (where the share component is expressed in unit shares). This restriction in the first three years is due to the allocation of 200 per cent (where share component is expressed as a volume) or 2 megalitres per unit share (where share component is expressed in unit shares), made in the first year of the plan to allow the operation of these accounting rules from year one of the plan.

The maximum amount of unused water allocation that can be carried over from one water year to the next in unregulated river access licence accounts will be 100 per cent of the share component (where this is expressed in megalitres), or 1 megalitre per unit share (where share component is expressed in unit shares).

During public exhibition of the draft plan, some submissions expressed a view that the account limit should be increased, and more than twice the allocation should be allowed to be used in any one year, to allow flexibility to capitalise on variable markets and highly ephemeral streams where limited access opportunities arise in dry seasons. However, the IRP was also aware of the potential for higher annual water use to have adverse environmental impacts, particularly in un-gauged streams where only basic access rules apply, and also for high annual use to contribute to exceeding the LTAAEL. For the Namoi, the accounting rules remain as described above.

Water sharing rules for alluvial groundwater sources

The water sharing rules that the Namoi IRP focused on were:

- access rules – for highly connected groundwater sources where access rules linked to surface water rules may apply
- dealing rules – which control the trade of water (both permanent transfer of access licence entitlements and temporary assignment of water allocation between access licences, the change of water sources and the location for extraction)
- extraction limits – which set the total volume of water that can be extracted on a long-term average annual basis from the water source.

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

- assessing growth – how growth in groundwater extraction is assessed
- rules for granting works approvals – what types of separation conditions are required
- rules for the protection of a specific environmental asset.

These rules form the basis of mandatory conditions on water access licences and approvals.

Managing connectivity

For the purposes of developing plans for inland aquifer systems in NSW, the Office of Water has defined a highly connected groundwater system as a system in which “70 per cent or more of the groundwater extracted is derived from stream flow within a single irrigation season”. This is a simplified version of, but still reasonably consistent with, the key findings and conclusions circulated for discussion amongst state jurisdictions by the Murray-Darling Basin Commission (MDBC) in their report “Evaluation of the connectivity between surface water and groundwater in the Murray-Darling Basin” (MDBC, 2006).

There are four alluvial groundwater sources covered in the Namoi plan, namely Manilla, Currabubula, Quipolly and Quirindi. The Manilla alluvial groundwater source is split into 3 management zones, one under Halls Creek, one under the unregulated Namoi River, and one under the regulated Manilla and Namoi Rivers. The Currabubula alluvial groundwater source lies under Currabubula Creek in the Werris Creek surface water source. The other two alluvial systems, namely Quipolly and Quirindi, are located under Quipolly and Quirindi Creeks respectively, which are part of the water sharing plan for the Mooki River catchment which commenced in 2004.

Gauging data for the regulated Manilla and Namoi Rivers, the unregulated Namoi River, and for Halls Creek verifies that these streams are virtually perennial streams and hence provide the opportunity for continuous recharge to the alluvium. During low flow periods there is a high likelihood that groundwater pumping affects stream flow. For this reason, the Manilla alluvial groundwater source will be treated as ‘highly connected’. However, Currabubula Creek, Quipolly Creek and Quirindi Creek only exhibit intermittent and highly unreliable flow. That is, recharge is likely to be more episodic during periods of moderate to high flow, and the extent to which groundwater pumping affects stream flow is less clear. Obviously there is no effect when there is no flow. Furthermore, there are no reliable gauges on these streams in proximity to the alluvial groundwater sources on which cease to pump rules could be based. Therefore these alluvial systems are classified as ‘less connected’.

Access rules

For highly connected water sources, specific rules that recognise that groundwater users draw significantly on the same water resource as surface water users may be applied. In low flow periods,

when cease to pump conditions apply to surface water users, it is not reasonable that groundwater users can continue to extract water without restrictions when the stream is losing water to the underlying aquifer. Aquifers that are highly connected to unregulated surface water sources may have access rules similar or consistent with access rules for surface water. Aquifers that are highly connected to regulated surface water sources, where access rules do not apply because water is ordered and released from dams on demand, may be linked through annual management by having consistent AWDs which are usually based on the water available in or expected from storage dams over the water year. This situation applies to the Namoi and Manilla Regulated Rivers Alluvial Management Zone and is discussed below, under Available Water Determinations.

In unregulated water sources, groundwater extraction may have similar cease to pump rules to the adjacent surface water source, but usually with a time lag that recognises the buffering effect of aquifer storage which delays the impact that groundwater pumping has on river flows. In order to implement such a time delay the cease to pump rules must relate to a telemetered gauge. This situation applies in the Namoi Unregulated River Alluvial Management Zone and the Halls Creek Alluvial Management Zone.

In the 'less connected' groundwater sources of Currabubula, Quipolly and Quirindi, there are no access rules.

In determining access rules for groundwater, the Namoi IRP was provided with advice from Office of Water hydrogeologists. Unfortunately, the absence of metering in the 4 alluvial systems meant there was no data available on groundwater extraction to assist decisions. Furthermore, none of the 4 systems have monitoring bores to provide information on historical water table behavior, making assessments of the sustainability of current practice difficult. Decisions were sometimes guided by studies of comparable alluvial systems such as in the Peel valley where climate and farming systems are similar.

Dealings

Dealing (trading) rules are intended to provide for efficient water markets whilst recognizing and protecting the needs of the environment and third-part interests. In most macro plans, dealings area allowed within a groundwater source but not into or out of the groundwater source.

Consistent with the Minister's dealing principles there is no trading permitted between the four alluvial groundwater sources covered by the water sharing plan for the Namoi Unregulated and Alluvial water sources.

For the Manilla Alluvial groundwater source, trade is also prohibited between the 3 management zones because of the likely impacts on different surface water systems, and because of the narrow and finger like shape of the alluvium which may not spread extraction impacts uniformly. Trade is permitted within each management zone.

Rules for water supply works approvals

In accordance with the principles of the *Water Management Act 2000*, the plan sets rules to minimise the cumulative impacts resulting from groundwater extraction. To do this, the plan specifies rules which prohibit new or 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 draw down of water occurring in the local vicinity of these users and sites.

A standard set of distance criteria for common groundwater aquifer types (for example fractured rock, alluvium, coastal sands and porous rock) was produced by comparing the various rules in similar geological provinces. The standard rules were then endorsed by the State Groundwater Panel.

This process has resulted in consistent rules across aquifer types being considered as 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.

NOW hydrogeologists provided advice on the applicability of the standard rules for groundwater sources in the Namoi plan. The IRP then made decisions as to which, if any, of the standard rules would be varied to suit local conditions. The majority of the standard rules were accepted unchanged for the Namoi plan, but the plan contains provisions to alter distance rules for specific circumstances where it can be demonstrated that the amended distances will achieve the same satisfactory outcomes. The adopted distance rules are largely unchanged from those that were placed on public exhibition, and very few comments were received in submissions.

For new works there are rules to:

- minimise interference between neighboring works
- locate works away from contaminated sites
- protect water levels in 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.

Replacement works in the Quipolly alluvial groundwater source

The submissions received from licence holders in the Quipolly groundwater source during the public exhibition period expressed concerns that an important local issue was not recognised in the plan. The issue is the potential impact of coal mining and associated water extraction on the alluvial groundwater system from the nearby Werris Creek Coal Mine. The mine has been in operation for a number of years and more recently received approval for further expansion. The environmental assessment for the most recent approval included some detailed studies on the groundwater system in the locality in regard to the risk that mine dewatering and water extraction activities could have on the alluvial aquifer and landholder water supply. As part of the ongoing environmental monitoring program for the mine, a series of piezometers have been installed in the locality, including some in the alluvial aquifer, to gather data on water table levels and water quality. In addition, some landholder bores are being monitored.

As part of the approvals process for the current mining operation, the mining company has made certain commitments to local landholders that, should it be demonstrated that mining activities have caused significant impacts on the groundwater resource and landholders' water supply, that the company would undertake remediation work or provide a satisfactory alternative water supply (R.Browne, pers. comms., October 2011). This could include modifying or deepening existing bores, or constructing a replacement bore if necessary. The Quipolly licence holders were concerned that the rules in the plan for replacement works made no provision for or mention of this issue. They were concerned that the water sharing plan had been developed in isolation, and should perhaps demonstrate consistency with other planning processes that impinge on local groundwater management.

NOW's position is that the rules for replacement groundwater works do not preclude possible remediation actions by the mining company, given that the plan provides the Minister with the option to vary the rules on the basis of valid hydrogeological studies. It is considered inappropriate and unnecessary for the water sharing plan to include specific clauses on the issue. The overlap between water sharing plan rules and conditions imposed through the development approval process is a matter that is likely to occur frequently across the state, but it does not mean the two processes are in conflict. Any major project is required to comply with the provisions of the *Water Management Act 2000* and relevant water sharing plans.

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.

High priority GDEs are identified during the planning process. The IRP also had the opportunity to review and amend the GDE list as well as the rules that have been developed to protect them based on their expertise.

No GDE's have been identified for the four alluvial groundwater sources included in the Namoi Unregulated and Alluvial Water Sharing Plan.

Managing extraction

Long Term Average Annual Extraction Limit (LTAAEL)

For this and other similar plan areas, NSW has resolved that the long-term average annual extraction limit (LTAAEL) for highly connected and alluvial groundwater resources within the NSW portion of the Murray-Darling Basin shall be set equal to current average usage. This is based on the principle that current levels of groundwater pumping are considered to be having acceptable impacts on surface water sources. Any extraction beyond this level will result in additional impact on the rivers, groundwater dependent ecosystems and other users of these connected water resources.

Estimating current active use and determining an appropriate LTAAEL for each of the four groundwater sources in this plan was a major task for the Namoi IRP. The majority of bores in all 4 areas are un-metered and therefore no information on extraction volumes. For the purposes of placing the plan on public exhibition, the IRP used an estimate of active use based on data gained from alluvial groundwater sources in other areas which were not too dissimilar in alluvial formation, climate and the types of irrigation enterprises, where metering records were available. The two available sources were the Peel Valley and the Cudgegong Valley. The ratio of active use to licensed entitlement in these areas averaged around 10% for aquifers connected to unregulated streams and slightly higher for those connected to regulated streams. The draft plan was placed on public exhibition in October 2011 with LTAAELs nominally shown as being around 10% of licensed entitlement.

The exhibited plan generated a significant response in submissions, especially from the Quipolly and Quirindi areas, with the view that such plan limits would not allow water users to replicate past usage patterns and significantly affect many farming operations. Many submissions mentioned the long term reliability and stability of water tables in the local area, and many provided estimates of current and recent water use or information on the scale of their irrigated enterprises. The Namoi IRP reviewed the submissions and determined that a more reliable estimate of current active use should be obtained by using information provided in submissions where verifiable and adequate, and by surveying

groundwater licensees in the four alluvial areas to gather water use information over the last 10 years where available. For many users without metered pumps, the best available data was on crop areas and levels of production, and historical areas irrigated could often be verified from satellite imagery. In order to have a consistent methodology, the IRP agreed to use a standard set of annual crop water requirement rates for converting areas of various crops into estimates of water use, rather than estimates from licensees which are influenced by seasonal conditions and variations in pumps, motors and irrigation equipment. The standard rates adopted were those used in the published Volumetric Conversion process (1999) earlier when area-based water licences were converted to a volume.

A telephone survey was undertaken to gather information, seeking historical data on water use or cropped areas, and the area estimates checked with paddock sizes determined from on satellite images. Licensees were not contacted again if they had already supplied detailed information in submissions. Also, following public exhibition, many property inspections were undertaken, especially some of the larger water users, to check first hand the scale of operations. Many licensees, especially some of the smaller entitlement holders, confirmed that their licences were inactive or used to limited extent, while the larger water users were clearly able to be identified. A small number of licensees were unable to be contacted. The Namoi IRP agreed that, where more reliable information was not available on a particular licence, an estimate of 10% of entitlement would be used. This generally applied only to a number of smaller entitlement holders, and the risk of overestimating water use was deemed not significant.

Through a combination of sources (submissions, telephone survey, property inspections and satellite imagery,) an estimate of active water use was collated for each alluvial water source. The totals for each water source, plus an estimate for basic landholder rights use was used to determine the LTAAELs in the plan. Due to time and resource constraints, it was not possible to extend the survey indefinitely to pursue several licensees who had been un-contactable. However, the IRP agreed to an amendment clause in the plan that allows the LTAAELs for alluvial groundwater sources to be adjusted in the first year where better groundwater usage data becomes available.

Manilla alluvial groundwater source

The LTAAEL for the Manilla alluvial groundwater source, covering all 3 management zones, is 1,229 ML per year, defined by the sum of:

- an estimate of the total of current average annual active use for each individual licence based on either, a survey of water users for pumping records or areas and crop types irrigated over the last decade, the latter multiplied by standard crop water requirement factors, or, in the absence of any licence holder information, 10% of the entitlement ; plus
- an estimate of use for basic landholders' rights (BLRs) of 24.7 ML per year, based on a consistent methodology used across all unregulated water sharing plans.

Extraction from the Manilla Alluvial groundwater source is currently not metered and the above limit is the best estimate of active use until extraction data becomes available. The above LTAAEL, discounting the BLR component, is equivalent to approximately one third of licensed entitlement.

During public exhibition of the draft plan, the Minister sought feedback on the LTAAEL for the Manilla alluvial groundwater sources, which was based on an estimate of 10% of entitlement in the absence of better data. While only a small number of comments were received from groundwater licence holders in this water source, there was some concern over the small estimate and how it would affect water users when metering was introduced and possibly confirmed a much higher pattern of use that would trigger a growth in use response. The Namoi IRP responded to these concerns by requesting a more detailed survey. The revised LTAAEL figure (result of survey), is more robust than the original figure and much closer to current active use.

It should be noted that many alluvial groundwater users may also have licences to access quite reliable surface water flows, and that use from one source may supplement the other. Hence usage can fluctuate according to seasonal conditions and availability of alternative sources. This underlies the importance of managing connected surface water – groundwater systems in an integrated fashion.

Currabubula alluvial groundwater source

The Currabubula alluvial aquifer is a relatively narrow system with only 8 small groundwater licences. There was negligible response from licence holders to the public exhibition. The LTAAEL for the Currabubula alluvial groundwater source is 60 ML per year, defined by the sum of:

- an estimate of the total of current average annual active use for each individual licence based on either, a survey of water users for pumping records or areas and crop types irrigated over the last decade, the latter multiplied by standard crop water requirement factors, or, in the absence of any licence holder information, 10% of the entitlement ; plus
- an estimate of use for BLRs of 17.8 ML per year, based on a consistent methodology used across all unregulated water sharing plans.

Extraction from the Currabubula alluvial groundwater source is currently not metered and the above limit is the best estimate of active use until extraction data becomes available. The above LTAAEL, discounting the BLR component, is equivalent to approximately 12% of licensed entitlement.

Most licensed bores in the Currabubula alluvium are either dormant or only used for domestic and stock water. Based on survey feedback, there is only one licence that is used for small scale irrigation periodically. There is also a Council owned town water supply bore which is used for public purposes from time to time.

The Namoi IRP is confident this LTAAEL figure is a reasonable estimate of historical usage.

Quipolly alluvial groundwater source

The Quipolly alluvial groundwater source has 10 groundwater licence holders. There is currently no comprehensive bore metering across the water source, although some users have installed meters in recent years for management purposes. This group responded strongly during the public exhibition period, with the major concern being a low LTAAEL figure which they felt seriously under represented current active use and which would be likely to be exceeded if metering provided accurate data on volumes being extracted. Many provided useful estimates of water use or areas and crops irrigated during the last decade. NSW Office of Water staff undertook an inspection of farms in the area with local water users.

The LTAAEL for the Quipolly alluvial groundwater source is now estimated at 476 ML per year, defined by the sum of:

- an estimate of the total of current average annual active use for each individual licence based on either, a survey of water users for pumping records or areas and crop types irrigated over the last decade, the latter multiplied by standard crop water requirement factors, or, in the absence of any licence holder information, 10% of the entitlement ; plus
- an estimate of use for BLRs of 3.9 ML per year, based on a consistent methodology used across all unregulated water sharing plans.

This LTAAEL figure, discounting the BLR component, is equivalent to approximately 64% of licensed entitlement, a significant increase over that which was exhibited in the draft plan, and reflects the fact there are several very active water users in this water source, concerns are more clearly expressed by the more active water users who may be aware of the extent of inactive licences in the water source

which, if activated, could result in exceeding the LTAAEL. These water users are also those who contribute most to the local irrigation economy.

Due to lack of confidence in the initial active water use estimate in the exhibited draft for this water source, the Namoi IRP was most keen to undertake the survey for this area. The survey revealed a significant number of licences that have been dormant in recent years, but also provided a much better assessment of active licences.

The resulting LTAAEL for the Quirindi alluvial groundwater source is now estimated at 1,231.4 ML per year, defined by the sum of:

- an estimate of the total of current average annual active use for each individual licence based on either, a survey of water users for pumping records or areas and crop types irrigated over the last decade, the latter multiplied by standard crop water requirement factors, or, in the absence of any licence holder information, 10% of the entitlement ; plus
- an estimate of use for BLRs of 14.1 ML per year, based on a consistent methodology used across all unregulated water sharing plans.

This LTAAEL figure, discounting the BLR component, is equivalent to approximately 42% of licensed entitlement, a significant increase over that which was exhibited in the draft plan. The Namoi IRP is confident that this is a better estimate of active use over the last decade. It is likely that Quirindi Creek is the major source of recharge, consistent with the fact that the creek in several places often appears to run 'below ground', with flow disappearing into the gravel beds, only to recommence flow at points further downstream. Unfortunately there are no Office of Water monitoring bores located in this alluvial system to quantify the stability of water tables.

Available water determination

Available Water Determinations (AWDs) are primarily used to credit water into a water allocation account each water year, but can also be used as the mechanism for reducing water extractions when a GIU response has been triggered (see below). For most alluvial groundwater sources connected to unregulated streams, where a GIU response is not in place, the AWD is normally announced at 100% or 1 ML per unit share of entitlement. However, in water sources or management zones which are deemed 'highly connected' to regulated stream flow, the AWD is also used as the adjustment mechanism for groundwater extractions when stream flow is reduced, such as when there are reduced storage volumes in the dam delivering regulated flows. This latter situation applies to the Namoi and Manilla Regulated Rivers Alluvial Management Zone in the Manilla alluvial groundwater source.

Namoi and Manilla Regulated Rivers Alluvial Management Zone

As with most alluvial systems, this groundwater management zone is most likely recharged from several sources including local rainfall and runoff from adjacent hills, but for 'highly connected' aquifers such as this, the major recharge (at least 70%) is understood to come from the regulated river. According to the principles of managing 'highly connected' systems, when regulated water users have reduced access, that is, reduced AWDs, groundwater users should also experience some restrictions, namely a reduction in their AWD. The reduction should apply to the proportion of recharge that is derived from regulated stream flow. It should be recognised though that recharge is likely to be occurring whenever the river is flowing and that not all the water flowing in the stream has necessarily been released out of regulated storage. The Namoi IRP was required to make a decision on the extent to which reduced allocations for regulated water users should be applied to groundwater users in this zone.

The hydrogeological data available for the aquifer in this zone is quite limited. However a detailed model of the relationship between alluvial groundwater and regulated and unregulated surface water

has been developed for the Peel Valley, and this model had been modified by using local aquifer properties and dimensions to simulate behavior in a number of connected alluvium systems across northern NSW, including the Manilla system. A range of estimates for the proportion of extraction coming from the regulated river was generated. The IRP considered this information, and noting the absence of accurate metered data, and the use of assumptions in the model, took a very conservative approach. It determined that approximately 15% of extraction could confidently be attributed to regulated river flow (river recharge component), with the remaining coming from other sources of recharge.

In terms of rules for this zone, the above decision means that 15% of the AWD for groundwater licences will be determined by the announced AWD for regulated surface water licences and 85% will correspond to the announced AWD for the remainder of groundwater users in the water source, that is, those in the other 2 zones. An example of how this works is as follows:

If the announced AWD for regulated river (general security) access licences is 60% or 0.6 ML per unit share, and the announced AWD for aquifer access licences in the water source is 100% or 1 ML per unit share,

The resulting AWD for groundwater users in this zone will be

0.6 x 15% + 1 x 85% = 0.09 + 0.85 = 0.94 ML per unit share.

That is, groundwater users will have a reduced AWD because there is less water available in the regulated system. For this reason, the replacement groundwater licences issued under the *Water Management Act 2000* for this zone are termed **aquifer (general security) access licences** to distinguish them from **aquifer access licences** issued in the other two zones and in other Namoi alluvial groundwater sources.

Growth in use

When comprehensive metering is installed across groundwater sources, annual extractions will be tallied and compared with the LTAAEL. If the average of annual extractions over a period of years exceeds the LTAAEL by a significant amount, then measures will be taken to reduce water use until the average is at or below the LTAAEL. The method used to reduce water use is a reduction in the annual Available Water Determination (AWD) for the particular groundwater source, that is, a maximum AWD of less than 1 megalitre per unit share. This is called a Growth in Use (GIU) response. As demonstrated above, the current statewide position is to set the LTAAEL for connected alluvial systems at current average usage. The averaging of annual extractions over a period of time is intended to smooth out the 'peaks' and 'troughs' of usage due to seasonal conditions and other factors, so that any trends in growth can be detected. The Namoi IRP provided recommendations on the appropriate length of the averaging period for GIU assessments, and also on the percentage threshold of the LTAAEL that should be used to trigger an adjustment of the AWD.

For public exhibition, the draft plan contained an averaging period of 5 years and a GIU trigger of 10%. That is, if metering was already in place, the earliest that a GIU response could occur would be in year 6 of the plan. A number of submissions expressed concern that 5 years may not be long enough to average out the impact of varying seasonal conditions, particularly when droughts can run for several years. Alternatively the trigger point could be increased to provide more flexibility. In considering these submissions the Namoi IRP felt that such concerns were premature and conjectural, given that there was no accurate usage data yet to support them. Such concerns may have been based on the relatively low LTAAEL figures in the draft plan which has now been adjusted. The IRP's decision was to retain the 5 year averaging period and the 10% trigger level.

Carryover and water accounts

No carryover of allocations from one water year to the next is permitted in any of the 4 groundwater sources covered by the plan, and the maximum amount of water permitted to be taken from alluvial groundwater sources in any one water year is equal to the water allocation accrued in the water account for that water year, as determined by the AWD. The justification for this conservative approach is based on the following:

- Alluvial groundwater licences are much more reliable than most unregulated surface water licences, as they are less affected by seasonal rainfall over the short term, due to the volume of water held in aquifer storage which can buffer extractions until the next recharge event.
- Significantly increasing the volume of extraction in any one year by allowing carryover in accounts, however, could threaten aquifer storage volumes because of the limited width and depth of the alluvium in many cases.
- Because average active use is significantly less than total entitlement in all 4 alluvial groundwater sources, there remains the potential for much higher extraction at any time which could significantly affect aquifer storage volumes and threaten sustainability until a GIU response kicks in to reduce extractions.

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 *Water Management Act 2000* and the National Water Initiative, and has been allowed for during the life of the plan through amending provisions.

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

The Namoi plan contains a substantial number of amendment clauses to cover a range of contingencies which are included in most water sharing plans to satisfy the various legislative and national requirements. However, there are some key amendment provisions that are included on the recommendation of the Namoi IRP. These potential adjustments to the plan are because of one or more of the following reasons:

- better or more comprehensive information becomes available on a particular issue than was available to the IRP during plan preparation, perhaps after a specific review
- the circumstances existing at the commencement of the plan change during the life of the plan
- experience during the early part of the plan indicates a change is warranted.

The key amendment provisions included at the behest of the Namoi IRP are as follows.

EMU and unregulated LTAAEL Amendment

In response to water user and community concerns about the applicability of a single EMU for the unregulated water sources of the Namoi catchment, the IRP has included the option of separating the unregulated water sources covered by the plan into two or more EMUs following a review of the distribution of extraction information and the potential for disproportionate growth in some water sources that might trigger a GIU response. Any review would require comprehensive extraction data such as would be provided by metering of unregulated water supply works.

Furthermore, based on concerns about the shortness of a 3 year averaging period for calculating the unregulated LTAAEL, and the small tolerance of 5% that would trigger a decrease in AWDs, the plan includes options, after year 5 of the plan following a review, to:

- extend the averaging period for calculating the LTAAEL
- increase the percentage before a GIU adjustment is made to AWDs.

Again, such a review would require comprehensive extraction data from metering.

Alluvial groundwater LTAAELs

Given that groundwater extraction is mostly unmetered and unreported in the groundwater sources covered by this plan, the LTAAELs for alluvial groundwater sources are based upon the best endeavors to estimate active water use in each groundwater source over recent years. However, to account for possible erroneous information or underestimation of active use, the plan includes the option, in the first 12 months, to amend the LTAAELs where new valid information on active use becomes available.

Review of Unregulated Trading Rules

The Namoi IRP's recommendations on trade (dealing in entitlements and assignment of allocations) were conservative and precautionary, to ensure minimal adverse environmental impacts and to safeguard security of access for current water users. In many water sources, there is very limited hydrological information (e.g. un-gauged sub-catchments) and a paucity of stream specific aquatic ecosystem data, especially in highly ephemeral streams. The economic and environmental benefits and dis-benefits need to be assessed in both the originating and receiving water sources. Furthermore, the majority of unregulated water sources discharge to the regulated river and unregulated trade may have some impacts on the pattern of flows in the regulated system.

The plan includes an option, after year 2, to amend the trade rules following a comprehensive review which would more thoroughly assess likely impacts, and identify water sources where trade restrictions are needed or otherwise, and what types of trade would be permissible.

Barraba Town Water Supply

One of the factors in determining access and trade rules in the Manilla River Management Zone of the Upper Manilla water source was the reliance of Barraba town water supply on unregulated flows. During recent drought years, maintaining a secure and adequate water supply for the town has been problematic. Approvals have now been issued for an augmentation scheme sourcing regulated supply from Split Rock dam, and the project is underway. The Namoi plan contains an option to review the access and trade rules in this management zone once such a scheme is completed and operational.

Evaluation of plan performance

The evaluation framework for water sharing plans is currently being developed. The objectives of the project are to:

- inform the community of the results from the 10 year operation of water sharing plans
- collate the results of the various legislatively-required evaluations, along with other relevant learning's to inform the remake of water sharing plans.

The evaluation framework will use a system of "program logic" to organise the inputs, outputs and outcomes from water sharing plans and their operation. Evaluation questions and monitoring indicators allow assessment of these steps to rate a water sharing plan for its:

- process of development (appropriateness)

- performance during operation (efficiency)
- socio-economic environmental and cultural outcomes (effectiveness).

The Office of Water's approach conforms to NSW and Commonwealth government guidelines for monitoring, evaluation and reporting, and demonstrates the adaptive management approach to water planning required under the principles of the *Water Management Act, 2000*. The Office of Water has also chosen to organise the evaluation questions and monitoring indicators using the NSW Natural Resource Commission's auditable standard for natural resource management.

Performance indicators

The Plan includes a number of performance indicators that will be monitored over the 10 year life of the Plan.

It is not practicable 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 Plan as improved methods are developed.

The WSP Environmental Flows Monitoring and Modelling program has been designed to make the results of environmental flows studies more transferable between water sources and to develop more generic relationships between flow, hydraulics and ecological responses. In adopting this approach it enables a more efficient and effective evidence-based approach to support monitoring and evaluation requirements of NSW water sharing plans and identifies specific knowledge gaps to allow further investigative work to be prioritised.

Plan review

Under the *Water Management Act 2000*, the Natural Resources Commission is required to undertake a review of this Plan prior to any decision to extend its term or to make a new plan.

The Evaluation framework developed will consider the statutory requirements for the different types of evaluation:

- An audit of the Plan, at intervals of no more than five years, for the purpose of ascertaining whether its provisions have been given effect to. This audit is to be carried out by the State Interagency Panel, which has now been appointed by the Minister (for Water).
- An audit of the Plan by the Natural Resources Commission to assess to what extent the water sharing provisions have contributed to the relevant state wide targets, and natural resource standards and targets in the relevant catchment management area. The Natural Resources Commission will call for public submissions when undertaking its review.

Glossary

Many of the terms in this document are defined in the *Water Management Act 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.

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 highest water level where there is no visible flow out of that pool.

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.

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 '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.

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

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

Water sharing plan (plan): A plan made under the *Water Management Act 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.

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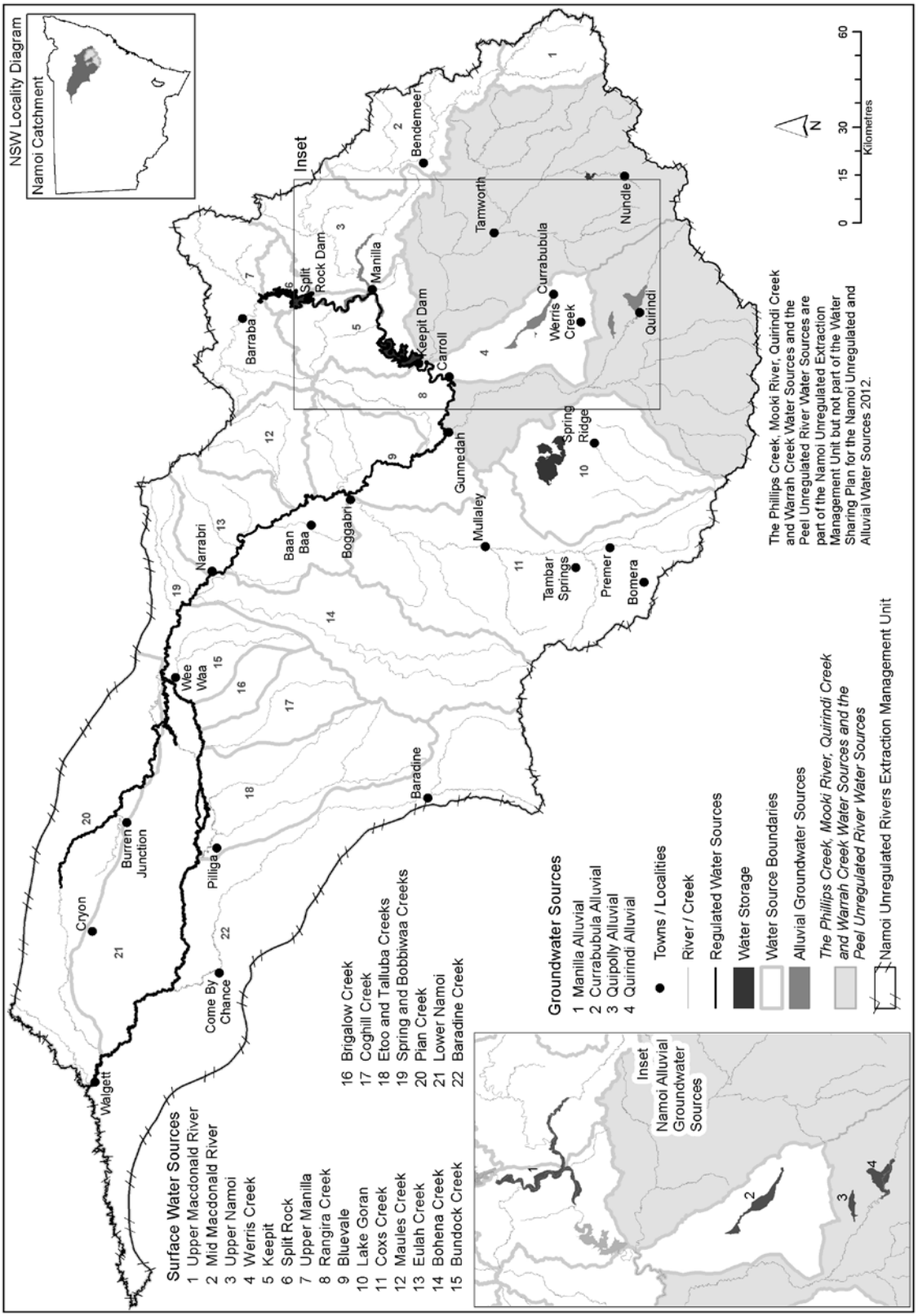
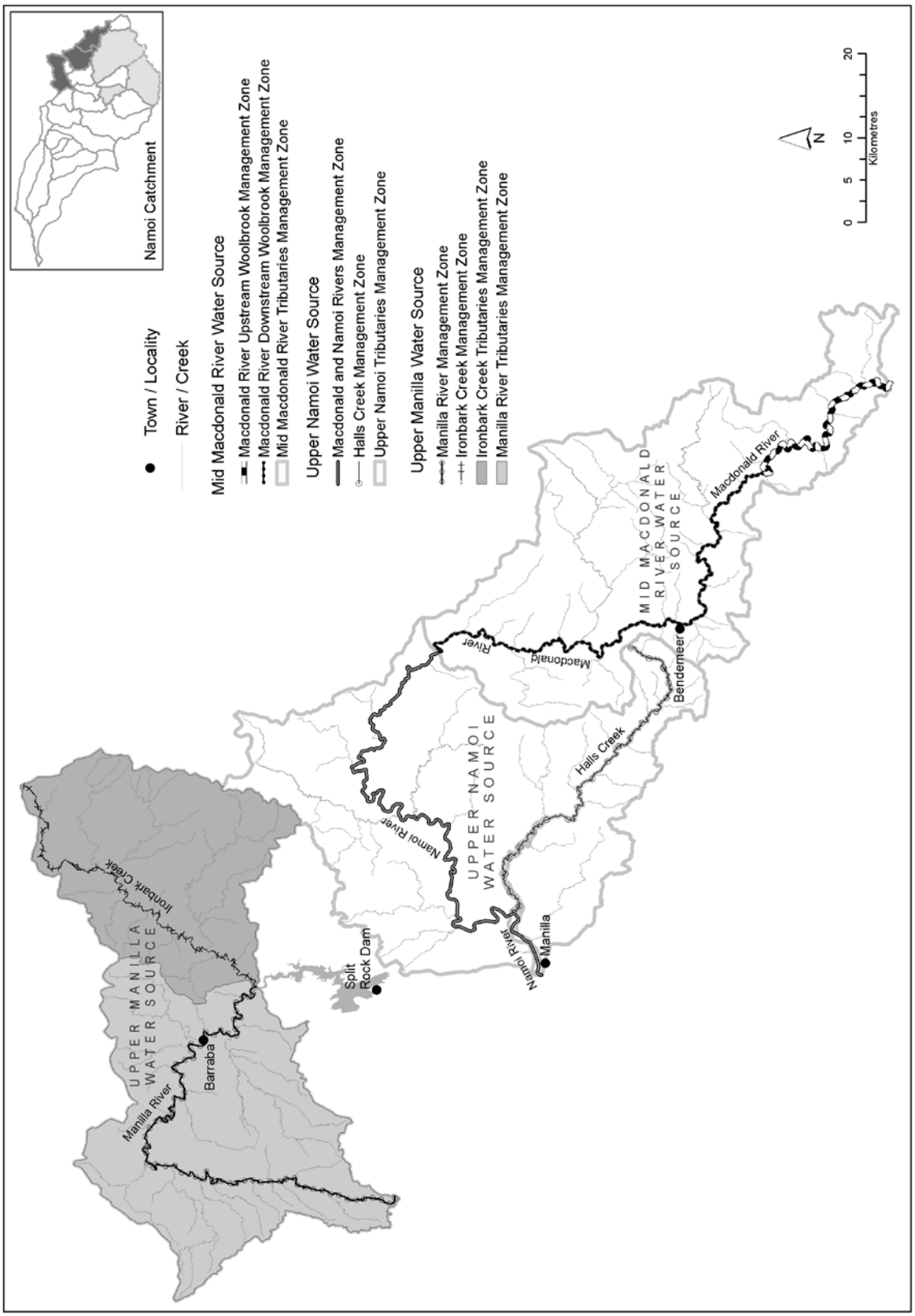
Appendices

Appendix 1: Water sharing plan maps

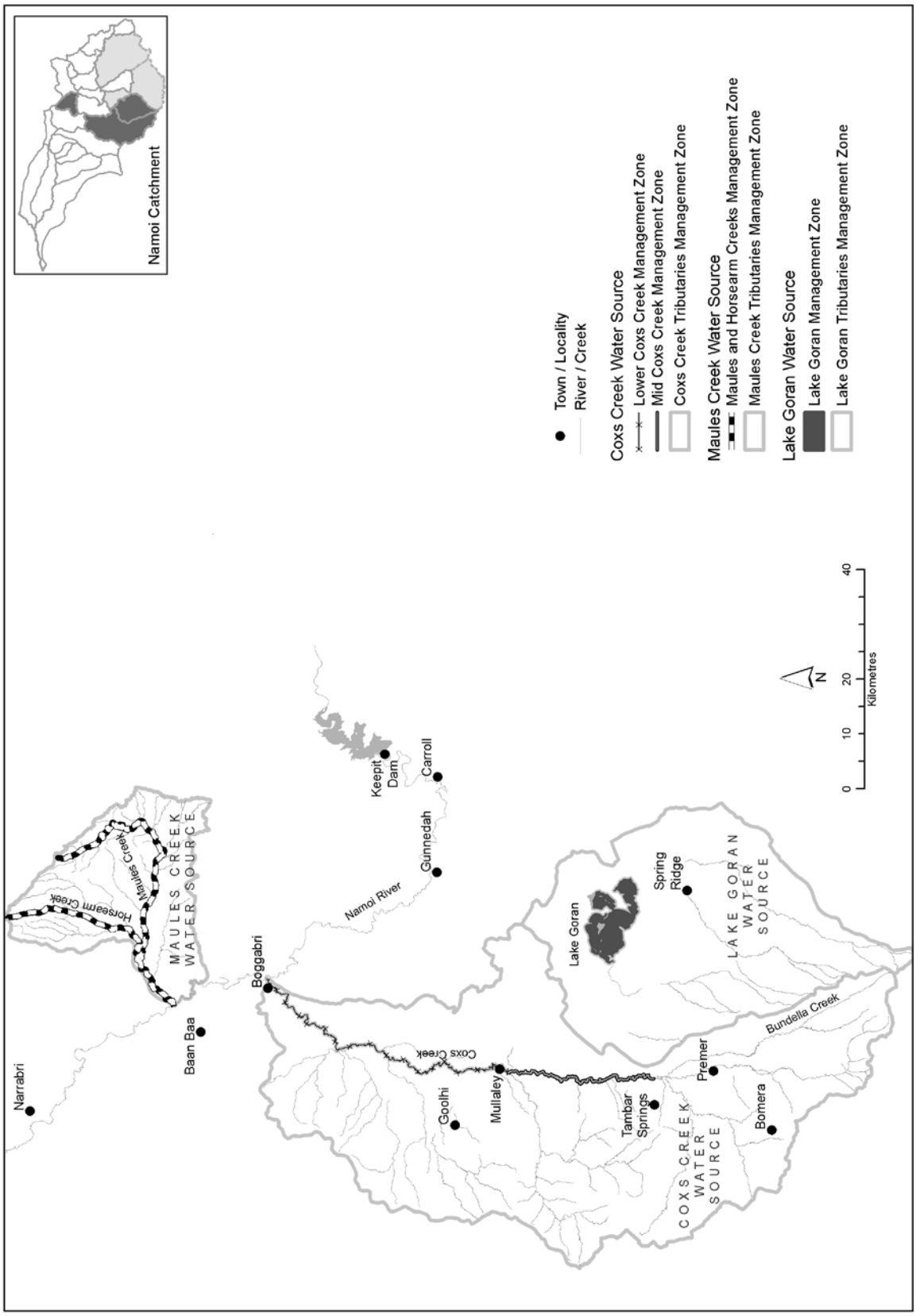
Map 1: Overview of the Plan Map showing the EMU and Water Sources



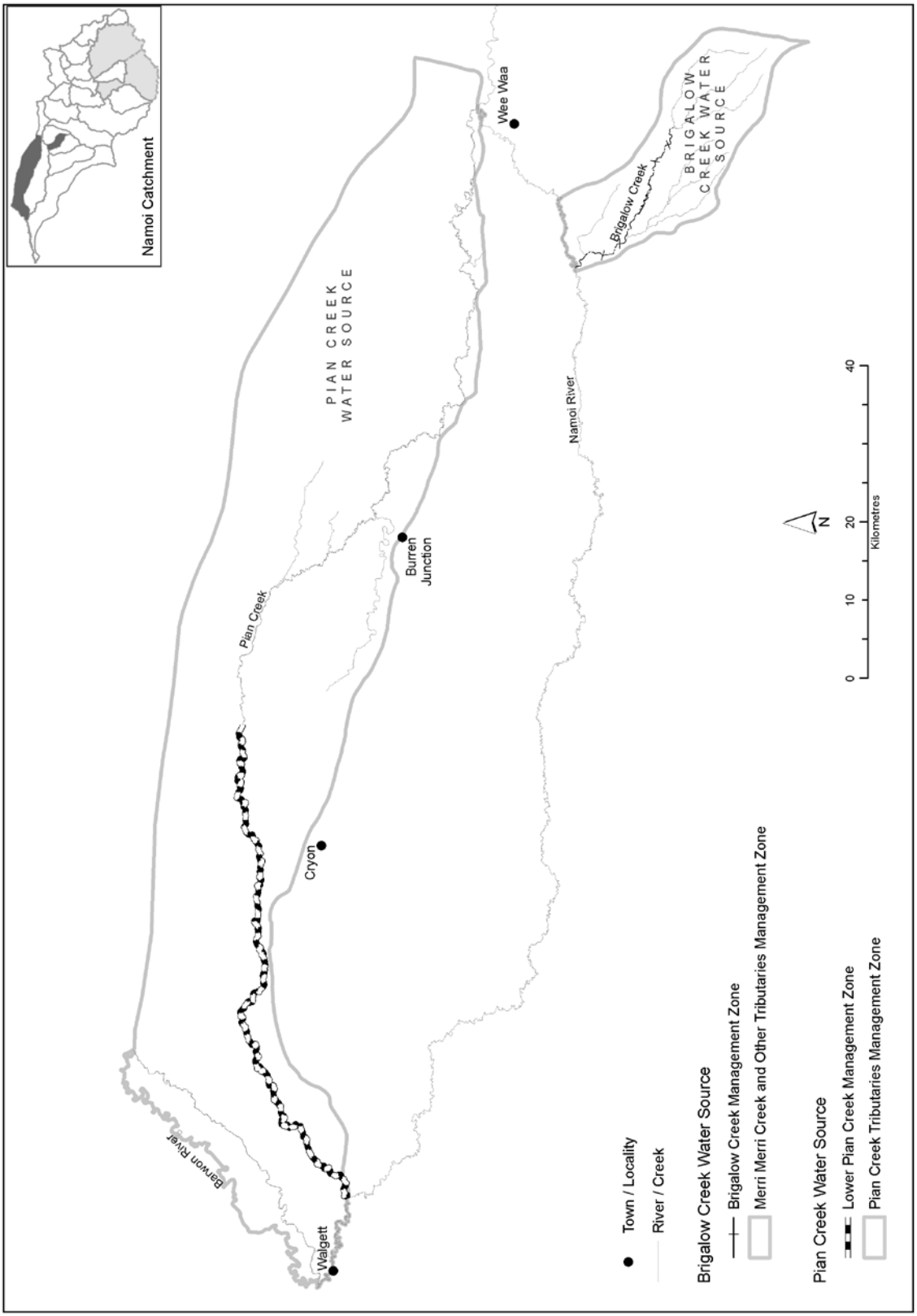
Map 2: Overview of Management Zones in the Plan: Upper Catchment Water Sources



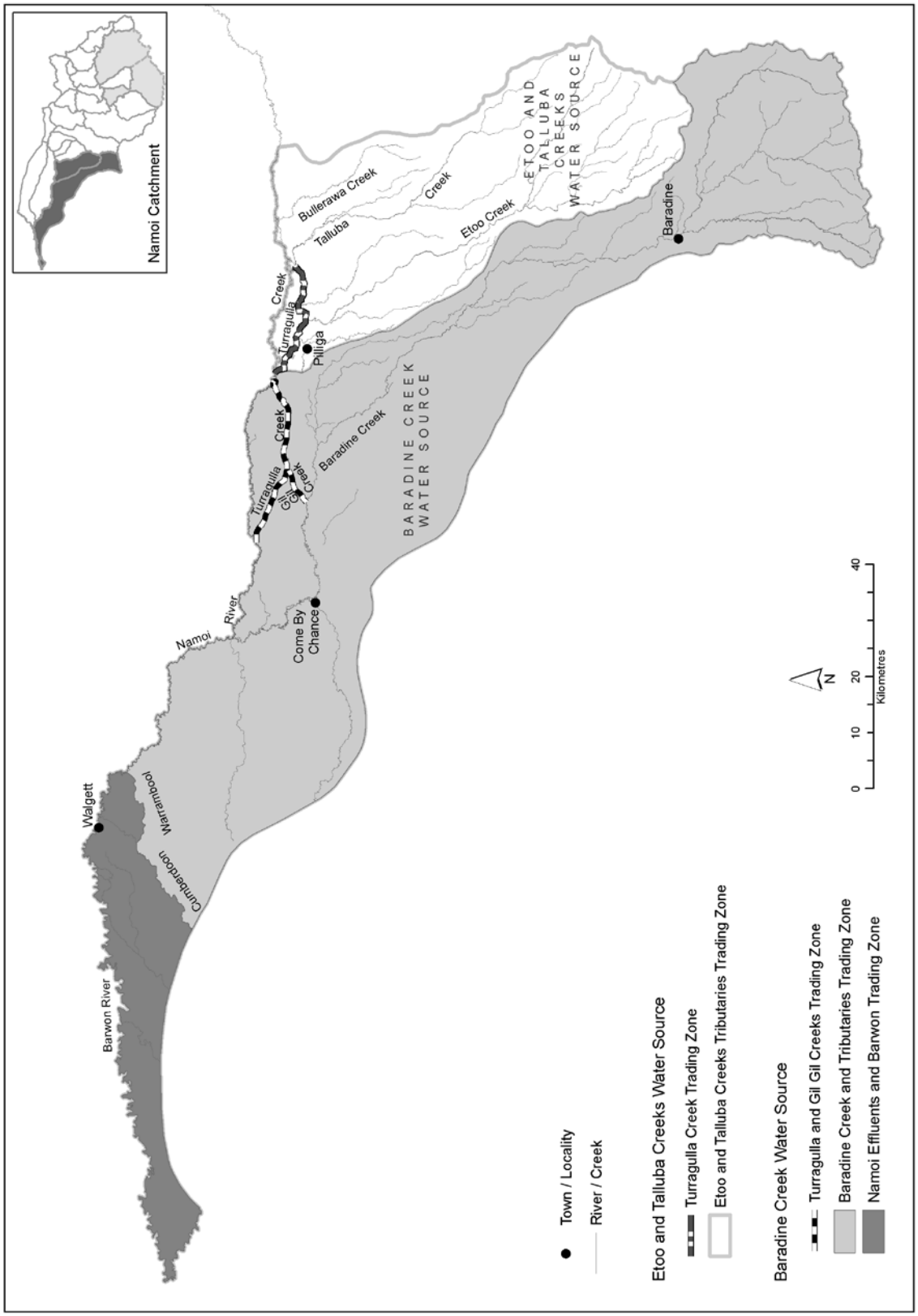
Map 3: Overview of Management Zones in the Plan: Coxs Creek and Maules Creek Water Sources



Map 4: Overview of Management Zones in the Plan: Brigalow Creek and Pian Creek Water Sources



Map 5: Overview of Management Zones in the Plan: Etoo and Talluba Creeks and Baradine Creek Water Sources



Appendix 2: Identified threatened species

It is important to note that the macro water sharing plan process is concerned with protecting in stream 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 the number of threatened species that are known (K) or expected (E) to occur in each water source.

Surface water source	Overall instream value	Threatened fish species		Threatened frog species		Threatened macro-invertebra		Threatened bird species		Other threatened fauna		Threatened wet flora species		Endangered ecological communities & threatened populations	
Expected (E) / Known (K)		**E**	**K**	**E**	**K**	**E**	**K**	**E**	**K**	**E**	**K**	**E**	**K**	**E**	**K**
Upper Macdonald River	High	1	0	0	5	0	0	2	1	1	1	0	0	0	2
Mid Macdonald River	High	1	0	0	5	0	0	4	1	1	2	0	0	0	2
Upper Namoi	High	2	1	0	1	0	0	6	2	0	2	0	0	1	1
Werris Creek	Low	2	0	0	1	0	0	4	5	0	1	0	0	1	2
Keepit	Med	3	0	0	1	0	0	5	3	0	1	0	0	1	0
Split Rock	Med	3	0	0	1	0	0	5	3	0	1	0	0	1	0
Upper Manilla	High	3	0	0	1	0	0	5	3	0	2	0	0	0	0
Rangira Creek	Low	2	0	0	1	0	0	3	6	0	2	1	0	0	3
Bluevale	Med	3	0	0	0	0	0	5	4	0	0	1	0	0	3
Lake Goran	High	1	0	1	0	0	0	1	8	0	1	1	0	1	2
Coxs Creek	Med	3	0	1	0	0	0	1	8	0	1	1	0	0	3
Maules Creek	Med	2	1	0	1	0	0	3	6	0	1	1	0	1	1
Eulah Creek	High	2	1	0	1	0	0	2	7	0	1	0	1	0	2

Surface water source	Overall instream value	Threatened fish species		Threatened frog species		Threatened macro-invertebra		Threatened bird species		Other threatened fauna		Threatened wet flora species		Endangered ecological communities & threatened populations	
Bohena Creek	Med	2	0	0	0	0	0	4	5	1	0	0	1	2	1
Bundock Creek	Med	2	0	0	0	0	0	0	8	0	0	0	1	2	1
Brigalow Creek	Med	2	0	0	0	0	0	4	4	0	0	0	1	2	1
Coghill Creek	Med	2	0	0	0	0	0	4	5	1	0	0	1	2	1
Etoo and Talluba Creeks	Low	3	0	0	0	0	0	4	5	1	0	0	1	3	1
Spring and Bobbiwaa Creeks	Med	2	1	0	1	0	0	0	9	0	1	0	1	2	1
Pian Creek	Med	3	1	0	0	0	0	0	8	0	0	0	1	3	1
Lower Namoi	Med	3	1	0	0	0	0	0	8	0	0	0	1	3	1
Baradine Creek	High	3	0	0	0	0	0	0	8	1	0	0	1	2	2

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 IRP deliberations. IRPs 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 NSW Office of Water support staff – membership and expertise

Name	Agency	Role	Expertise
Interagency Regional Panel			
Peter Christmas	Office of Water	Agency Representative	Water planning/implementation/policy.
Dave Miller	Office of Water	Agency Representative - alternate	Water planning/administration/policy. Geomorphology, riparian management and stream ecology/restoration.
Pam Welsh	DPI	Agency Representative	Farming systems, industry liaison, economic evaluation, water planning, policy and administration.
Andrew Scott	DPI	Agency Representative - alternate	Water valuing and policy, development assessment, sustainable agriculture strategic land use planning.
Daryl Albertson	OEH	Agency Representative	Wetlands and rivers conservation, environmental flow delivery and wetland ecology and biodiversity.
Jane Humphries	OEH	Agency Representative - alternate	Wetlands and rivers conservation, environmental flow delivery.
Sally Egan	CMA	Agency Representative	Threatened species, conservation biology and environmental resource management.
Support Staff			
Rod Browne	Office of Water	Plan coordinator	Water planning/administration/policy.
Karen Hearnden	Office of Water	Plan support	Water planning/administration/policy.
Rob Albert	Office of Water	Plan technical support	Local licensing, knowledge of stakeholders, water user associations and local access arrangements.
Anthony Colvin	Office of Water	Plan technical support	Local licensing, knowledge of stakeholders, water user associations and local access arrangements.
Martin O'Rourke	Office of Water	Plan technical support	Hydrogeology, extensive knowledge in northern groundwater resources.

Appendix 4: Interagency regional panel reference materials

Office Data Sets

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

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

Regional Groundwater Monitoring Network – the Office of 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).

Regional Geographic Information Systems – the Office of Water land use and topographic information.

Central Data Sets

Stressed rivers reports – used as the basis for identifying where there are instream barriers.

Threatened species (fish) – Data supplied by DPI.

Threatened species (other) – Data supplied by OEH.

Index of Social Disadvantage – Australian Bureau of Statistics.

Employment in Agriculture - Australian Bureau of Statistics.

Other Agency Data

National Parks and Wildlife (OEH) state wide atlas – State wide flora and fauna database

NSW Fisheries (DPI) modelled data sets (Fish Community Index, Fish Community Vulnerability)