NSW GOVERNMENT | Office of Water

Water Sharing Plan
Peel Valley regulated, unregulated, alluvial and fractured rock water sources

Background document

Leading policy and reform in sustainable water management

Publisher

NSW Office of Water

Level 17, 227 Elizabeth Street
GPO Box 3889
Sydney NSW 2001

T 02 8281 7777 F 02 8281 7799

information@water.nsw.gov.au

www.water.nsw.gov.au

The NSW Office of Water is a separate office within the Department of Environment, Climate Change and Water. The Office manages the policy and regulatory frameworks for the State's surface water and groundwater resources to provide a secure and sustainable water supply for all users. The Office also supports water utilities in the provision of water and sewerage services throughout New South Wales.

Water Sharing Plan for the Peel Valley regulated, unregulated, alluvial and fractured rock water sources: background document

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Introduction

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

In recent years, water sharing plans for the unregulated[1] rivers and groundwater systems have been completed using a 'macro' or broader-scale river catchment or aquifer system approach. Approximately 90 per cent of the water extracted in NSW is now covered by the *WMA 2000.* The macro planning process is designed to develop WSPs 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 (e.g. fractured rock) within the river basin. These macro plans will generally apply to catchments or aquifers where there is less intensive water use compared with the areas that were covered by plans in 2004.

The Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvial and Fractured Rock Water Sources 2010 (the plan) covers all of the water extraction within the Peel Valley.

Water sharing provisions that the plan focuses on are:

- environmental water provisions – the share of the water reserved for the environment,
- access provisions – which determine when extraction is allowed (for example above a set river flow rate), and
- dealing provisions – which control the trade of water, both the transfer of share components of an access licence and assignment of water allocation between access licences, as well as changing the location for water extraction.
- In developing these provisions, other water management rules are considered, including:
- environmental water rules,
- system operation rules,
- long-term average annual extraction limits – a growth-in-use assessment and management tool,
- available water determinations – for allocating water to access licence water accounts,
- water allocation account management rules,
- rules for managing access licences,
- management of surface and groundwater connectivity rules,
- rules for granting access licences – what types of licences may be granted,
- rules for works approvals – e.g. what types of set back conditions are required,
- dealing rules, and
- mandatory conditions on access licences and water supply work approvals.

[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.

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 Peel Valley including land and water use,
- the process of the plan development including scope, history and basis for decisions,
- the relationship between the plan and the Basin Plan,
- the use of adaptive management, and
- 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 Peel Valley Regulated, Unregulated, Alluvial and Fractured Rock Water Sources 2010 (the plan itself is a legal instrument written in its required statutory format),
- a guide to the plan (a plain English version of the plan explaining the key sections and rules), and
- rules summary sheets for each water source detailing management rules.

In addition, general information is also available on the macro planning process including:

- *Macro Water Sharing Plans: The Approach for Unregulated Rivers. Report to Assist Community Consultation* – explains the method used to classify and set water sharing rules for unregulated streams across the State,
- *The Macro Approach for Groundwater Sharing Plans* – explains method used to develop water sharing rules for groundwater systems across NSW, this report is currently being prepared by the NSW Office of Water and will be published shortly,
- *Assessment of Sustainable Limits for groundwater sources in NSW (Bish et*. al. 2006) – explains the macro approach to groundwater methodology, including assessment of risk and determinations of sustainability indexes for aquifers, this method was adopted for the Peel Fractured Rock Water Source,
- Guidelines for surface water sharing plan report cards – explains the information presented in report cards
- *Guidelines for groundwater sharing plan report cards* – explains the information presented in report cards,
- *Setting the water sharing rules* – a one page brochure which outlines the key steps for developing the rules.

These documents are available on the website at www.water.nsw.gov.au.

Purpose of a water sharing 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.

Water sharing plans provide a legislative basis for sharing water between the environment and consumptive purposes. Under the *WMA 2000*, a plan for the sharing of water must protect each water source and its dependent ecosystems and must protect basic landholder rights. Sharing or extraction of water under any other right must not prejudice these. Therefore, licensed water users are effectively the next priority for water sharing. Amongst 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.

WSPs also recognise the economic benefits that commercial users such as irrigation and industry can bring to a region. Upon commencement access licences held under the *Water Act 1912* are converted to volumetric water access licences and works and use approvals under the *WMA 2000* and as such, 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 other provisions of the *WMA 2000*, WSPs also set rules so that commercial users can continue to operate productively. In general, commercial licences under the *WMA 2000* are granted in perpetuity, providing greater commercial security of water access entitlements. WSPs also define the access rules for commercial users providing all users with greater certainty regarding sharing arrangements[2].

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 5 year period (as it is considered an interim water resource plan under the Commonwealth's *Water Act 2007*)
- clear trading and access rules which will help foster trading
- 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.

The plan recognises the economic benefits to the region that are generated by commercial users such as irrigators and industry. It sets rules so that commercial users can continue to operate productively.

[2] Security versus reliability: These terms are used differently across different jurisdictions, often interchangeably. The National Water Commission encourages the adoption of nationally consistent terminology based on the National Water Initiative. The definitions in the glossary relate to NWI-consistent use of these terms. In summary, security provides better tenure for an entitlement and does not necessarily provide greater reliability as this term refers to the long-term availability of water, which is determined by seasonal and climatic conditions.

Environmental considerations

Water sharing plans are required to reserve water for the overall health of the river and groundwater sources and to protect specific ecosystems that depend on river flows and groundwater, such as wetlands, lakes, estuaries and floodplains. This share of water reserved for the environment is also intended to sustain the aquatic system's fauna and flora. Most of the flows and groundwater within the plan area is protected from extraction.

Description of the plan area

The Peel Valley covers an approximate area of 4,669 km^2 and is located in the New England – North West region of NSW approximately 440 km north-west of Sydney (see appendix 1). It is a highland valley that drains onto the plains of the sedimentary basin of the Upper Namoi and is part of the wider Namoi Valley. The characteristic landforms of the Peel Valley are low peaked hills with north-westerly alignment, moderate slopes and flat river valleys with deep, fertile, alluvial soils.

The Peel River flows from its source in the Great Dividing Range in the east, through the Peel Valley, in a westerly direction to its confluence with the Namoi River, approximately 40 km downstream of Tamworth. There are a number of tributaries entering the Peel River as it travels through the Valley including; Duncans Creek, Dungowan Creek, the Cockburn River, Goonoo Goonoo Creek, Moore Creek, Timbumburi Creek, Tangarratta Creek and Attunga Creek. The Peel River is regulated by Chaffey Dam, a major headwater storage. In addition to the Peel River the Cockburn River, Goonoo Goonoo Creek and Dungowan Creek exhibit perennial flows in most years. All other creeks and streams within the Peel Valley have a more ephemeral nature.

The groundwater sources in the valley include the Peel alluvial aquifer associated with the main Peel River and its tributaries and the Peel Fractured Rock aquifer. The fractured rock aquifer is part of the much bigger fractured rock aquifer system of the New England Fold Belt. This system contains water of variable yield and quality, unlike the alluvial areas that have a more reliable yield and generally more consistent quality.

Population

Tamworth is the major urban area and social hub for the regional community. Surrounding Tamworth are a number of villages including; Nundle, Attunga, Kootingal, Moonbi, Duri, Limbri, Woolomin, Dungowan, Nemingha and Somerton, all within the Tamworth Regional Council area. The population of the Peel Valley is approximately 47,900 with the majority of individuals concentrated in Tamworth City (see Table 1). The area has a relatively large proportion of indigenous persons (6.9 per cent) compared to the state average (2.1 per cent).

Table 1: Population in the Peel Valley

Group	Tamworth City	Rest Peel Valley	Total Peel Valley
Indigenous Population	8.1%	3.2%	6.9%
Total Population	36,100	11,800	47,900

Adapted from ABS 2006 Census

Employment

The Peel Valley labour force is approximately 22,900 with an unemployment rate of around 6.5 per cent (see .Table 2). The retail and healthcare industries employ a large proportion of the total workforce (refer Table 3). The agriculture, forestry and fisheries industry employs the largest proportion of persons located outside Tamworth City.

Table 2: Population and Employment in the Peel Valley

Group	Tamworth City	Rest of Peel Valley	Total Peel Valley
Total employed	15,600	5,800	21,400
% unemployed	7.3%	4.3%	6.5%
Total labour force	16,800	6,100	22,900

Adapted from ABS 2006 Census

Table 3: Employment by major industry in the Peel Valley (% of total population employed)

Industry	Tamworth City	Rest of Peel Valley	Total Peel Valley
Retail	13.6%	9.9%	12.6%
Health Care	12.9%	11.1%	12.4%
Manufacturing	10.3%	9.5%	10.1%
Education	8.3%	8.3%	8.3%
Accommodation	7.8%	5.2%	7.1%
Construction	6.7%	7.8%	7.0%
Public Administration	6.5%	5.6%	6.3%
Agriculture, Forestry and Fisheries	2.4%	16.5%	6.2%
Transport	5.4%	5.2%	5.3%
Wholesale	4.0%	2.8%	3.7%
Total population employed	15,600	5,800	21,400

Adapted from ABS Census 2006

See Appendix 2 for an explanation of the methodology used to generate population and employment statistics.

Land use history

Prior to European settlement in the mid 1800's, the Kamilaroi people occupied the Peel Valley but were displaced from their ancestral lands with European settlement and associated land use changes throughout the Valley. The Kamilaroi were a grouping of tribes which all used a common language known as Gamilaraay. In the east of the region, along the Moonbi ranges and up onto the New England Tablelands were the Anaiwan people.

Present information indicates that Aboriginal occupation of the area dates back at least 3,600 years and possibly up to 20,000 years. With further research and excavations this is likely to be extended. It has been estimated that the Aboriginal population from the Peel River to the Barwon in the 1820s was 10,000 to 12,000 people (Tamworth Regional Council, 2005).

Much of the region prior to European settlement was characterised by the now threatened grassy box woodlands. This included white box grassy woodlands with yellow box and Blakely's red gum on lower slopes.

European settlement started in the Peel Valley in 1831. In 1834, 313,298 acres of land was granted to the Australian Agricultural Company on the western side of the Peel River from Nundle downstream to Attunga. Tamworth was established in the 1840's as a centre for sheep, cattle and wheat. The discovery of gold at Hanging Rock and Nundle in 1851 further supported the expansion of European settlement in the area (Tamworth Regional Council, 2006).

The landscape in the Peel Valley has now been highly modified as a result of grazing, cropping and intensive agriculture, forestry, mining and urban development. This has led to clearing of large areas of native habitat.

Agriculture and industry

The relatively young volcanic geology of the region and extensive alluvial floodplains derived from these materials has resulted in heavy black and grey clays that are sought after for farming and irrigation (CSIRO, 2007). Land in the Peel Valley outside Tamworth City is predominantly used for agricultural production (see figure 1). Irrigation is generally associated with the alluvial soils adjacent

to streams. Remote sensing data, derived from aerial photos of the Peel Valley taken between 1997 and 2002, provides an indication of the area and distribution of irrigated crops (see Table 4). Key findings include that:

- irrigated pastures comprise the large proportion of irrigated land use (approximately 80 per cent), and
- approximately 85 per cent of irrigated agriculture is concentrated around the Peel Regulated River Water Source in the Upper and Lower Peel River Tributaries Water Sources.

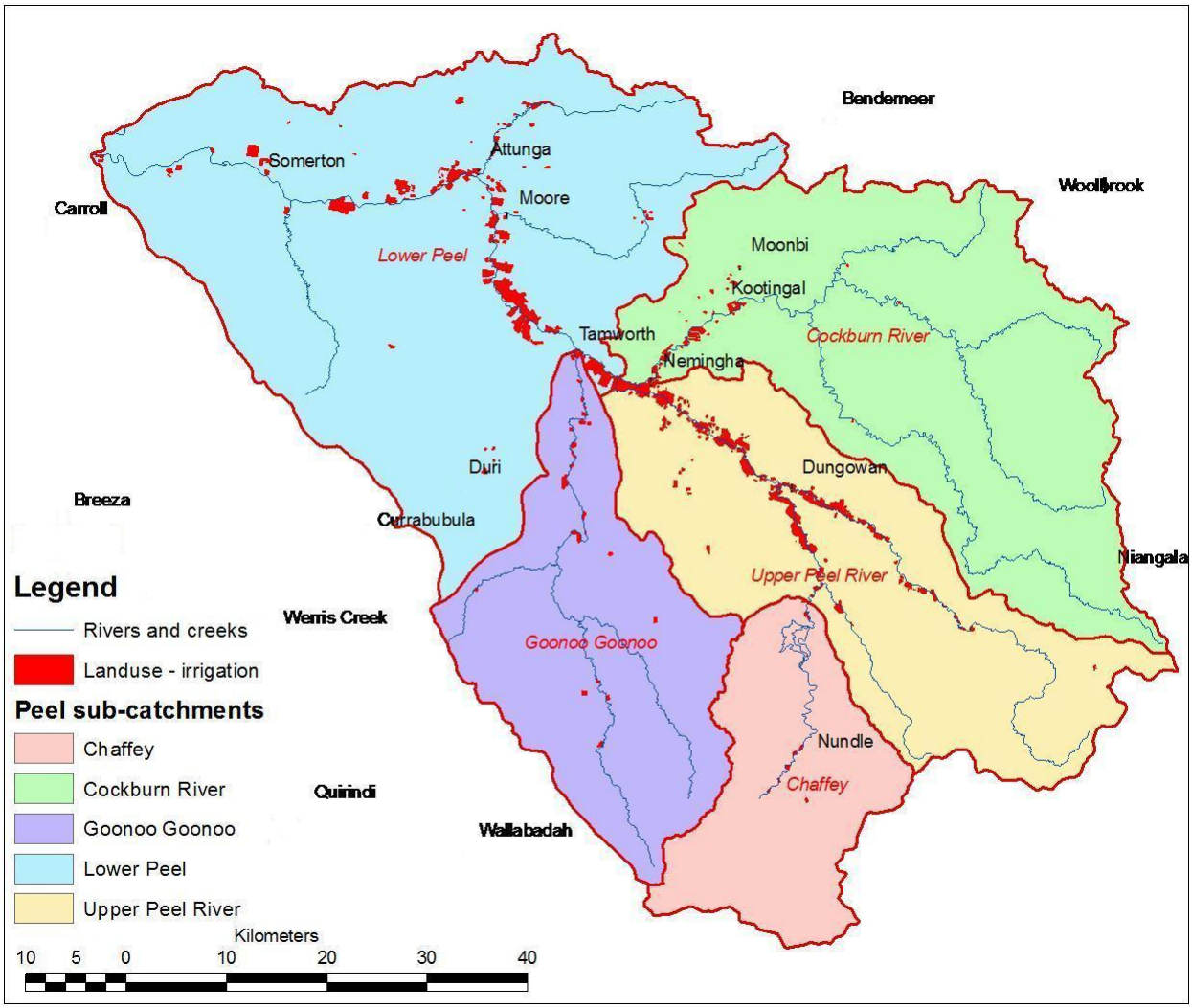
Table 4: Irrigated crop land use for regulated and unregulated systems (hectares)

Land use type	Lower Peel River Tributaries	Upper Peel River Tributaries	Chaffey	Cockburn River	Goonoo Goonoo Creek	Total (%)
Irrigated pastures	2,475	2,060	75	325	320	5,255 (79%)
Irrigated fodder crop	485	290	-	245	-	1,020 (15%)
Other irrigated crops	235	55	-	75	-	365 (6%)
Total	3,195	2,405	75	645	320	6,640
(%)	(48%)	(36%)	(1%)	(10%)	(5%)	

Note: Other irrigated crops include vegetables, turf, vineyards, olives and orchards.

While Tamworth's economy continues to diversify, agriculture remains the backbone of the economy. It is estimated that over 307,000 hectares of land is devoted to agricultural production, with the gross value of production estimated at over $75 million. Recently, Tamworth has hosted an extraordinary growth of boutique agriculture ventures including olives, vines, nuts, specialised game fowl, fish farming, hydroponics, goats, alpacas, buffalo and berries, (Tamworth Regional Council, 2009). The broiler industry also has a strong presence in the region, being one of the largest production areas in NSW.

Figure 1: Peel Valley land use for irrigation



Climate

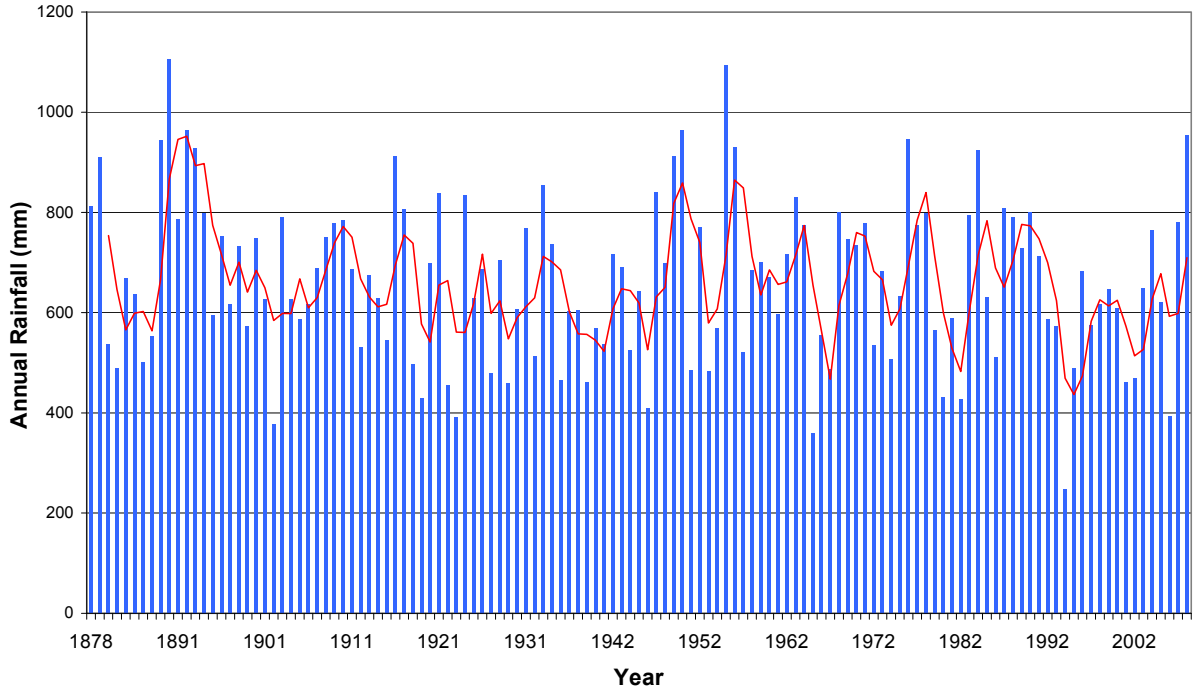
The Peel Valley has been described as semi-arid (Kalaitzis, 1996) to subtropical (Lamontagne and Cook, 2006), while Tomlinson (2008) classifies it as a temperate climate. Temperatures are warm to hot in summer with relatively low humidity, mild in autumn and spring and cool to mild in winter. This climate is particularly suited for today's significant agricultural activities in dryland agriculture, pasture grazing, fodder crops (lucerne), vineyards and olive production.

Rainfall

The long-term climate data collected from Tamworth indicates that the Peel Valley has a seasonal rainfall pattern with predominantly summer rainfall, hot summers and cool winters. Average monthly evaporation exceeds average monthly rainfall for all months, (O'Rourke, 2009).

Climate stations at Tamworth Airport, operating since 1876, have recorded an average rainfall for Tamworth of 672.8 mm per annum. Figure 2 shows the rainfall for Tamworth, the red line shows the three year moving average. The rainfall does vary across the Peel Valley. Tomlinson (2008) quotes the annual median rainfall over the headwaters of the river above an elevation of 920 m is between 890 mm and 1,140 mm, while in the vicinity of the junction of the Peel and Namoi Rivers the annual median rainfall is 584 mm, (Water Conservation and Irrigation Commission NSW, 1970).

Figure 2: Historical rainfall data for Tamworth



Created from Bureau of Meteorology data, 2009

Streamflows

The average annual discharge from the Peel River at Carroll Gap is 252,900 mega litres (ML). This annual discharge fluctuates significantly over time, which illustrates the significant variability in flows between wet and dry years. Variability in stream flow also occurs between seasons (due to predominate rainfall and irrigation use in summer) and across the Valley. Flows originating from the Cockburn River catchment contribute approximately 40 per cent of the average annual discharge measured at Carroll Gap. Other significant contributors to flow at Carroll Gap include Goonoo Goonoo and Dungowan Creeks, both contributing approximately 10 per cent to its average annual discharge. The Peel River above Chaffey Dam is best described as a minor contributor to discharge at Carroll Gap. Carroll Gap more or less represents the end of the regulated system, with very few orders filled beyond this point and historically no significant prescribed end of system flow targets. Contributions to the discharge at Carroll Gap from the Peel Regulated River are restricted to in-frequent dam spill and flood events.

The Peel Valley is considered an important contributor to flows in the wider Namoi Catchment. The percentage of rainfall to runoff ratio in the Peel Valley is approximately 8.1 per cent, whilst across the entire Namoi Valley is 3.8 per cent.

The major in-stream structure within the Peel Valley is Chaffey Dam (current capacity 62,000 ML); it is located on the Peel River, approximately 40 km upstream of the township of Tamworth and north of the township of Nundle. The dam has a catchment of 420 km^2 which comprises mainly agricultural land (URS, 2008). Chaffey Dam is owned and operated by the State Water Corporation, used as town water supply for Tamworth and for irrigation purposes. Dungowan Creek Dam is also a relatively large structure in the Valley, located on Dungowan Creek, approximately 50 km south-west of Tamworth. This dam has a small, largely forested catchment with an area of 125 km^2 (URS, 2008). Dungowan Dam is owned and operated by Tamworth Regional Council and used solely as town water supply for Tamworth.

Chaffey Dam captures water during times of high flow and releases it during periods when natural Peel River flows are insufficient to meet demands for water. The overall effect of this is to dampen out flow variability immediately downstream of the dam. In the areas downstream of the dam, the proportion of time the river spends in flood and high flow is reduced, but the time it spends in very low flow is also reduced.

In addition to the Peel River the Cockburn River, Goonoo Goonoo Creek and Dungowan Creek exhibit perennial flows in most years. All other creeks and streams within the Peel Valley have a more ephemeral nature.

Streamflow is currently measured at 24 gauging stations within the Peel Valley as listed in Table 5. Other records are kept, such as dam water levels and release volumes from both Dungowan and Chaffey Dams. Records from both the current and discontinued gauging stations provide a history of streamflow throughout the Valley and have been used in the development of the plan.

Table 5: Stream gauging stations in the Peel Valley

Station name	Water source	Station no.	Catchment (km^2)	Period of record	
				Start	Finish
Peel River at Taroona	Peel Regulated River	419081	280	1991	Ongoing
Peel River at Bowling Alley	Chaffey	419004	310	1925	1970
Peel River downstream Chaffey Dam	Peel Regulated River	419045	407	1968	Ongoing
Peel River at Piallamore	Peel Regulated River	419015	1140	1936	Ongoing
Peel River at Tamworth (Calala)	Peel Regulated River	419070		1980	Ongoing
Peel River at Paradise Weir	Peel Regulated River	419024	2410	1953	Ongoing
Peel River at Tamworth (Bridge)	Peel Regulated River	419009	3080	1925	Ongoing
Peel River at Appleby Crossing	Peel Regulated River	419073	3190	1981	Ongoing
Peel River at Bective	Peel Regulated River	419024	3700	1981	Ongoing
Peel River at Attunga	Peel Regulated River	419046	3880	1936	1952
Peel River at Somerton	Peel Regulated River	419075	4160	1981	Ongoing
Peel River at Carroll Gap	Peel Regulated River	419006	4670	1923	Ongoing
Peel River at Pearly Gates Bridge	Chaffey	419906		2006	Ongoing
Swamp Oak Creek Limbri	Cockburn River	419054		1974	Ongoing
Cockburn River at Mulla Crossing	Cockburn River	419016		1936	Ongoing
Cockburn River at Kootingal	Cockburn River	419099		2003	Ongoing
Mulla Creek at Goldcliff	Cockburn River	419055		1974	1989
Mulla Creek at Bullimball	Cockburn River	419037		1965	1978
Goonoo Goonoo Creek at Meadows Lane	Goonoo Goonoo Creek	419097		2002	Ongoing
Goonoo Goonoo Creek at Timbumburi	Goonoo Goonoo Creek	419035		1965	Ongoing
Moore Creek downstream of Moore Creek Dam	Lower Peel River Tributaries	419092		1997	1997
Dungowan Creek at Dungowan Dam (Outflow)	Upper Peel River Tributaries	419078		1985	1996
Dungowan Creek at Dungowan Dam (Inflow)	Upper Peel River Tributaries	419077		1985	1996
Duncans Creek at Woolomin	Upper Peel River Tributaries	419036		1965	1986

Flow duration curves for the Peel Regulated River at Piallamore (Figure 4), Paradise Weir (Figure 5), and Carroll Gap (Figure 6) are included later in this document.

Groundwater

The NSW Office of Water (the Office) has 54 monitoring bores in the Peel Alluvium, most of which were installed following the initiation of a monitoring bore program for the Peel Alluvium, in 2000. Groundwater level monitoring in the Peel Alluvium commenced in March 1972 with four bores. By the mid 1990s four more monitoring bores had been drilled. Of these original eight bores, five are still monitored (see Table 6). River cross sections showing groundwater levels from monitoring bores are included in Appendix 3. Note that there are no monitoring bores maintained by the Office in the Peel Fractured Rock. Analysis of the river cross sections and groundwater levels shown in Appendix 3 reveals that:

- the Regulated Peel River loses water to the groundwater along most of it length. However, below Attunga the river appears to gain water from groundwater,
- Dungowan Creek functions like a regulated river due to the regular domestic and stock releases from Dungowan Dam, Dungowan Creek typically loses water to groundwater along most of its length,
- Attunga Creek, Moore Creek and Duncans Creek are essentially ephemeral creeks that only flow after heavy rain, they are not groundwater driven systems,
- Cockburn River is both a gaining and losing stream. In the upper reaches of the river above the alluvium, the Cockburn becomes a groundwater driven system in times of low rainfall. Where the main alluvial aquifers along the Cockburn River start, the groundwater and surface water are linked. At Kootingal, groundwater flows in a southerly direction through the bed of the Cockburn River. At Nemingha, a cross section of monitoring bore hydrographs shows that the Peel River looses water to the alluvium which then flows northward towards the Cockburn River, and
- Goonoo Goonoo Creek is a base flow driven creek system with groundwater levels above the bed of the creek, most of the time.

Table 6: Groundwater monitoring bores in the Peel Alluvium

Monitoring bore number	Period of Record		Comments
	Start	Finish	
GW030136	1972	Ongoing	Break in monitoring from 1988 to 1995
GW030139	1972	1988	Bore destroyed in floods
GW030140	1979	Ongoing	Intermittent readings from 1979 to 1995
GW030150	1995	Ongoing	
GW030167	1972	Ongoing	Break in monitoring from 1987 to 1995
GW030168	1972	Ongoing	Break in monitoring from 1987 to 1995
GW030169	1978	1980	
GW030195	1978	1979	
GW093000 to GW093046	2000	Ongoing	

Source: O'Rourke, 2009

Surface water and groundwater connectivity

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. The volume of water stored in an aquifer, the rate at which water can recharge, the volume of water extracted from it, and the rate at which water can move through it are all controlled by the geologic nature of the aquifer.

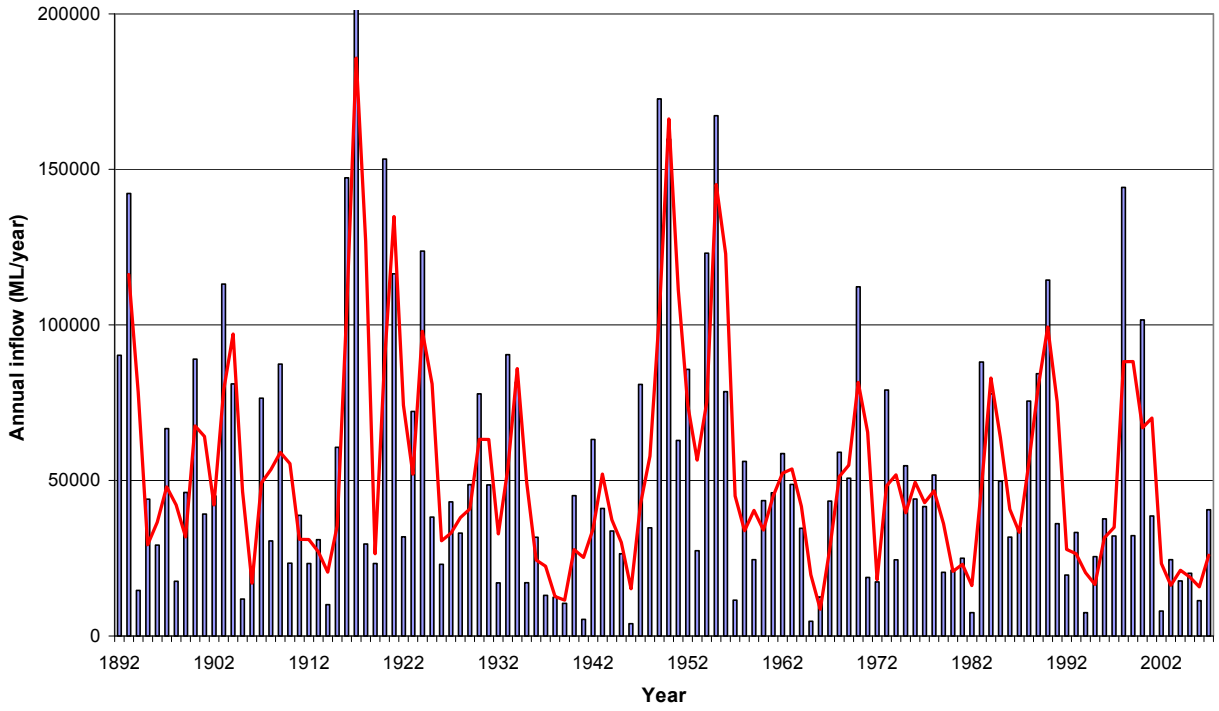
Groundwater aquifers in the Peel Valley are primarily fractured rock or alluvial. The alluvial groundwater and surface water in the Peel Regulated River and some of its major unregulated tributaries are intricately linked. The Peel Regulated River loses water to the Peel Alluvium along most of its length, only gaining water from groundwater at the bottom end of the valley, below Attunga. The general flow direction of the groundwater is away from the river and then down gradients parallel to the river.

The unregulated tributaries of Attunga Creek, Moore Creek and Duncans Creek are largely ephemeral, losing water to the groundwater in times of high flow then gaining groundwater again until the level of the groundwater drops below the bed of the creeks resulting in the creeks drying up during dry times. The Cockburn River is both a losing and gaining system depending on location. Goonoo Goonoo Creek is largely a groundwater driven gaining stream in times of low flow. Dungowan Creek is typically a losing stream (O'Rourke 2009).

Historical droughts

Drought was one of the first difficulties experienced by European settlers to the area in 1841, with another drought experienced in 1847-1848. Other extended periods of drought include 1875-1877, 1901-1902 and 1919 (Tamworth Regional Council, 2006). In terms of impact on water resources, the drought in 2007, when Chaffey Dam fell to 10.5 GL within storage, is reported as the most severe reported water shortage experienced by the Peel Valley, to date. From the two year moving average (red line) in Figure 3 it can be seen that the sequence of inflows in the mid 1960's, could have had a worse impact on water resource availability within the Valley under current usage patterns and infrastructure development.

Figure 3: Annual inflows for Chaffey over period of record



Climate change and variability

Following the November 2006 Water Summit on the southern Murray-Darling Basin (MDB), the then Prime Minister and MDB state Premiers commissioned CSIRO to report on sustainable yields of surface and groundwater systems within the MDB. The CSIRO Murray-Darling Basin Sustainable Yields Project assessment was undertaken for 18 regions including the Namoi. The CSIRO (2007) report made the following conclusions for the Namoi:

- Current average surface water availability is 965,000 megalitres per year (ML/yr) and a high proportion (37 percent) of this water is used. Groundwater use is also high – representing nearly half of all water use in the Basin – and continued use at current levels will lower water tables and reduce streamflow.
- The recent climate (1997 to 2006) was similar to the long-term average climate.
- The best estimate of climate change by 2030 would reduce average surface water availability by five percent and reduce surface water diversions by one percent.
- Likely future development of farm dams (13 percent growth) and groundwater (77 percent growth) would reduce average river inflows by three percent, increase streamflow leakage to groundwater by 14 percent and reduce surface water diversions by four percent.

However, CSIRO (2007) also report that the hydrological impacts of climate change in the MDB remain very uncertain. Rainfall-runoff modelling with climate change projections from global climate models indicates that future runoff in the Namoi region is more likely to decrease than increase. The CSIRO (2007) report suggests that the best estimate 2030 climate scenario is a six percent reduction in mean annual runoff. The extreme estimates (from different climate models under high global warming) range from a 31 percent reduction to a 39 percent increase in mean annual runoff (CSIRO, 2007).

Under the best estimate 2030 climate, there would be a five percent reduction in water availability, an eight percent reduction in end-of-system flows and a one percent reduction in surface water diversions overall (CSIRO, 2007). Under the wet extreme 2030 climate there would be increases of 38 percent in average water availability, 52 percent in end-of-system flows and 10 percent in surface water diversions (CSIRO, 2007). Under the dry extreme 2030 climate there would be decreases of 30 percent in average water availability, 39 percent in end-of-system flows and 17 percent in surface water diversions (CSIRO, 2007).

Entitlement and use

Entitlement in the Peel Valley is divided between regulated and unregulated surface water as well as alluvial and fractured rock groundwater. Current water entitlement across the water sources is listed in Table 7.

Table 7: Entitlement and usage in the Peel Valley

Water source	Entitlement (ML/yr)	Average use (ML/yr)#	Number of licences
Unregulated water sources			
Chaffey	400		14
Goonoo Goonoo Creek	1,062		24
Upper Peel River Tributaries	9,267		72
Lower Peel River Tributaries	2,541		69

Water source	Entitlement (ML/yr)	Average use (ML/yr)#	Number of licences
Cockburn River	4,438		87
Total	**17,708**	**N/A**	**266**
Peel Alluvium			
Peel Regulated River Alluvium	32,422[1]	5,752[1]	323
Attunga Creek Alluvium	1,501	260	18
Moore Creek Alluvium	1,247	64	18
Cockburn River Alluvium ,	4,481	1,201	51
Dungowan Creek Alluvium	5,268	621	43
Duncans Creek Alluvium	180	3	4
Goonoo Goonoo Creek Alluvium	6,282	473	60
Total	**51,381**	**8,374**	**517**
Peel Fractured Rock			
Total	**10,694**	**1,077***	**255**
Peel Regulated River			
General Security	30,335	7,014[2]	168
High Security	17,373	5,189	30
Total	**47,708**	**12,103**	**198**

Average use = for groundwater between 1998/99 - 2007/08, for Peel Regulated River between 1998/99 – 2007/08, usage is based on State Water usage data, both are affected by historical allocations and under-utilisation of otherwise active licences. Note that there are no metering records for unregulated usage.

* Not all extraction in the fractured rock is currently metered.

[1] Peel regulated river alluvium entitlement and usage includes the estimated average annual extraction between June 1993 and July 1999 for the eight unregulated river licences in Wallamoore Anabranch, to be converted to aquifer (general security) access licences on commencement of this plan.

[2] Regulated river general security includes usage as on and off allocation.

Local water utility requirements

Chaffey Dam is the primary infrastructure to service the town water supply for Tamworth. Tamworth Regional Council (TRC) has a high security entitlement of 16,400 ML/yr from Chaffey Dam. Dungowan Dam is also used to supplement the town water supply for Tamworth, in fact it is the favoured water source for TRC, although has a maximum supply limit of 20 ML/day, via the pipeline from the dam itself to TRC's water treatment plant. TRC holds a water licence for the extraction of water from Dungowan Dam of 5,600 ML/year. Dungowan Dam is operated by TRC according to licence conditions including that the outlet from the Dam be split to maintain a flow of 10 ML/day into Dungowan Creek when inflows exceed 10ML/day, or provide all inflows as outflows when inflows are less than 10 ML/day.

Following the recent drought period peaking in mid 2007, TRC has reconditioned a series of wells, commonly known as the 'drift wells', located on the bank of the Peel River and adjacent to Scotts Road. The original purpose of this reconditioning was to provide council with an alternate water supply, for drought periods. These 'drift wells' currently have a combined licensed volume of 10 ML/yr. Notwithstanding this, TRC proposes to extend a previous pumping trial, to investigate the feasibility of

using these 'drift wells' for supplementing normal water supply operations. The assessment of this proposal lies outside the scope of the plan.

Table 8: Town water supplies, location and entitlement in the Peel Valley

Water supply	Water source	Entitlement (ML/yr)
Tamworth - Chaffey Dam	Peel Regulated River	16,400
Tamworth - Dungowan Creek Dam	Upper Peel River Tributaries	5,600
Tamworth - Drift Wells	Peel Alluvium	10
Moonbi / Kootingal	Peel Alluvium	400
Attunga	Peel Alluvium	120
Nundle	Peel Fractured Rock	100

TRC operates the town water supply for Tamworth in accordance with their Drought Management Plan, which includes specified triggers for restrictions based on the capacity of Chaffey and Dungowan Dams, as shown in Table 9.

The village of Nundle's town water supply is sourced through bores accessing the Fractured Rock water source, while the Moonbi / Kootingal and Attunga's town water supplies are sourced from bores accessing the Peel Alluvium. Moonbi / Kootingal town water supply is also supplemented during dry conditions, through a pipeline from Tamworth.

Table 9: Tamworth Regional Council Drought Management Action Plan triggers

Drought response level (when Dungowan Dam at or below 40% capacity)	Trigger point for tightening restrictions (as Chaffey Dam falls)	Trigger point for easing restrictions (as Chaffey Dam rises)
Permanent Water Conservation		60%
1 - Low	50%	45%
2 - Moderate	40%	37.5%
3 - High	35%	32.5%
4 - Very High	30%	32.5%
5 - Emergency	25%	32.5%

Source: Tamworth Regional Council, 2008

Developing the plan

Scope of the plan

The plan recognises that the water resources of the Peel Valley are linked, and would therefore benefit from being managed collectively. The plan includes extraction from all surface water, connected alluvial and fractured rock aquifers in the Peel Valley.

The plan covers four distinct types of water systems:

- the Peel Regulated River water source (regulated rivers are declared in the legislative regulations and typically refer to those rivers where State owned storages catch water during wetter periods and use the river to supply the stored water to meet downstream orders during dry times),
- the groundwater in the alluvial aquifers,
- the unregulated rivers, and
- the groundwater in the fractured rock aquifers.

By considering all water resources within the Peel Valley at the same time in the plan, the interconnectivity between these water resources can be fully explored and consultation on, and resolution of issues is streamlined and consistent.

Water management units

Water sharing plans have a hierarchy of planning units, including:

- The **water management area** – an area of land that is constituted as a water management area by an order in force under section 11 of the *WMA 2000*, it is generally declared at the catchment scale.
- The **extraction management unit** (EMU) – there may be more than one EMU for each water management area. EMUs are the management unit to which a single long-term average annual extraction limit (LTAAEL) will be applied and therefore growth-in-use is assessed. An available water determination (AWD) is made for each licence category within the EMU and any growth in extraction above the LTAAEL is managed across the EMU, not at an individual water source or licence level.
- The **water source** (WS) - means the whole or any part of one or more rivers, lakes or estuaries, or one or more places where water occurs naturally on or below the surface of the ground. There may be more than one water source within an EMU. Where there is only one water source within an EMU, however, the LTAAEL is essentially defined for both the EMU and the water source. Flow access and water trading rules apply at the water source level, unless specified for a management zone.
- The **management zone** (MZ) - is a portion of a water source used for specific flow access or water trading (dealing) rules if they are required to differ within a water source. Sub-management zones can also be specified if warranted.
- The Peel Regulated River **reaches** - which are used to manage access to and thus appropriate protection of uncontrolled inflows from tributaries or dam spills downstream of the dam.

Maps of the water sources in the plan are included in Appendix 1. Table 10 provides a summary of the hierarchy of water management units used in the plan.

Table 10: Water management units for the plan

Extraction management unit (EMU)	Water source (WS)	Management zone (MZ)
Namoi Unregulated Rivers EMU	Chaffey WS	Peel River MZ
		Chaffey Tributaries MZ
	Goonoo Goonoo Creek WS	Upstream Boiling Down Creek MZ
		Downstream Boiling Down Creek MZ
	Cockburn River WS	Cockburn River Tributaries MZ
		Cockburn River MZ
	Upper Peel River Tributaries WS	Duncans Creek and Other Tributaries MZ
		Dungowan Creek MZ
	Lower Peel River Tributaries WS	Moore Creek MZ
		Lower Peel River Tributaries MZ
N/A	Peel Regulated River WS	N/A
N/A	Peel Fractured Rock WS	N/A
N/A	Peel Alluvium WS	Peel Regulated River Alluvium MZ
		Duncans Creek Alluvium MZ
		Dungowan Creek Alluvium MZ
		Cockburn River Alluvium MZ
		Goonoo Goonoo Creek Alluvium MZ
		Attunga Creek Alluvium MZ
		Moore Creek Alluvium MZ

Project groups

State Interagency Panel

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

The SIP is chaired by the NSW Office of Water. The Department of Environment, Climate Change and Water (DECCW) has two representatives, the Chair, specifically from the NSW Office of Water and another representing the other functional areas of DECCW (these include climate change, environmental protection, parks and wildlife and the cultural and heritage division). Industry and Investment NSW (I&I NSW) is also represented on the SIP. Industry & Investment NSW represent primary industries in NSW across a number of departmental functional areas, including agriculture, fisheries management and mineral resources. There are also three representatives from different Catchment Management Authorities (CMAs) across the State. The NSW Office of Water is responsible for the overall project management.

Interagency Regional Panel

The plan rules were developed by the Peel Interagency Regional Panel (Peel IRP). DECCW has two representatives on this interagency group, one specifically from the NSW Office of Water and another representing the other functional areas of DECCW (as above). Industry & Investment NSW is also represented as well as the Namoi Catchment Management Authority (CMA) (as an observer). Appendix 4 lists the names of the Peel IRP representatives and their areas of expertise. The Peel IRP had access to staff from the agencies to provide technical and scientific information. A summary of these support staff and their roles is also listed in Appendix 4. The key roles of the Peel IRP were to:

- review the hydrological units or water sources,
- review the suitability of existing licence conditions under the *Water Act 1912*,
- prepare recommendations to advise the Government on water sharing rules within each water source to achieve the Government's objectives in the panel's planning region,
- assist with the public consultation on the proposed rules, and
- review submissions and make changes where necessary to the draft water sharing rules.

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

State Groundwater Panel

The State Groundwater Panel (SGP) provides a senior level interagency forum for discussing and resolving a wide range of water planning and policy issues specific to groundwater. The SGP plays a specific role in reviewing and, where appropriate, modifying the outcomes of the regional groundwater assessments and the proposed groundwater sharing rules to ensure consistency across the State for aquifer types.

The group is chaired by the NSW Office of Water and has representatives from the Office of Water, DECCW, I&I NSW and CMAs. The panel had access to staff from the agencies to provide technical and scientific information.

Minister's Advisory Group

The Minister for Water established the Peel Advisory Group (PAG) to directly advise his office on the many complex issues relevant to a water sharing plan for the Peel Valley. This group was formed in response to the level of community concern in the Valley over the possible impacts of a water sharing plan and the imperative to complete a plan covering at least the Peel Regulated River by December 2009 (this time line was later extended to March 2010), to partially satisfy the Commonwealth's funding conditions for Chaffey Dam's augmentation.

The PAG is chaired by the Member for Tamworth, Peter Draper. The group comprises a wide range of local stakeholders. These include:

- Peel Valley Water Users,
- Cockburn Valley Water Users,
- Namoi Water,
- Tamworth Regional Council,
- a local indigenous representative,
- a local environmental representative,
- Tamworth Chamber of Commerce,
- a local residents' representative,

- the Federal Member for New England,
- Namoi Catchment Management Authority,
- the NSW Office of Water, and
- a representative from the Minister's Office.

On announcement, Minister Costa advised that the PAG will be responsible for providing his office with an understanding of the general concerns of the community relating to water sharing and the PAG's expectations of the plan. The PAG would also be responsible for providing the Minister for Water with possible options for resolution to key water sharing issues, the advantages and disadvantages of each option and, where possible, the PAG's preferred option.

Policy context

There are a number of national and State policies that impact on and direct the development of WSPs. The Namoi Valley covers 3.8 per cent of the total area of the Murray-Darling Basin (MDB) and is subject to agreements and statutes which cover water management within the MDB. The plan has to be developed within the context of the MDB and existing Namoi Valley-wide commitments to water sharing.

Murray-Darling Basin Cap

Water diversions from rivers in NSW progressively increased throughout the last century, but most rapidly in the 1980's. Growth in water diversions:

- takes more water away from the river and may threaten its environmental health,
- reduces water available to other legitimate businesses thus increasing competition and the potential for inequitable access, and
- reduces flows from upstream river systems into downstream systems.

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 (now Schedule E) 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 long-term average yearly volume of water that would have been diverted under 1993/94 levels of development and management rules. There is no MDBMC Cap Agreement on groundwater diversions.

WSPs 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 also committed to ensuring that the LTAAEL be not less than 90% of the Cap. NSW has chosen to divide the surface water 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 and conversion rates were developed to establish licensed entitlements and derive average levels of water use based on crop water requirements. There was no discernable 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 the regulated rivers in the Namoi is assessed and reported on at the Namoi Valley scale although any management actions, should growth occur, will be applied to the Namoi or the Peel, independently. The Cap for unregulated surface water in the Namoi is assessed and reported on at the Namoi Valley scale and any growth management actions required will also be applied at this scale.

National Water Initiative

The NSW Government is a partner to an intergovernmental agreement, 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 has a number of relevant requirements for water planning in Clauses 23, 25, 35 to 40, 52, 78, 79 and Schedule E (refer to the National Water Commission website www.nwc.gov.au in the Water Reform section for details). This intergovernmental agreement contains provisions on water planning including:

- settling the trade-offs between the competing uses must be based on the best available science and socio-economic analysis, as well as consultation with the community
- ensuring that environmental and other public-benefit outcomes are provided for through planned and adaptive environmental water on a statutory basis and achieved, including actions to sustain high-conservation value rivers, reaches, and groundwater areas
- providing for water trading to enhance water markets
- recognising and addressing surface and groundwater connectivity
- managing local impacts in groundwater areas as well as protecting groundwater dependent ecosystems (GDEs)
- providing for indigenous consultation and aboriginal cultural and commercial entitlements,
- assessing and addressing interception
- monitoring and reporting on implementation.

The NWI sets out outcomes, guidelines and timelines for water plans and planning processes. The National Water Commission (NWC) 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 States' progress on implementing the NWI relative to the States' accredited implementation plans.

Natural Resources Commission

The WSPs also comply with the NSW Natural Resources Commission (NRC) State-wide standards and contribute to the relevant state-wide targets such as Targets 5 and 6 (see www.nrc.nsw.gov.au for details) which is a requirement of the State Plan, Priority E4 (see www.nsw.gov.au/stateplan 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 state-wide targets for natural resource management in NSW, which have been embedded in the NSW State Plan. As with the National Water Initiative, 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 will review WSPs against this Standard and its associated targets.

Catchment Action Plans

The plan is consistent with and contributes to the Namoi Catchment Action Plan[3]. The catchment action plan has a management target for the region's water sharing which is "from 2006, oversee and review water management planning and other processes under the *WMA 2000*, so that water management plans, including water sharing plans, result in fair and reasonable access to surface and ground water sources for the environment (water dependent ecosystems), economic uses (agricultural, industrial, town water supply) and social values (recreation, cultural)" (Namoi CMA, 2007).

Similar to the state-wide targets on improvement in riverine ecosystems and the ability of aquifers to support groundwater dependent ecosystems, the plan contributes to achieving the management target of the Catchment Action Plan, by ensuring:

- equitable sharing and access between all users, including the Indigenous community,
- use of the productive share of the resource in areas of best return,
- maintenance of water quality objectives, and
- compliance with MDBMC Cap on surface water extractions.

Furthermore, the role of the Namoi CMA observer on the Peel IRP has in part been to provide advice on the alignment of the classifications, LTAAEL and rules for the plan, with the priorities in their Catchment Action Plan.

Basin Plan

The Commonwealth *Water Act 2007* requires the Murray–Darling Basin Authority (MDBA) to prepare and oversee a Basin Plan. The 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, and
- improve water security for all uses of the Basin water resources.

The Basin Plan will provide the foundation for managing the Basin's water resources in a way that can be sustained through time and in the national interest. The MDBA is working to a timetable that will release a draft Basin Plan for formal consultation in mid-2010, and the first Basin Plan will commence in 2011.

At the heart of the Basin Plan will be limits on the quantities of surface water and groundwater that can be taken from the Basin's water resources. These are known as 'sustainable diversion limits' (SDLs). As the SDLs come into effect, they will replace the current MDBMC Cap on diversions in the Basin. They will set limits on the taking of both groundwater and surface water from the Basin.

The Water Sharing Plan for the Peel Valley Regulated, Unregulated, Alluvial and Fractured Rock Water Sources 2010 (the plan) will be considered an interim plan under Section 242 of the *Water Act 2007*. As such it will be in force for five years from the date of commencement (July 2010). After this time it will be assessed against and require accreditation under the Basin Plan before being remade or extended. NSW has 'consulted' with the MDBA on the plan, consistent with the requirement to consult on all interim WSPs under the Commonwealth *Water Act 2007*.

[3] See www.namoi.cma.nsw.gov.au for details

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

Other considerations

There are a number of policies and water related issues that required consideration when developing the plan and its associated water sharing rules.

Related water sharing plans

The Peel Regulated River has historically been managed as a separate volumetric allocation scheme under the *Water Act 1912* to the Namoi regulated rivers. Operationally, the management of Chaffey Dam is independent of storages on the Upper and Lower Namoi Regulated River Water Sources. As such, NSW has chosen to manage the Peel and Namoi regulated rivers under different plans, despite their collective assessment and reporting relationship under the MDBMC Cap.

The *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2003* (the Namoi Regulated Plan) commenced in 2004. The Namoi Regulated Plan includes rules to manage growth in the town water supply for Tamworth. In effect, 95 per cent of the growth in Tamworth City diversion is absorbed by the Upper Namoi and Lower Namoi Regulated River Water Sources, as is explicit in clause 32 of the Namoi Regulated Plan. The provisions of the plan for the Peel Regulated River Water Source are required to be consistent with those in the Namoi Regulated Plan. The Namoi Regulated Plan also established the provisions for dealings under section 71R of the *WMA 2000,* where share components can be transferred into water sources within the Namoi Regulated Plan, from another water source, providing that the other plan provides for this to occur and that the volume transferred in will be added to the LTAAEL.

The Namoi Unregulated Rivers Extraction Management Unit (EMU) was established in the *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*. This EMU includes the Peel unregulated water sources, and as such, the management to a long-term average annual extraction limit and MDBMC Cap accounting will be carried out across all unregulated water sources within the Namoi Unregulated Rivers EMU. The provisions of the plan for the Peel unregulated water sources are required to be consistent with the *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*.

Managing extraction

During the development of the plan, water user groups, through the Peel Advisory Group (PAG) advised the Minister that they wanted the Peel Valley to be managed under a single water source and that a single 'Peel Valley Sustainable Diversion Limit' should be established. The Minister requested that the NSW Office of Water investigate this proposal. This request was predicated on the assumption that a single water source 'sustainable diversion limit' based on surface water availability within the Peel Valley, would exceed the sum of likely water source extraction limits as inferred by the MDBMC Cap Agreement for surface waters and sustainable yield for groundwater aquifers. The PAG also considered that a single water source 'sustainable diversion limit' for the Peel Valley may help in addressing issues of surface and ground water inter-connectivity within the Valley.

The NSW Office of Water considered this issue and made recommendations in regard to the extraction limits for the water sources of the Peel Valley to the Peel IRP, in doing so it was noted that:

- NSW Government remains a signatory to the 1995 MDBMC Cap Agreement and that the established methodology for determining sustainable yield will be used for the Peel Valley Fractured Rock only.
- Water sources are a management tool in WSPs which dictate a consistent level of management so that a single water source approach covering the entire Peel Valley would

create inequity issues between users. These inequity issues are in part due to the unique characteristics of these respective resources i.e. seasonal water availability, long-term reliability, storage infrastructure, environmental assets, and so on.

- The inter-connectivity between surface/groundwater water sources in the Peel Valley is most appropriately managed through linked (but not necessarily the same) access rules and available water determinations between water sources.
- In accordance with the Commonwealth *Water Act 2007*, the Basin Plan will establish 'Sustainable Diversions Limits' for all surface and groundwater resources within the Murray-Darling Basin, to be implemented in the Peel after this interim plan expires in June 2015.

The Peel IRP acknowledged that an over arching sustainable valley extraction limit with individual water source extraction limits derived thereafter would only be appropriate if the valley extraction limit could be split into smaller management units (EMUs and water sources) to achieve sustainability at that component level. The Peel IRP noted that there is no current tested method to set sustainable diversion limits for a valley in this manner and that there is no method for ensuring that any sustainable diversion limit developed at the whole of valley scale, could then be administered in a manner that prevents overuse of any of the component water sources. Given this limitation, the Peel IRP recommended that:

- all the Peel Valley water sources should be covered in the one plan,
- the sum of all water source LTAAELs could be viewed as the combined extraction limit for the Peel Valley,
- growth in use should be managed at the component EMU level, which, for the Peel, is the same as the water source level, excluding the unregulated water sources in the Peel Valley that are managed at the Namoi Unregulated EMU scale,
- AWDs would therefore be made at the EMU/water source level, and
- linked management rules should be used to recognise connectivity between water sources, where this is appropriate.

This has been adopted in the final plan for commencement. The NSW Office of Water has also included an estimate of the combined Peel Valley extraction limit for all water sources, as a note in the plan.

Managing surface water and groundwater connectivity

A key objective of the National Water Initiative (2004) is 'recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource'.

For the purposes of developing WSPs for inland aquifer systems in NSW, a highly connected system has been defined as a system in which "70 per cent or more of the groundwater extraction volume 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, 2008).

Using the above definitions of connectivity, the Peel Regulated River, Cockburn River, Goonoo Goonoo Creek and Dungowan Creek Alluvial Management Zones of the Peel Alluvium Water Source, will be treated as 'highly connected' systems, whilst the Attunga Creek, Duncans Creek and Moore Creek Alluvial Management Zones of the Peel Alluvium Water Source and the entire Peel Fractured Rock Water Source will be treated as 'not highly connected' systems. This definition is being applied to all NSW water sharing plans under development.

Granting new access licences

Water sharing plans make provision for the application for new access licences in addition to those prescribed by the *Water Management (General) Regulation 2004*. All of the water sources in the Peel Valley have been embargoed under the *Water Act 1912*, meaning that applications for new licences will not be accepted. These various embargoes include:

- Peel Alluvium and Peel Fractured Rock:
    - April 1995, a moratorium on issuing new groundwater entitlements above 19ML was put in place for the Peel Alluvium,
    - July 1999, an embargo on any further applications groundwater licences was gazetted for the Peel Alluvium, and
    - December 2008, an embargo on applications for groundwater licences was gazetted which applied one set of exemptions to all inland groundwater in highly committed aquifers including the Peel Alluvium and Peel Fractured Rock.
- Peel Regulated River - an embargo on applications for regulated river surface water licences for the Peel Regulated River was gazetted on 9 March 1990.
- Peel unregulated water sources - an embargo order was made for unregulated surface water licences in the unregulated areas including those in the Peel on 8 March 1993.

In consideration of the previous embargo orders on the Peel Valley water sources, the plan does not provide for additional applications for licences outside those provided for under the regulations. *The Water Management (General) Regulation 2004* prescribes a number of different types of specific purpose access licences for which applications may be made. Clause 19 of the *Water Management (General) Regulation 2004* allows for applications to be made for the following specific purpose access licences:

- a local water utility [domestic and commercial] access licence, for the purpose of domestic consumption and associated commercial activities,
- a domestic and stock [domestic only] access licence, for the purpose of domestic consumption,
- an unregulated river [town water supply] access licence, for the purpose of supply to communities for domestic consumption and commercial activities,
- a Regulated River (high security) [town water supply] access licence, for the purpose of supply to communities for domestic consumption and commercial activities,
- an aquifer [town water supply] access licence, for the purpose of supply to communities for domestic consumption and commercial activities, and
- any category of specific purpose access licence that has a subcategory ‘Aboriginal cultural’, for Aboriginal cultural purposes.

Under the plan, applications for specific purpose access licences may be made in accordance with Clause 19 of the *Water Management (General) Regulation 2004*, and an access licence may be granted in accordance with a dealing. The plan limits the application for an Aboriginal Cultural licence to 10ML/yr/application.

Mandatory conditions

The plan sets out a number of provisions that will be applied as mandatory conditions to water access licences and water supply work approvals, developed by other rules contained within the plan. These mandatory conditions are designed to protect the rights of all users in the water source and the environmental water rules of the plan. They cannot be removed or altered unless the plan itself is amended.

Protecting Aboriginal values

Aboriginal People have a spiritual, customary and economic relationship with land and water that provides an important insight into 'best practice' for 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.

WSPs 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 artefacts, 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.

Aboriginal cultural licences allow communities to access water for important cultural purposes and the plan provides for them to be granted, throughout the Peel Valley. These cultural licences are limited to 10ML/yr/application.

During the development of the plan, an initial assessment into Aboriginal cultural heritage values in the upper riparian zones of the Chaffey and Upper Peel River Tributaries water sources was undertaken. This assessment was via a preliminary desktop analysis and ground reconnaissance and has provided a first evaluation of the potential impacts on Aboriginal cultural heritage values, resulting from current and proposed water flow regimes.

The desktop analysis and ground reconnaissance did not foresee that the plan provisions would result in any deleterious effects on Aboriginal cultural heritage values within the upper extent of the water sources examined (Albertson, 2009).

Further input was sought from the Aboriginal community during the public exhibition period through liaisons with the executive of the Tamworth Local Aboriginal Land Council. Note that no formal submissions were received from indigenous individuals or groups during the public exhibition of the plan.

The legislation and the plan also allow for any future claims for Native Title Rights, as part of a basic landholder right.

For more information, see the fact sheet *Macro water sharing plans. Information for Aboriginal water users*, which is available on the Office website[4].

[4] http://www.water.nsw.gov.au

Protecting environmental values

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

The freshwater environment of the Peel Valley is comprised of a range of aquatic habitats, including extensive in-stream pool habitats, small flood runners, anabranches, in-stream benches, point gravel bars and terraces.

Particularly important for the riverine ecology of the Peel are the in-channel structures such as terraces or benches on which debris or detrital material deposits accumulate during low flow periods (Foster, 1999). This material may include leaf litter and the remains of insects that have fallen from the vegetation above. When flood events occur and these areas are inundated, the organic material, in addition to being an in-situ food source for many aquatic organisms, may also be transported from the bench to be recycled within the river / floodplain system. These areas also provide an important function in providing a seedbank of riparian and aquatic plant species and populations of organisms at all levels of the food chain occur, which may be an important colonisation source during large floods. The benches and terraces are more frequently inundated due to their location lower down the cross-sectional profile of the river channel and therefore provide an important role in the cycling of carbon and nutrients.

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

The Peel River does not support a great number of floodplain wetlands. Those that occur on the floodplain are infrequently watered by floods from the Peel River that are in the order of 30,000 – 50,000 ML/day or greater. A number of lagoons occur in the reach of the Peel River near Somerton, however, these and others similar in the lower reaches of the Peel are generally maintained by rainfall events occurring within their local catchments.

The aquatic habitat in the Peel supports a diverse assembly of species, including threatened fish, frogs, and bird species. Introduced fish species such as carp compete with native fish species found within the catchment. The pressures from introduced species, as well as other factors such as increased fishing pressure and habitat degradation, have resulted in the population densities of native fish being significantly lower than historical levels. Threatened species likely to be dependent on water resources in the Peel Valley, are included in Appendix 5.

In the lower end of the Valley, the channel has become degraded with loss of in-stream pools and vertical riverbanks due to riverbed erosion, altered vegetation cover, associated land use changes and subsequent channel expansion. Prospects for channel recovery are constrained by the limited amounts of large woody debris present in these degraded reaches. Overall, there is poor tree cover within the riparian zone across the Valley. The greatest loss of riparian vegetation cover exists in the Goonoo Goonoo Creek water source and in the lower reaches of the Peel River between Somerton and Carroll Gap. Poor vegetation results in loss of habitat and biodiversity, minimal shade protection, reduces carbon input and also leads to reduced bank stability and consequential increases in sedimentation and excessive nutrients in surface water which can threaten aquatic biota and lead to increased potential for blue-green algal blooms.

An endangered ecological community (EEC) is an assemblage of species occupying a particular area (plant or animal communities) that is in danger of becoming extinct. These EECs are listed in

schedules to the Threatened Species Conservation Act 1995. Three endangered ecological communities were identified within the Peel Valley, namely the:

- Lower Darling Aquatic Community,
- Upland Wetlands of the Drainage Divide of the New England Tablelands Bioregion, and
- Carbeen Open Forest community in the Darling Riverine Plains & Brigalow Belt South Bioregion.
- There has also been one identified threatened population, the Tusked Frog (Adelotus brevis) population in the Nandewar & New England Tablelands Bioregion.

The Peel Valley shows a high degree of connectivity between surface and groundwater, with potential groundwater dependent vegetation, such as red gums occurring on the floodplains accessing groundwater through historical stream channels buried beneath the surface. Six high priority groundwater dependent ecosystems (GDEs) have been identified in the Peel Valley. 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 EECs. A list of identified GDEs in the Peel Valley can be found in Appendix 6.

Maintaining ecosystem functions

In 1997, the NSW Government undertook a public process of developing water quality and river flow objectives for NSW river and groundwater systems. The rules in the plan were developed based on these objectives.

In general terms we have some understanding of the flow needs of particular ecological functions and processes and through the application of hydrological modelling, we can determine to some degree of confidence, the best ecological outcomes given the constraints and limitations imposed by the physical nature of the river, the available climatic sequence and the presence of Chaffey Dam.

The Ecological Features Report for the Peel Regulated Water Source (Foster and Lewis, 2009) considers the relevant river flow objectives as well as changes to the flow regime and the ability to meet the water requirements for specified in-stream and wetland features, when selecting and developing environmental flow rules for consideration. Appendix 7 lists the in-stream and wetland features of the Peel Regulated River and describes their likely water requirements.

Identification and scheduling of groundwater dependent ecosystems

The methodology utilised for the identification and scheduling of high-priority groundwater dependent ecosystems (GDEs) in the development of this plan is consistent with the *NSW State Groundwater-Dependent Ecosystem Policy* (DLWC, 2002).

During the initial development of the plan a desktop exercise assembling all known records of GDEs was undertaken, including interrogating known data bases, GIS records and other studies. This identified the 'high priority' GDEs. This work was undertaken by an interagency group with staff from DECCW and NSW Office of Water and is consistent with Step 1 and Step 2 set out in the 'Rapid Assessment Process for Groundwater Dependent Ecosystems' described in the *NSW State Groundwater-Dependent Ecosystem Policy* (DLWC, 2002).

This desktop assessment allowed the plan to protect GDEs of known high conservation value from year 1 of the plan. These GDEs, identified as having important conservation significance, are listed in a schedule to the plan and there are rules developed to protect them. Examples of the types of high priority GDEs identified through a desktop analysis such as this include: GDEs listed under the Directory of Important Wetlands, RAMSAR listed wetlands, communities listed under the *Threatened*

Species Act 1995 and Karst Conservation Reserves listed under the *National Parks and Wildlife Act 1974* by the Karst Conservation Unit of DECCW.

Records of other GDEs are also collated from interrogating other Government databases, GIS records and relevant studies. Note that there may be GDEs identified as having high levels of groundwater dependence and/or high conservation value, which are not currently considered to be 'high priority' and are not scheduled in the plan. These GDEs are listed as moderate priority on NSW Office of Water's GDE records and are considered in the assessment of licence applications. The scheduled list of high priority GDEs may be amended after year five of the plan following more rigorous investigation of known GDEs or detailed analysis that identifies additional 'high priority' GDEs.

Protecting basic landholder rights

Under the *WMA 2000*, extraction of water for basic landholder rights (BLR) does not require a licence, although in the case of accessing groundwater under BLR the water supply work must still be approved by the NSW Office of Water. BLR include water for domestic and stock purposes extracted from a water source fronting a landholder's property or from any aquifer underlying the land, harvestable rights and for native title rights.

The principles of the *WMA 2000* also require that water sharing must protect BLR. The plan does this by including an estimate of the water requirements for BLR at the start of the plan. There are currently no extractions for native title rights. However, these rights may be activated during term of the plan.

Furthermore, the access rules apply to licensed water users but not to extractions for BLR. This in effect affords these BLR users some additional protection.

Domestic and stock rights can be restricted by the Minister to protect the environment or public health, or to preserve existing basic landholder rights. These restrictions are outside the framework of the plan and are applied by way of an order under section 324 of the *WMA 2000*. The NSW Office of Water is developing a regulation which will limit extractions under domestic and stock rights to a reasonable volume where they are metered and also more clearly define what is considered to be a reasonable purpose, which is important where they are not metered.

The current best estimate of BLR volume for the Peel Valley water sources draws on the reasonable take and use zones and the domestic and stock consumption allowances from the NSW Office of Water's draft Reasonable Use Guidelines (RUG). Consideration is given to both surface and groundwater estimations simultaneously, effectively reducing the double counting of these rights in the estimations. The method is summarised as follows:

- Areas of significant reliance on groundwater and surface water are determined.
- 2005 land use data held by NSW Office of Water is used to determine grazed area as defined by the draft RUG and a consequent volume determined by applying the stock consumption allowance (ML/ha) from the draft RUG, to estimate stock watering use in each water source.
- ABS Population and Housing Census data by collector districts is used to calculate the number of houses in each water source and the domestic consumption allowance (ML/'house') from the draft RUG is applied to estimate the total domestic water use for each water source.

Water interception activities

A change in land-use activities can 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, significant interception activities are required to be accounted for within a WSP's extraction limit.

Exemptions for farm dams

Farm dams currently require an access licence only when:

- they are located on a 3rd 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 10 per cent of the mean annual runoff from the property, or
- they are on a permanent (spring fed) 1st or 2nd order stream.

Unlicensed extraction from farm dams is permitted as a component of the basic landholder rights, called the Harvestable Right. The plan cannot actually limit these rights. The provisions relating to Harvestable Rights are unaffected by any of the rules identified in the plan. However, the uptake of Harvestable Rights will be monitored to determine if at any stage total unlicensed dam capacity has increased to a level considered significant in relation to interception and to inform the implementation of the NWI.

Acknowledgement of floodplain harvesting activities

Floodplain harvesting is the collection, extraction or impoundment of water flowing across floodplains. 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.

Floodplain harvesting can generally be characterised as follows:

- diversion or capture of floodplain flows using purpose built structures or extraction works to divert water into storages, supply channels or fields or to retain flows, or
- capture of floodplain flows originating from outside of irrigated areas using works built for purposes other than floodplain harvesting, or
- opportunistic diversions from floodplains, depressions or wetlands using temporary pumps or other means.

It is intended to establish volumetric entitlements, measurement and long-term limits for floodplain harvesting during the life of the plan. Volumetric entitlements, measurement and long-term limits for floodplain harvesting will be established through the development of a NSW Floodplain Harvesting Policy, which went on public exhibition in May 2010. The plan may be amended at a later date in order to deal with the management of floodplain harvesting. Due to the nature of the Peel Valley, it is unlikely that large entitlement volumes for floodplain harvesting water will be issued.

Risk of interception through forestry expansion

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

Protecting town water supply access

Under the *WMA 2000*, 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 current infrastructure is unable to meet their water needs and requires upgrading. In this case, when a major augmentation of the works occurs, town water utilities will need to meet access conditions specified in the plan to ensure that there is enough water flowing to protect the environment and consider any potential impacts on other consumptive users.

Development of future water supplies

Any development of new water storages in the Peel Valley must be undertaken within the bounds of the plan and the *WMA 2000*. 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.

Chaffey Dam upgrade and augmentation

In 2003 State Water embarked on a Chaffey Dam Upgrade Program to bring the dam up to the required safety standards. Interim works were completed in 2004. These works have reduced the flood safety risk, but further works are required to protect the Dam against extreme flood events.

State Water and the Chaffey Dam Community Reference Panel, which included Tamworth Regional Council and NSW Office of Water representation, identified augmentation options that could be included in the dam safety upgrade. The only feasible augmentation option was to increase the capacity of Chaffey Dam to 100,000 ML.

Under the MDBMC Cap, total water extractions cannot exceed those that would have occurred under 1993/94 level of development and management. The motivation to proceed with the upgrade and augmentation is therefore to secure the future of Tamworth's town water supply, whilst providing some protection to the current reliability of the Peel irrigation industry, should growth in town water supply diversion occur to the fullest extent of their current entitlement.

The Commonwealth Government's funding for the Chaffey Dam augmentation is conditional upon the finalisation of a water sharing plan for the Peel Regulated River, which has now been achieved. Therefore, State Water and the Minister for Water are now leading the negotiations with the Commonwealth on progressing this issue.

From a water sharing perspective, an augmented Chaffey Dam will result in several management changes, notably it may be possible to provide a larger volume of planned environmental water. All management changes under an augmented dam, including planned environmental water are either explicitly written into the plan or provided for through amendment clauses. The plan demonstrates 'no growth' beyond that limited by the current MDBMC Cap Agreement, providing detailed rules to ensure that extractions remain within the LTAAEL (see 'Peel Regulated River'). The requirement to demonstrate that an enlarged Chaffey Dam will not result in growth in extractions, necessitates that management under an augmented dam had to be considered during the planning process.

Peel Regulated River

Background

The Peel River is regulated by Chaffey Dam in its headwaters. Chaffey Dam has a capacity of 62,000 ML and was constructed in 1979. In operating Chaffey Dam, State Water releases water to meet water orders, basic landholder rights plus system losses, taking into account tributary inflows. A significant amount of water is lost annually to the Peel Alluvium, as well as minor losses associated with evaporation.

Hydrologic modelling

Hydrologic modelling refers to the use of a numerical computer tool to simulate river flows, dam storage, water extraction, losses and operation, irrigation demands and water sharing plan rules. In NSW, the Integrated Quantity and Quality Model (IQQM) is the preferred hydrologic model for water planning. A full description of IQQM, including details about model structure, algorithms, and assumptions are described in the IQQM Reference Manual (DLWC, 1995).

Details on the configuration of the Peel IQQM Model are shown in Appendix 8. The Peel IRP used the model output to assess the implications of current development and full development scenarios, as well as various changes to Peel Regulated River operations and trading rules to recommend draft rules for inclusion in the plan.

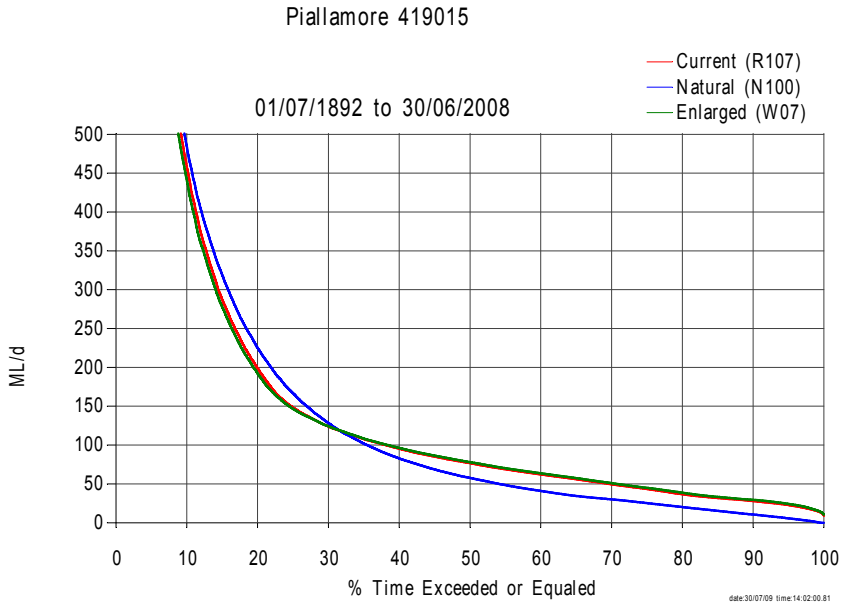
Impact of river regulation

The IQQM for the Peel has been used to generate a range of flow statistics for both pre-development (‘natural’) and current development conditions to highlight the effects of river regulation through Chaffey Dam. These scenarios are simulated over the full available climatic period, which is currently configured in the model from 1892 to 2008.

Chaffey Dam regulates only a small proportion of the Peel Valley and as such the end of system flows under both natural (without Chaffey Dam) and developed (with Chaffey Dam) conditions simulated over the full 117 year period are very similar (see below). Therefore, it can be argued that medium to high flows in the mid to lower reaches of the Peel Regulated River are relatively unaffected by current river regulation. The upper most reach of the Peel Regulated River i.e. Chaffey Dam to Dungowan Creek, has been affected by river regulation as there are no significant tributaries providing unregulated flows to this reach.

Impact of river regulation at Piallamore

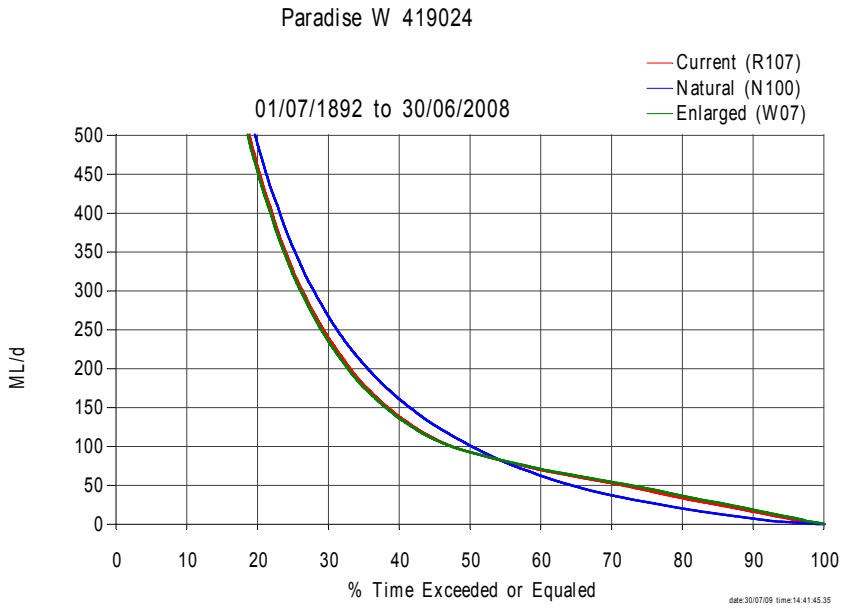
Figure 4: Impact of river regulation at Piallamore (all year flow)



The regulation of the Peel River through Chaffey Dam (current and enlarged) has / will result in a decrease in the frequency and duration of flows in excess of 120 ML/day and an increase in the frequency and duration of flows less than 120 ML/day, as measured at Piallamore. Simplistically, flows above 120 ML/day are captured by the Dam to be later released at lower rates i.e. less than 120 ML/day to satisfy water orders as well as the water requirements for domestic and stock users. The effect of river regulation is most significant in this reach due to the limited number of downstream tributaries contributing to flows at this location and that many diversions of ordered water occur downstream of this point. An enlarged Chaffey Dam will have captured a greater percentage of flows measuring above 120 ML/day at Piallamore than the current Chaffey Dam. This effect is more pronounced in summer.

Impact of river regulation at Paradise Weir

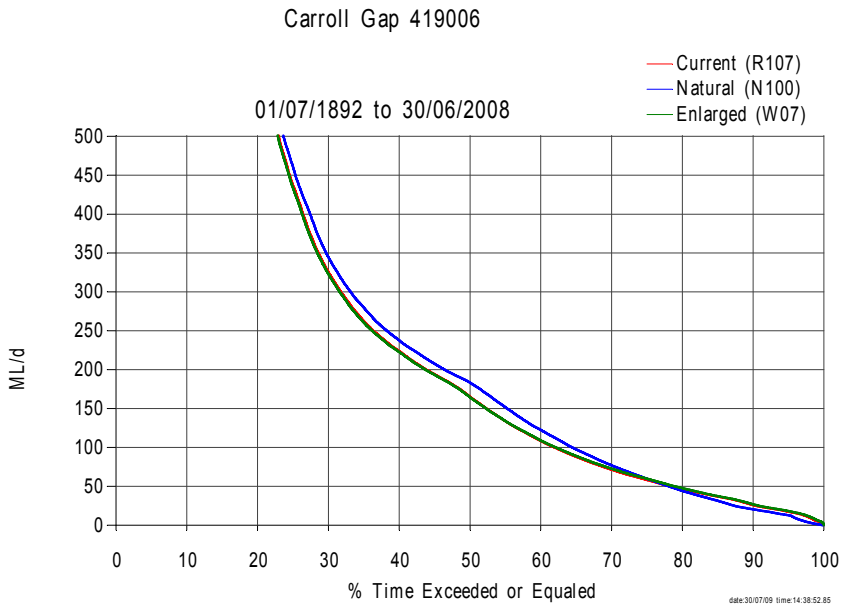
Figure 5: Impact of river regulation at Paradise Weir (all year flow)



The regulation of the Peel River through Chaffey Dam (current and enlarged) has / will result in a decrease in the frequency and duration of flows above 80 ML/day and an increase in the frequency and duration of flows less than 80 ML/day, as measured at Paradise Weir. The effect of river regulation is less significant in this reach than at Piallamore due to the contribution of unregulated flows from Cockburn River and that a larger proportion of ordered water has been extracted by this point in the River. An enlarged Chaffey Dam will have captured a greater percentage of flows measuring above 80 ML/day at Paradise Weir than the current Chaffey Dam. Again this effect is more pronounced in summer.

Impact of river regulation at Carroll Gap

Figure 6: Impact of River regulation at Carroll Gap (all year flow)



The effect of river regulation through Chaffey Dam (current and enlarged) is almost nonexistent at Carroll Gap. As Carroll Gap is near the end of the system, only a small volume of extraction of ordered water is delivered beyond this point. Additionally, the flow at this location is heavily influenced by unregulated river flows from tributaries entering the Peel Regulated River. An enlarged Chaffey Dam will have captured a greater percentage of flows measuring above 50 ML/day at Carroll Gap than the current Chaffey Dam.

Water sharing rules

Protecting environmental values

General

Various combinations of flow thresholds and conditions were modelled by NSW Office of Water on a 'first cut' basis to assess the following types of environmental flow options. Further refinement of the modelling and specific parameters within the options was undertaken when the feasibility of each of the initial options was investigated. An inventory of the environmental flow rule modelling runs tested in IQQM are included in Appendix 9.

A scenario with a raised access threshold to uncontrolled flows in the Peel Regulated River below Chaffey Dam was modelled in IQQM to test its ability to influence the frequency and duration of instream bench/ point bar inundation. The results revealed no detectable change to flows at any of the gauging stations on the Peel Regulated River, as a result of raising the uncontrolled flows arising from unregulated inflows access conditions from the 40/50 ML/day at Carroll Gap (dependent on general security allocations) to 500 ML/day at Carroll Gap. Consequently, the plan reflects the off-allocation access arrangements that exist in this water source for access to uncontrolled flows pre plan development (see section 'access to uncontrolled flows').

Current Chaffey Dam

For the current Chaffey Dam of 62,000 ML capacity, planned environmental water will include:

- a stimulus flow of 1,600 ML over seven days with a peak of 500 ML/day on day 2 (IQQM run W41 - designed to inundate low level benches and restore some of the natural flow variability to the upper reaches of the Peel River), minus any water extracted in accordance with the access conditions for uncontrolled flows originating from stimulus flow releases and basic landholder rights extraction,
- at least 50 per cent of water above the threshold for access to uncontrolled flows originating from tributary inflows to the Peel Regulated River Water Source, designed to ensure that the unregulated inflow event hydrograph mimics its natural shape,
- uncontrolled flows originating from tributary inflows to the Peel Regulated River below the access thresholds, minus any basic landholder rights extraction, and
- a minimum daily release of 3 ML/day minus any extraction, except when a release greater than 3 ML/day is required for basic landholder rights and access licence extractions or the stimulus flow.

Note that water will not be set aside for the stimulus flow until Chaffey Dam water storage is greater than 50,000 ML and the stimulus flow can only be releases in the months of March to August if there has not been a flow of greater than 500 ML/day in the Peel River at Piallamore in the proceeding 90 days.

An IQQM analysis shows that these planned environmental water provisions will have less than a 2 per cent impact on general security allocation reliability and an undetectable impact on Chaffey Dam's minimum storage volume over the simulation period, 1892 – 2008.

Enlarged Chaffey Dam

For an enlarged 100,000 ML Chaffey Dam, planned environmental water will include:

- a 5,000 ML (general security) environmental contingency allowance (ECA) account, minus any water extracted in accordance with the access conditions for uncontrolled flows originating from ECA releases and basic landholder rights extraction,
- at least 50 per cent of water above the threshold for access to uncontrolled flows originating from tributary inflows to the Peel Regulated River Water Source, designed to ensure that the unregulated inflow event hydrograph mimics its natural shape,
- uncontrolled flows originating from tributary inflows to the Peel Regulated River below the access thresholds, minus any basic landholder rights extraction, and
- a minimum daily release of 3 ML/day, minus any extraction, except when a release greater than 3ML/day is required for basic landholder rights and access licence extractions or the ECA.

Note that the 5,000 ML (general security) ECA is likely to be used as a stimulus flow over seven days with a day 2 peak of 1,200 ML/day, although has the flexibility to be used for any purpose at the discretion of the NSW Environmental Water Manager. This flexibility will ensure that the ECA water is used to maximise environmental outcomes in this water source.

Figure 7: Impact of environmental water provisions on general security reliability (enlarged Chaffey Dam)

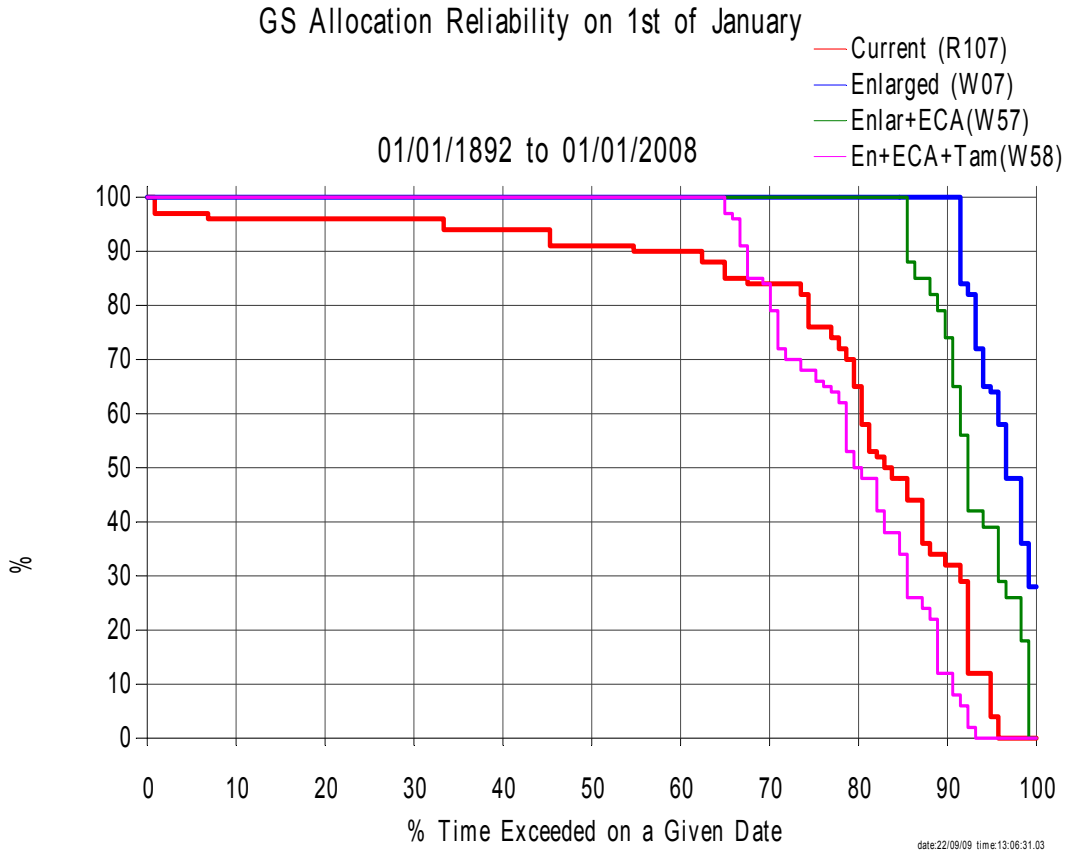


Figure 7 shows the 5,000 ML (general security) ECA coupled with growth in Tamworth to its full entitlement (16,400 ML) will reduce general security allocations by less than five per cent from current conditions under the existing Chaffey Dam (R107).

Table 11: Comparison of minimum storage volumes under various conditions

IQQM Run Number/ Description	Minimum Storage (ML)	Year
R107 – current conditions, current Dam	15,500	1966
W07 – current conditions, enlarged dam	29,900	2007
W57 – 5,000 ML ECA, enlarged Dam	20,000	2007
W58 – 5,000 ML ECA, enlarged Dam, growth in TWS to 16,400 ML	18,000	2007

Table 11 shows that a 5,000 ML (general security) ECA coupled with growth in Tamworth's diversion through to its full entitlement (16,400 ML) will still result in a 2,500 ML improvement in minimum storage volume from current conditions under a current Chaffey Dam (R107) over the simulation period, 1892 - 2008.

Managing extraction

Setting the long-term average annual extraction limit (LTAAEL)

For the Peel Regulated River water source the LTAAEL will be the lesser of:

1. the long-term average annual extraction from this water source that would occur with the water storages and water use development that existed in 2007/08, the share components existing at the commencement of the plan and application of the rules defined in the plan, plus the long term average annual extraction from Dungowan Dam water storage by a local water utility access licence; or
2. the long-term average annual extraction from this water source (including the long term average annual extraction from Dungowan Dam water storage by a local water utility access licence) that would occur under the MDBMC Cap baseline conditions as agreed under the Murray Darling Basin Agreement Schedule 1 of the *Water Act 2007*(Cth).

An assessment of the long-term average annual extractions that would occur under the conditions specified in (1) is made using the Peel IQQM and the model run is specified as a note in the plan. This indicates a long-term average annual extraction volume of 15,100 ML (IQQM model run W59).

An assessment of the long-term average annual extractions that would result from the Cap baseline conditions in (2) above has been made using the Peel IQQM and the model run is specified as a note in the plan. This indicates a long-term average annual extraction volume of 15,100 ML (IQQM model run C103).

The LTAAEL recognises the effect of past climatic variability on the availability of water, in accordance with section 20 (2) (c) of the *WMA 2000*, as historic climate and river flow information are used in its determination. Consistent with *the WMA 2000* the LTAAEL will include the following:

- all water extractions by holders of all categories of access licences in the water source, except for those access licences to which section 8C[5] of the *WMA 2000* related,
- all extractions under those local water utility access licences used to extract water from Dungowan Dam water storage;
- floodplain harvesting extractions determined to be taken for use in conjunction with extractions under access licences in this water source, and
- all water extractions pursuant to domestic and stock rights and native title rights.

The LTAAEL will not include:

- any replenishment flows made in accordance with the plan, or

[5] 8C of the *WMA 2000* relates to licences that may be granted as a result of system savings and have an adaptive environmental water conditions imposed on the licence.

- diversion of water pursuant to the planned environmental water rules in Part 4 of the plan.

Consideration was given to setting two separate LTAAELs for the Peel Regulated River Water Source. One would set the irrigation extraction limit and the other the local water utility extraction limit. The NSW Office of Water is preparing a policy position to put to the State Interagency Panel for consideration as a State-wide policy on the separation of LTAAELs between major or local water utilities and other consumptive use. This policy considers a risk based approach looking at consequences and likelihood, e.g. if there is a large utility compared to rest of the consumptive pool and if this is likely to grow relative to its extraction limit allowance then this would be considered both a high consequence and high likelihood and would justify separation of LTAAELs.

In the case of the Peel Regulated River Water Source, the decision on assigning the impacts of growth in Tamworth's water extractions has already been established by the existing *Water Sharing Plan for the Upper and Lower Namoi Regulated River Water Sources 2003,* when the Government included provisions for 95 per cent of the growth in Tamworth City town water supply extractions to be attributed to the Lower Namoi Water Source. Similarly, any decision about how to attribute the remaining growth in local water utility extraction in the Peel Regulated River Water Source must be in accordance with the access licence priorities already specified in the *WMA 2000*. Under the *WMA 2000*, local water utility licences have priority over general security licences and general security licences have priority over supplementary licences. The *WMA 2000* requires that if allocations are to be diminished then the water allocations of the higher priority licence are to be diminished at a lesser rate than the lower priority licence. Therefore, five per cent of any growth in Tamworth City town water supply extractions will be attributed within the Peel. Given the low consequence of assigning five percent of the growth to the Peel, the water sharing plan includes the Tamworth usage within a combined LTAAEL for the consumptive pool. Therefore, any growth-in-use response will be achieved through reductions in maximum available water determinations, to general security access licences, if required.

Managing to the LTAAEL

Audit and reporting of the Peel Regulated River Water Source total extractions will be undertaken on an annual basis.

Most water sharing plans for regulated river water sources, including the Upper and Lower Namoi Regulated River Water Sources, compare modelled long-term average annual extractions under WSP LTAAEL conditions and modelled current conditions. The 'current conditions' scenario is continually updated during the life of the WSP to ensure that it remains the best modelled estimate of long-term extractions that would occur under the development conditions at any point in time and with the rules established by the plan. In these other existing plans, the LTAAEL will be assessed to have been exceeded if the long-term average annual extraction under the current conditions scenario exceeds:

- the LTAAEL by three per cent or more, or
- the LTAAEL by more than half the difference between the LTAAEL and Cap long-term average annual extractions, or
- the Cap long-term average annual extractions, or
- the LTAAEL and has been shown to have exceeded the LTAAEL in three consecutive annual assessments.

However, this approach in the Peel Regulated River is not appropriate. If Peel irrigator behaviour / crop planting decisions were able to be modelled and reflected in the Peel IQQM, then application of the above process to the Peel Regulated River Water Source may result in an immediate LTAAEL compliance response as soon as Chaffey Dam is enlarged, even if the new enlarged dam has not filled and actual growth in extractions has not occurred. In effect, the standard approach assumes that

an increase in headwater storage capacity will automatically increase extractions. In reality, this automatic growth is not necessarily going to occur in the Peel.

Modellers have found Peel irrigator behaviour extremely difficult to reflect in the Peel IQQM as they do not have any historical behaviour pattern that can be easily replicated and because behavioural responses to a larger dam are unknown. Certainly, the anecdotal evidence based on feedback from industry representatives is that the larger dam is about water supply security, not about growth. This is primarily because growth is constrained by other factors such as land suitability and market forces. The main crop type in the Peel is lucerne and while the area planted may not increase, additional water is used in dry years as opposed to wet years. This is different to most other regulated valleys, which generally reveal a strong relationship between dam storage levels, annual diversions and area cropped, ie less water is used in dry years. The main reason for this difference is the low levels of individual licence activation in the Peel relative to other regulated valleys, therefore reduced water allocations only affect a few individuals with licence activation levels above the allocation in that year.

An alternate strategy for managing extractions to the LTAAEL is contained in the Peel Regulated River WSP. This alternative is a 'reactive' strategy rather than a 'proactive' one. The alternate approach is appropriate in the Peel Regulated River for a number of reasons, including the low ratio of the LTAAEL to entitlement, the inability to reflect irrigator behaviour in IQQM and that the proposed infrastructure change (Chaffey Dam augmentation) is a significant one-step increase in headwater storage capacity, which is not related to licence holders behaviour and will not necessarily result in growth in use.

Therefore, under the new 'reactive' approach, it is recommended that the initial assessment to detect growth above the LTAAEL will be based on a comparison of:

- the modelled 10 year rolling average of annual extractions under the plan's LTAAEL scenario, with the 10 year simulation period being that period up to and including the water year immediately prior to the date of assessment, and
- the observed 10 year rolling average of annual extractions, from metered data, for the same period as defined above.

If the observed 10 year rolling average is greater than 120 per cent of the modelled 10 year rolling average, then this will trigger a more intensive assessment as to whether growth in use has actually occurred.

The 20 per cent threshold and 10 year rolling average has been recommended to reduce the possible impact of model biases and climatic variation and to reduce the volatility of assessments due to annual changes in these factors. An analysis of the data to-date demonstrates that the rolling annual average of historical extractions is significantly less than 120% of the 10 year rolling annual average of simulated diversions, which is as expected since there has been no evidence of growth in the Peel Valley since the Cap Agreement was established. This is shown in Figure 8, comparing the modelled 10 year moving average under the plan LTAAEL (pink) and the observed 10 year moving average of extractions from metered data (blue).

The more intensive assessment, triggered by the observed 10-year rolling average extractions being more than 120 per cent of the corresponding modelled 10-year rolling average plan LTAAEL extractions, will compare the long-term average annual extraction under:

- the 'current development' model run, and
- the 'plan LTAAEL' model run.

The 'current development' model run would be updated to include the most recent irrigator behaviour parameters, including an updated irrigated area and updated on-farm infrastructure. This process for

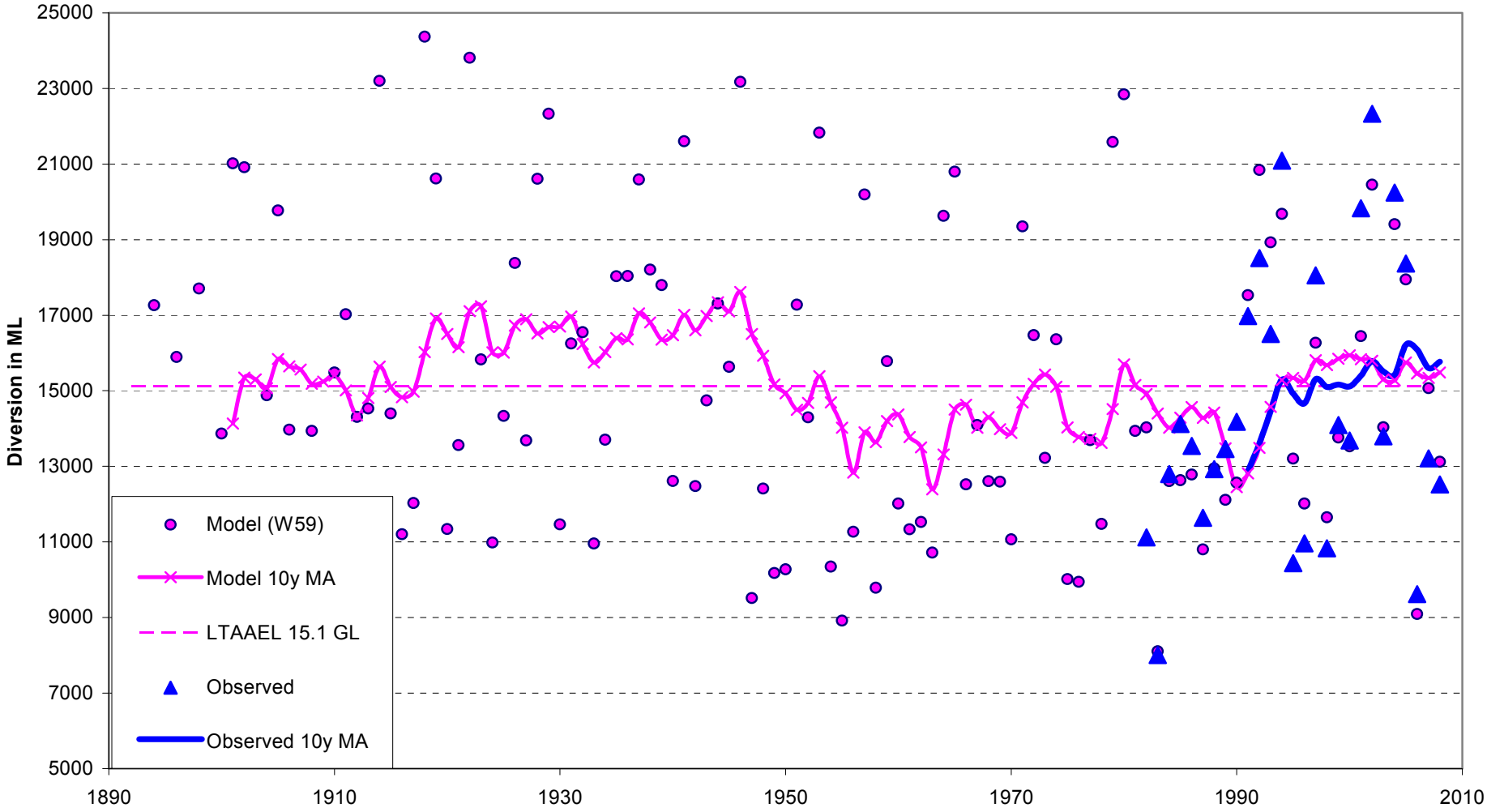
assessing growth above the LTAAEL is similar to the Cap auditing process used for all NSW inland regulated river systems.

The LTAAEL will be assessed to have been exceeded if the current long-term average annual extraction represented by the 'current development' model run, minus 95 per cent of the growth in extraction by Tamworth City, exceeds:

- the long term average annual extraction represented by the 'plan' model run by three per cent or more, or
- the long term average annual extraction represented by the 'Cap' model run, or
- the plan LTAAEL by any amount for three consecutive water years.

Note that 95 per cent of any growth in extraction by Tamworth City is to be attributed to the Upper and Lower Namoi Regulated River Water Sources and only five per cent to the Peel Regulated River Water Source. The plan does not include the "more than half the difference between the long term average annual extraction represented by the 'plan' model run and the 'Cap' model run" rule that appears in other regulated river plans, as there is no discernable difference between the Cap and LTAAEL and therefore, such a rule is in effect redundant.

Figure 8: Comparison of 10 year moving average for observed extractions and modelled plan LTAAEL extractions, from the Peel Regulated River



Carryover and water accounts

In NSW, regulated river access licence accounts are managed under either annual accounting (carryover/ no carryover) or continuous accounting (carryover). Hume Dam (jointly managed between NSW and Victoria), is an example of bulk capacity sharing. The Peel Valley has a significant number of inactive licences, small headwork's storage and limited opportunities for on-farm storage. If carryover was to be allowed with annual accounting, or if continuous accounting methods were used, a significant volume of water would be locked up in storage, reducing water available to active users and reducing the effectiveness of Chaffey Dam. Annual accounting with no carryover effectively socialises the inactive component of the water allocations each year, allowing water to be reallocated the following year. Capacity sharing arrangements may be considered with an enlarged Chaffey Dam, but under current infrastructure development this would result in very small portions of the dam being made available for general security licences given the prioritisation of high security and local water utility licences.

Under the plan, the Peel Regulated River Water Source will be operated under annual accounting rules. Carryover will not be permitted and the maximum available water determination at the commencement of the plan is one ML/unit share for all access licences. Individual account usage is limited to one ML/unit share/year or 100 per cent/year (where the share is expressed in megalitres), adjusted for allocation assignments out of or into individual accounts.

The plan makes provision for an amendment to the account management rules to be introduced; if/when Chaffey Dam is enlarged.

Available water determinations

The maximum available water determination (AWD) for a water source is used to manage growth in extractions, above the long-term average annual extraction limit (LTAAEL). If systemic growth is detected then maximum AWDs will be reduced to respond to this growth i.e. a maximum AWD of less than one ML/unit share. Available water determinations are primarily used to credit water into a licence's water allocation account and in the regulated river at any given time, are a reflection of seasonal water availability. Minimum available water determinations also make explicit the lowest AWD that can be made under the plan, for relevant licence categories.

Maximum available water determinations

If the LTAAEL has been assessed as being exceeded, the maximum AWD for general security access licences shall be reduced below 1ML/ unit share. The degree of reduction shall be that necessary to return long-term average annual extractions minus 95 per cent of growth in extraction for Tamworth City (including extractions from local water utility licences that divert water from Chaffey Dam, Dungowan Dam and any other diversions relating to these local water utility licences by Tamworth Regional Council e.g. should some of the local water utility licence volume in the Peel Regulated River Water Source be extracted through the Scott's Road wells), to the LTAAEL.

If action has been taken to reduce the maximum AWD, and a subsequent assessment indicates that the sum of the current long term average annual extractions minus 95 per cent of any growth in extraction by Tamworth City is below the LTAAEL by more than three per cent, then previous reductions may be reversed to the degree that it is assessed necessary to return the sum to the LTAAEL, but the magnitude of the reversal in reductions may not exceed the magnitude of the previous reductions themselves.

Any reversal of previous maximum AWD reductions shall reverse in opposite order to the reduction process i.e. if the last licence category to have its maximum AWD reduced was general security then that will be the first category to have its maximum AWDs increased.

Seasonal water availability

The available water resources in Chaffey Dam will be initially assessed by the NSW Office of Water at the beginning of a water year. The assessment includes water in the storage plus estimated minimum inflows for the year. Available resources are committed firstly to essential supplies (domestic and stock, local water utilities and high security licences) for the current year with an additional "storage reserve' to cover basic needs in the following year. Allowances are also set aside for storage losses (evaporation, seepage) and delivery losses which effectively include basic landholder rights extraction. Then the remaining reserves are allocated to general security licensees as a volume per unit share or a percentage of licensed entitlement not exceeding the maximum AWD for each licence category. The ECA account and the inter-valley trading account (if Chaffey Dam is augmented to 100,000 ML or greater) will also be allocated water at the same rate as general security access licences. Note that an allowance for the stimulus flow must also be made if Chaffey Dam is not augmented to 100,000 ML or greater, the storage level of Chaffey Dam is greater than 50,000 ML, there has been more than 1,600ML of inflows since reaching 50,000 ML in that water year and there has been 90 days with flow less than 500ML/day at Piallamoore gauging station. If significant additional inflows into the headwater storages are received during the water year a further assessment of available water in Chaffey Dam is undertaken and additional AWDs may be made.

Minimum available water determinations

Water sharing plans need to cater for a replication of the worst drought on record, a drought more severe than this may require the plan to be suspended.

In July 2007, Chaffey Dam had been reduced to a storage volume of 10,500 GML (~17 percent capacity), following a period of prolonged drought. The consequent resource assessment resulted in allocations of less than 100 per cent made for town water supply as well as stock and domestic and high security licences. The announcement of a 70 per cent allocation for town water supply was made to complement the severe (level 5) restrictions that were imposed by Tamworth Regional Council at the time. As such, under the plan the following minimum AWDs are guaranteed:

- 70 per cent of share component for local water utility licences,
- 70 per cent of share component for domestic and stock access licences, and
- 0.5 ML/unit share for regulated river (high security) access licences.

Note that an AWD of less than 100% or 1ML/unit/share for the licence categories listed above, may only be made when an AWD for regulated river (general security) licences is not possible due to available water in Chaffey Dam.

Under the plan, some individual high security users may be affected in times of severe water shortage by reductions to their minimum AWD, which historically has not been reduced below full allocation (with the exception of July 2007). However, the socio-economic impact across the whole Valley has been rated as low, and in line with restrictions placed on all other water users.

Access to uncontrolled flows

Uncontrolled flows in the Peel Regulated River refer to;

- unregulated inflows that enter the system either downstream of the dam or from dam spills, or
- releases from the dam as stimulus and/or ECA flows.

Water originating from tributary inflows and dams spills was historically referred to as off-allocation water, when managed under the *Water Act 1912*. Under the *WMA 2000*, these flows can be accessed under Section 85A which allows a water sharing plan to provide for the taking of water from uncontrolled flows via a regulated river (general security) access licence that has not been credited to

an allocation account. This access to uncontrolled flows under section 85A (often referred to as no-debit access) in the Peel Regulated River Water Source has been established as a substitution type arrangement where uncontrolled flows can substitute for general security allocations. It is this type of access that largely reflects the historical access to off-allocation in the Peel Valley.

- In many inland regulated water sharing plans, an entitlement to supplementary water was issued in recognition of the historical access to uncontrolled flows in the regulated system. In some cases, access under section 85A has also been utilised to complement supplementary water access or instead of supplementary water access. Issuing large volumes of supplementary water access licences may encourage growth in a system that already has large volumes of inactive entitlement and would be in opposition to managing to an LTAAEL which is already significantly less than the sum of entitlements in the Peel Regulated River Water Source.

A Minister's note was included in the draft plan to specifically invite feedback on the provision of supplementary water access licences in the Peel Regulated River Water Source during its public exhibition. All submissions received during the exhibition period were against the issue of additional entitlement such as this in this water source. As such the Peel IRP recommended that no supplementary licences be issued in the Peel Regulated River water source and that access to uncontrolled flows be provided for through no-debit substitution access only. This recommendation has been adopted in the final plan.

Rules for uncontrolled flow access to unregulated inflows:

The rules for access to uncontrolled flows in the Peel Regulated River water source originating from unregulated inflows into the water source are largely unchanged from the current *Water Act 1912* off-allocation access and as such are dependent on the sum of AWDs for regulated river (general security) access licences. These rules are as follows:

- All uncontrolled flows that originate from unregulated inflows in the Peel Regulated River above the following uncontrolled flow access commencement thresholds will be shared 50:50 between users and the environment.
- When the sum of AWDs for regulated river (general security) access licences in the Peel Regulated River Water Source is less then 0.35 ML/unit share in the water year then uncontrolled flows:
    - can commence to be taken when the uncontrolled flow in the Peel River at Carroll Gap is equal to or greater than 40 ML/day, and
    - must cease to be taken within each section of the water source when the uncontrolled flow in the Peel River at any river gauging station within the respective section falls below 5 ML/day.
- When the sum of AWDs for regulated river (general security) access licences in the Peel Regulated River Water Source is equal to or greater then 0.35 ML/unit share in the water year then uncontrolled flows:
    - can commence to be taken when the uncontrolled flow in the Peel River at Carroll Gap is equal to or greater than 50 ML/day, and
    - must cease to be taken when the uncontrolled flow in the Peel River at Carroll Gap is less than 50 ML/day.

Note that the sections of the water source refer to the current water ordering sections of Chaffey Dam to Paradise Weir, Paradise Weir to Attunga Creek and Attunga Creek to Namoi River junction. Access to uncontrolled flows will be related to the section, if there is no uncontrolled flow in a section then no access will be declared in that section.

Rules for uncontrolled flow access to stimulus and/or ECA flows released from Chaffey Dam:

The plan also allows for general security access to the uncontrolled flows that originate from the environmental flow releases from Chaffey Dam. Users upstream of Piallamore gauge have in the past had reduced access to uncontrolled flows due to the lack of major tributary inflow in this section of the river. The rules around access to uncontrolled flows arising from stimulus flow or ECA releases now allow some access that otherwise would not have been possible under the pre-plan off-allocation access rules. There are different access rules for sections upstream and downstream of Piallamore gauge as follows:

- In the section of the Peel Regulated River from Chaffey Dam to Piallamore gauge uncontrolled flows that arise from stimulus flow or ECA:
    - shall only be taken when the stimulus flows or ECA water is equal to or greater than 50 ML/day at Piallamore gauging stations, provided the water taken is used to directly irrigate crops and is not pumped into on-farm storage, and
    - must cease to be taken when the stimulus flow or ECA water is less then 50 ML/day at Piallamore gauging station.
- In the section of the Peel Regulated River from Piallamore gauge to the Namoi River junction, when the sum of AWDs for regulated river (general security) access licences in the Peel Regulated River Water Source is less than 0.35 ML/unit share in the water year uncontrolled flows that arise from stimulus flow or ECA:
    - shall only be taken when the uncontrolled flow in the Peel River at Carroll Gap is equal to or greater than the forecast flow rate of 40 ML/day, and
    - must cease to be taken within each section of the water source when the uncontrolled flow in the Peel River at any river gauging station within the respective section falls below 5 ML/day.
- In the sections of the Peel Regulated River from Piallamore gauge to the Namoi River junction, when the sum of AWDs for regulated river (general security) access licences in the Peel Regulated River Water Source is equal to or greater than 0.35 ML/unit share in the water year uncontrolled flows that arise from stimulus flow or ECA:
    - shall only be taken when the uncontrolled flow in the Peel River at Carroll Gap is equal to or greater than the forecast flow rate of 50 ML/day, and
    - must cease to be taken when the uncontrolled flow in the Peel River at Carroll Gap is less than 50 ML/day.

Note that the threshold for access to uncontrolled flows arising from the environmental flows releases from Chaffey Dam in the reach upstream of Piallamoore was changed as a result of public exhibition, from 100 ML/day to 50 ML/day. This change was based on the negligible impact that this change would have on environmental outcomes, given the small installed pump capacity along this reach of the Peel River. An amendment clause has been included in the final plan to return the threshold to 100 ML/day, should the installed pump capacity in this reach increase by 20 per cent or more from that installed at commencement of the plan.

Accounting for uncontrolled flow access

Normally water that can be taken has to first be credited to an access licence water allocation account before it can be extracted by an individual licence and the licence holder can not extract more water than is available in their allocation account. Section 85A of the *WMA 2000* authorises water to be taken from uncontrolled flows without having to be credited to a water allocation account.

The total volume of uncontrolled flows that may be taken under each Peel Regulated River (general security) water access licence is, however, limited to an amount equal to the difference between the

sum of available water determinations for that water year for the regulated river (general security) access licence and the maximum sum of AWDs that can be made for regulated river (general security) access licences. (Note that the maximum sum of AWDs that can be made is 1 ML/unit share of entitlement at the start of the plan or some lesser amount during the plan as a result of a response to growth in use).

The water taken as no-debit uncontrolled flow access is recorded in the individual access licence allocation account, but is not to be debited from the account unless the total amount of uncontrolled flow taken exceeds the volume limit specified above, then the volume equivalent to the exceedence is debited from allocations credited to the water allocation account in that water year. Total water taken for the water year from uncontrolled flows and allocation from the water allocation account can not exceed the maximum sum of AWDs that can be made for regulated river (general security) access licences in that water year.

This type of water access is not tradeable separately to the general security access licence, as it is a component of this access licence.

Trading of water access entitlements and account water

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

The trading rules in the plan and the basis for setting these rules are detailed below.

Constraints on trading within water sources

General security water access licences

- No limitations on permanent or temporary trading within the water source.

Basis: when the general security AWDs are greater than zero ML/unit share, then operational flows are maintained to end of system and losses are socialised.

High security water access licences

- Nomination of a new or existing work to replace a previously nominated work on a high security access licence is not permitted if the original work was upstream of Jewry St bridge and the replacement work is downstream of Jewry St bridge, [i.e. no permanent trading of high security entitlements from upstream of Jewry St bridge to downstream of Jewry St bridge)].
- Nomination of new or existing works to replace previously nominated works on a high security access licence below Jewry St bridge is not permitted if the replacement work is in a downstream direction from the original work (i.e. permanent trading permitted in upstream direction only).
- No limitations on permanent or temporary trading between Jewry St bridge and Chaffey Dam.
- No assignment of high security allocation (temporary trading) is permitted where the nominated works are downstream of Jewry St bridge.

Basis: limited ability of river operators to provide high security access to downstream points in the system in resource constrained years.

Note that the original reference point in the draft exhibited plan was the downstream junction with Wallamore Anabranch, but as a result of public exhibition this was changed to the Jewry St bridge, as this is a more objective location.

Rules for change of water source

All access licence categories

Permanent trade from the Peel Regulated River Water Source to the Lower Namoi Regulated River Water Source is permitted, providing that:

- Whilst Chaffey Dam remains at 62,000 ML capacity, each ML of entitlement traded from the Peel will result in 0.4 ML of Namoi Regulated River entitlement and total trades are limited to 7,500 ML of Peel entitlement i.e. 3,000 ML new entitlement into the Lower Namoi.
- If Chaffey Dam is augmented to 100,000 ML or greater capacity, each ML of entitlement traded from the Peel will result in 0.4 ML of Namoi Regulated River entitlement and total trades are limited to 15,000 ML of Peel entitlement i.e. 6,000 ML of new entitlement into the Lower Namoi.
    - To offset the impacts of the second 3,000 ML of additional entitlement in the Lower Namoi under an augmented Chaffey Dam, an inter-valley trading account will be established and credited a volume at the same rate as Peel regulated river general security allocation increments, with a maximum account limit corresponding to 0.4ML for every ML of water in excess of 7,500 ML permanently traded out of the Peel to the Lower Namoi.
    - This inter-valley trading account water could be called upon by State Water and released from Chaffey to meet any water requirements in the Lower Namoi. Any losses associated with delivery of the water released from Chaffey Dam to the Peel River at Carroll Gap will be accounted for as losses in the Peel. Any losses associated with this water beyond Carroll Gap and in the Lower Namoi will be accounted for as losses in the Namoi, (i.e. the inter-valley trading account will be debited the volume of water ordered by State Water from the account as measured at Carroll Gap).
    - The traded entitlement into the Lower Namoi will be incorporated into the WSP LTAAEL modelling for the Namoi by increasing the entitlement in IQQM to reflect the new volume of entitlement. In effect, this means the current modelled LTAAEL in the Namoi would increase by the amount of usage corresponding to that additional entitlement.
    - The current modelled LTAAEL in the Peel would stay the same regardless of how much water is traded out to the Lower Namoi, up to the maximum limits 7,500 ML (current Chaffey dam) and 15,000 ML (augmented Chaffey Dam – 100,000 ML or greater).

A Minister's note was included in the draft exhibited plan to specifically invite feedback on this provision. A number of submissions were received in response to the Minister's Note, as well as concerns raised by the Ministers Peel Advisory Group which were in opposition to the tagged trading provisions that were proposed in the draft plan. In response to the submissions received, the Peel IRP recommended the above permanent inter-valley trading rules which minimise third part impacts as a result of trade, enable inactive users to trade their entitlement and ensure consistency with the National Water Initiative in terms of the removal of barriers to trade. These recommendations were adopted in the final plan.

Rules for conversion of access licence category

Conversion of an access licence category to another is prohibited.

The draft exhibited plan allowed the conversion from general security to high security and vice versa with the application of an appropriate conversion factor. Submissions received during public exhibition highlighted concern that there is already too much high security entitlement for the commitment to be met with a high degree of certainty, hence there should be no general security to high security conversions. Further, that any conversion from general security to high security would exacerbate the low activation levels of licences in this water source, creating unrealistic expectations and encouraging growth above the water source LTAAEL. In response to the public submissions received the Peel IRP recommended that all conversions of an access licence to another category in this water source are prohibited. This recommendation was adopted in the final plan.

Rules for interstate transfers and interstate assignment of water allocations (temporary trading)

- Not permitted.

Basis: creates a third party impact by imposing a commitment on another water source to deliver the allocation and the permanent trading provisions provide adequate incentives to address the issue of a high proportion of inactive licences within the Peel, whereas temporary trading would not.

Peel unregulated water sources

Background

There are five unregulated water sources in the Peel Valley, namely Chaffey, Goonoo Goonoo Creek, Upper Peel River Tributaries, Lower Peel River Tributaries and Cockburn River. Initial classification of the Peel unregulated water sources, was undertaken in line with the macro classification process outlined in "Macro water sharing plans: the approach for unregulated rivers' [6] as part of a wider process for the entire Namoi, Gwydir and Border Rivers Valleys. Based on this classification and identified indicative rules, the Namoi Interagency Regional Panel (IRP) recommended draft access and trading rules for each of the five Peel Valley unregulated water sources, initial consultations on these draft rules were carried out during May 2006.

Given the time lapsed since these rules were first drafted and in recognition of surface groundwater connectivity between many of these Peel unregulated water sources and the Peel Alluvium water source, the classification of the unregulated water sources in the Peel has been reviewed. Information used in the classification process was updated and the entitlement for the adjacent Peel Alluvium was included when looking at hydrological stress, within each of the respective water sources. As such, the risk classifications for all water sources were updated. The Peel IRP reviewed these classifications and made final recommendations which have been incorporated into the final plan. The Peel unregulated water sources remain a part of the broader Namoi Unregulated Rivers Extraction Management Unit as established in *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*.

Classification method

The 'macro planning' process is the current approach of the NSW Office of Water to developing water sharing plans for unregulated rivers and is described in the manual 'Macro water sharing plans: the approach for unregulated rivers'. These broad-scale relative assessments showed where water sharing rules were needed to strongly protect valuable natural assets by limiting extraction or to provide for extraction by water users where there is significant community dependence on this extraction. Generic indicative rules were developed for each classification to expedite the development of the water sharing plans by interagency regional panels. Where necessary, the panels refined these indicative rules to reflect local circumstances.

The macro approach combined existing data with a risk management framework to explicitly manage the trade-offs required to develop water sharing plans. The Peel IRP classified each of the Peel unregulated water sources as high, medium or low on the basis of their instream values, and then determined the risks to these values. A comparison was then made against community dependence. The risk and value matrix summaries for each water source are included in Appendix 10.

Exceptions to generic classification approach

It is important to note that the matrix approach was used as an 'indicative tool' to develop initial classifications. While these classifications guided the water sharing rules, a major role of the Peel IRP was to use the local knowledge of its members to check whether these classifications were realistic. Amendments to both the classifications and the management rules were based on local and technical knowledge of the water sources. In addition, the approach did not include some information (e.g. extraction for town water supplies) which was considered later by the Peel IRP. There were no changes to the classifications of water sources made by the Peel IRP; however there were

[6] Refer www.water.nsw.gov.au for the most recent version of the manual

refinements to the indicative access rules both as a result of the IRP's expertise and in response to input from stakeholders during consultation.

Water sharing rules

Protecting environmental values

In-stream value is the value of retaining water in a river. Three different types of values contribute to in-stream value: ecological (intrinsic), economic (non-extractive use) and place (cultural) values. Instream value was used in two ways in developing the plan: first, to identify high conservation value areas which are protected in the plan and, secondly, to assess the risk to instream values. Table 12 identifies the high instream values considered in setting the access and dealing rules for of the unregulated water sources of the Peel Valley.

Table 12: Instream values for unregulated water sources in the Peel Valley

High Instream Values	Chaffey	Goonoo Goonoo Creek	Upper Peel River Tributaries	Lower Peel River Tributaries	Cockburn River
Instream value overall	High	Low	High	Med	High
Threatened fish species	2	2	2	3	3
Threatened frog species	5	1	5	1	5
Threatened bird species	3	3	3	3	3
Threatened reptile species				1	1
Other threatened fauna	1	1	1	1	1
Threatened wet flora species			1		
Endangered ecological communities	1	1	0	1	1
Endangered populations	1		1		1
Naturalness	High				
Diversity	High	High	High	High	High
Rarity			High		High
Non-extractive value	High				

Key environmental assets identified in the unregulated water sources are protected by the dealings and access rules. Water sources with high instream values have indicative access rules designed to protect instream values and dealings rules (trade) to encourage extraction to shift from areas of high environmental impact to areas of lower impact.

Managing extraction

The Namoi Unregulated Rivers Extraction Management Unit (EMU) which includes the five unregulated water sources within the Peel Valley and all the other unregulated water sources in the Namoi Water Management Area was established by the *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*. Extractions from all unregulated water sources within the Namoi Water Management Area are therefore managed collectively under an LTAAEL that applies to the Namoi Unregulated Rivers Extraction Management Unit.

The long-term average annual extraction limit for the Namoi Unregulated Rivers Extraction Management Unit is equal to the total of the estimated annual extraction of water averaged over the period from July 1993 to June 1999 for those entitlements issued under Part 2 of the *Water Act 1912* in this Unit, immediately prior to the commencement of Part 2 of Chapter 3 of the *WMA 2000* for this

Unit; plus an estimate of annual extraction of water under domestic and stock rights and native title rights in this Unit, at the commencement of the plan.

A growth in use response will be triggered if average annual usage over three years from all water sources within the Namoi Unregulated Rivers Extraction Management Unit, exceeds the LTAAEL by more than five per cent. This is as established in the *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*.

Note that as a result of submissions received during public exhibition, existing Part 2 *Water Act 1912* (unregulated) licences within the Wallamore Anabranch management zone will be converted to aquifer (general security) access licences on commencement of the plan. This licence conversion recognises that historical sumps and excavations from the Anabranch have resulted in what are essentially large open 'wells' that take alluvial groundwater driven by flows in the adjacent Peel Regulated River. As such, the estimated annual extraction averaged over the period from July 1993 to June 1999 for these licences has been excluded from the LTAAEL for the Namoi Unregulated Rivers EMU. Note that this estimate of annual extraction has been included in the LTAAEL for the Peel Alluvium Water Source.

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 overall debit.

Unregulated rivers have enormous variation in annual flow volumes between years. As such unregulated river access licence account management will operate under three year accounting rules, subject to compliance with the daily access rules. Available water determinations combined with the carryover will enable licence holders to use up to twice their water allocation in a year provided that over a consecutive three year period they do not exceed the sum of their water allocations for those three years. 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 MLs), or 3 ML 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 ML 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 ML), or 1 ML per unit share (where share component is expressed in unit shares).

Example of unregulated river access licence three year accounting rules

For an unregulated river access licence holder with a share component of 50 shares, an example of three year accounting is as follows:

Year 1 - AWD made of 2 ML per unit share credits 100 ML into the account at the start of year 1.

- 0 ML extracted for that year
- 100 ML in account at end of year

Year 2 – AWD made of 1 ML per unit share credits 50 ML into the account at the start of year 2.

- Carryover from year 1 = 50 ML (only 50 ML can be carried over as carryover is limited to 1 ML/unit share. The remaining 50 ML is forfeited)
- Account balance =100 ML (which is available for extraction in this year)
- 50 ML extracted in this year
- 50 ML in account at end of year

Year 3 - AWD made of 1 ML per unit share credits 50 ML into the account at the start of year 3.

- Carryover from year 2 = 50 ML (50 ML can be carried over as the limited is 1 ML/unit share)
- Account balance =100ML (which is available for extraction in this year)
- 100 ML extracted in this year (which is also the maximum that can be extracted in this year i.e. Twice the allocation for the year which is 2x 50ML = 100 ML)
- 0 ML in account at end of year

Year 4 - AWD made of 1 ML per unit share credits 50 ML into the account at the start of year 4.

- Carryover from year 3 = 0 ML (none available in the account at end of year 3 to carry over)
- Account balance = 50 ML (none of which is available for extraction as the maximum extraction over three years is the sum of water allocations accrued ,(AWDs) in those 3 years which in this example is 150 ML and this was extracted in year 2 and 3 so no extraction can occur in year 4)
- 0 ML extracted in this year
- 50 ML in account at end of year (this can be carried over into year 5)

Available water determination

The maximum available water determination (AWD) for a water source is used to manage growth in extractions, above the long-term average annual extraction limit i.e. if growth occurs then the maximum AWD will be reduced to respond to less than 1 ML/unit share.

AWDs are primarily used to credit water into a licences water allocation account. Specific purpose access licences such as domestic and stock or local water utility access licences, will generally always receive 100 per cent of their share component, although in years of exceptional drought, daily access rules may limit extraction so that the full annual entitlement cannot be realised.

The AWD for unregulated river access licences will be one megalitre per unit share, unless a growth in use response is required. However for the first year of the plan, a one-off announcement of 2 ML/unit share will be made to allow the operation of three year accounting rules described above.

Access rules

In reviewing the indicative rules proposed for each water source as a result of the classification process, the Peel IRP used their local knowledge and expertise of agency staff to refine access and trading rules where appropriate. Any amendments made were based on factors such as:

- availability of infrastructure (e.g. river gauges)
- availability of management systems (e.g. Telemetered gauging stations)
- existing management rules (e.g. existing licence conditions or Water Users' Association rostering rules which distribute low flow access amongst licensed users), or
- whether the heterogeneity of flow regimes within different areas of a water source required differing management rules for those sub-areas.

A summary of the access rules and any amendments made by the Peel IRP from the indicative rules is shown in Table 13. Once the proposed water sharing rules were determined, a check was undertaken to ensure that the rules are consistent in their application and practical to implement across the Valley.

The Peel IRP also considered the ability to effectively manage and monitor flow in a water source. For example, where there is no flow gauging station, they assessed the risks to the water source, and in

some cases recommended that a new gauge be installed as part of the Hydrometric Network Expansion Project for high risk or highly stressed water sources.

For most water sources, the access rules reflect an attempt to ensure consistency between existing licence conditions, so that they are applied uniformly across the management zone, or within a section of the management zone, where there is inadequate gauging to implement the rule.

Cockburn River access rules

The current *Water Act 1912* cease-to-pump condition for unregulated licences in the Cockburn River Management Zone is 0.5 m at Kootingal gauge on the Cockburn River, with occasional access permitted below this height on application to the NSW Office of Water.

The NSW Office of Water has recently concluded a 12 month cease-to-pump trial in the Cockburn River. This trial was conducted on the need to better define access to flows below 0.5m, in preference to making each individual assessment on application. Following the completion of this trial, a notice signifying the intention to amend licence conditions was issued to all access licence holders within the proposed Cockburn River Management Zone.

At the conclusion of the trial and upon assessing all submissions, the NSW Office of Water proposed to amend the access condition from 0.5m to 0.35m at Kootingal gauge on the Cockburn River.

The Ministers Peel Advisory Group advised Minister Costa's Office that it is not appropriate for the Peel Valley WSP to incorporate the access conditions from the recent cease-to-pump trial, on the Cockburn River as they believe the new conditions are too stringent, even though they are significantly lower than the previous conditions.

The macro planning indicative rule suggests that a cease to pump be applied when the presence of water is not observed at the end of the water source or when a specific flow relating to in-stream values is reached.

The draft Peel WSP proposed that a cease-to-pump be applied in the Cockburn River Management Zone when flows are less than 0.25m at Kootingal or there is no visible flow at the pump site.

A Minister's note was included in the draft exhibited plan to draw attention to this issue and to encourage stakeholders to make submissions during the public exhibition period.

Submissions received during public exhibition requested that the cease-to-pump level for the Cockburn River Management Zone be lowered from 0.25m to 0.2m at Kootingal Bridge and that a second flow reference point, at a rock bar 700m upstream from the Cockburn River confluence with the Peel River be included in lieu of the 'visible flow at the pump site rule' i.e. users must cease-to-pump if there is less than 0.2m of flow at the Kootingal gauge or no visible flow at the rock bar – 700m upstream for the Cockburn River confluence with the Peel River.

Anecdotal reports received during the public exhibition period through the Fisheries Conservation Unit of Industry and Investment NSW suggests that the current rate of water extraction in the Cockburn River Management Zone is causing populations of the Eel-tail Catfish (a recently determined threatened species) to abandon their nests. These reports were unable to be validated.

The Peel IRP could see no evidence to support a change in the cease-to-pump level from 0.25m to 0.2m at Kootingal gauge, especially in light of the ground already conceded by dropping the cease-to-pump level from 0.5m to 0.25m, over the past few years. Local knowledge suggests that even flows at 0.25m will not provide connection between all pools on the Cockburn River, although it was noted that this does not imply that there is no sub-surface flow into and out of pools. Further, the Eel-Tail Catfish, known to occur in the Cockburn River, has recently been determined as a threatened species and the panel is cognisant that a lower cease-to-pump may adversely impact upon this species.

Further, the Ministers Peel Advisory Group supported water users' claims and advised from their local knowledge, that the most appropriate location for a second flow reference point is the rock bar 700m upstream of the Cockburn Rivers confluence with the Peel River. The plan stipulates that the second flow reference point for the Cockburn River management zone is at the rock bar 700m upstream of the Cockburn Rivers confluence with the Peel River.

Moore Creek access rules

Prior to 2000, *Water Act 1912* licence conditions for unregulated licences in Moore Creek required them to cease-to-pump when the presence of water was not observed at Davidson's Lane Causeway. Davidson's Lane Causeway is located below the Moore Creek Caves where surface water flows have reduced dramatically i.e. a visible flow at Davidson's Lane is not very common.

The current *Water Act 1912*, access conditions for unregulated licences in Moore Creek have been divided into two reaches, upstream and downstream of Slippery Rock. Licences upstream of Slippery Rock must cease-to-pump when there is no visible flow in Moore Creek at either the road crossing located at Slippery Rock or the Scout Camp, whereas licences downstream of Slippery Rock must cease-to-pump when there is no visible flow in Moore Creek at Slippery Rock.

The NSW Office of Water has recently (2008) concluded a flow condition review for *Water Act 1912* licences within the proposed Moore Creek Management Zone. The review investigated the decision to amend licence conditions in October 2000. Note that climatic conditions did not enable a significant variation in flows to assist in assessing the appropriateness of flow condition locations until early 2008. The NSW Office of Water decided to delay any further amendments to licence conditions as a result of this review until a WSP incorporating this water source was developed.

The macro planning indicative rule suggests that a cease-to-pump be applied when the presence of water is not observed at a specific site or a specific flow rule relating to in-stream values. Local knowledge suggests that continuous flow along the entire length of Moore Creek occurs only rarely with groundwater inflow from the alluvium sustaining intermittent minor flows between such events.

The draft exhibited Peel WSP included the current *Water Act 1912* licence conditions and further proposed that licences must also cease-to-pump when there is 'no visible flow at the pump site'. A number of submissions as a result of public exhibition of the draft Peel WSP were received in regard to water access in Moore Creek, in particular, impacts on basic rights access for downstream users. In response to submissions, the Peel IRP endorsed the NOW proposal that the draft Peel WSP be amended so that licences:

1. upstream of Slippery Rock must not commence-to-pump in the first 24hrs of visible flow in Moore Creek at Slippery Rock and must Cease to Pump when there is no visible flow in Moore Creek at either the Scout Camp, or Slippery Rock.
2. downstream of Slippery Rock must Cease to Pump when there is no visible flow in Moore Creek at Slippery Rock, and
3. in Moore Creek upstream of Slippery Rock are exempt from the 'visible flow at the pump site' rule.

The Peel IRP considered that these amendments will allow for the replenishment of pools downstream of Slippery Rock, whilst maintaining reasonable access to flows for upstream irrigators. The pools downstream of Slippery Rock provide refugia habitat for aquatic species and important access to domestic and stock water under basic landholder rights. The Peel IRP has also recommended the installation of a stream gauge at Slippery Rock to assist in the implementation of the 24hr flow rule for licences upstream of Slippery Rock.

The Minister's Peel Advisory Group advised the Minister that some water users in the Moore Creek Valley do not support these rules as they still do not consider that they provide access to basic landholder rights downstream of Slippery Rock. In response to these concerns, an amendment clause was added to the plan to allow the refinement of access conditions in Moore Creek Management Zone should monitoring information collected and analysed during the life of the plan indicate that this is required.

Access to very low flow

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

- domestic supply through a domestic and stock access licence (first 3 years of the WSP only),
- town water supply, until major augmentation of the scheme's infrastructure occurs,
- fruit washing,
- cleaning of dairy plant and processing equipment for the purpose of hygiene,
- poultry washing and misting, or
- cleaning of enclosures used for intensive animal production for the purposes of hygiene.

The plan provides an estimate of the water requirements for domestic and stock basic landholder rights within each of the water sources, noting that these rights may increase during the life of the plan. The plan cannot limit or restrict these rights, but the *WMA 2000* itself provides the Minister with the authority to place restrictions on basic landholders rights, through the reasonable use guidelines that are currently under development by the NSW Office of Water.

Note that access to the very low flow class for domestic and stock (domestic only) access licences for the first 3 years of the plan is the result of current State policy, driven by water planning in coastal regions. The applicability of this rule to inland NSW is the subject of ongoing policy development; consequently, the plan may be amended to allow access to the very low flow class for all categories of 'domestic' purpose licences over the term of the plan.

Construction of dams

Note that this plan does not prohibit the construction of on-farm storages (turkey's nests) which will not intercept overland flow i.e. dams that are not rainfall runoff harvesting dams.

Rainfall runoff harvesting dams

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

In river dams

The plan specifically prohibits a water supply work approval for a new in-river dam being granted on a 3rd or higher order stream in these water sources. This has been recommended due to the impact on

fish movement and downstream flows. Licences that nominate existing water supply works approvals for in river dams and extract water from their in river pools will not be subject to the cease to pump for the water source or management zone.

Trading of access entitlement

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

The Peel unregulated water sources are part of the Namoi Unregulated Rivers Extraction Management Unit (EMU) as defined in the *Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek Water Sources 2003*. Dealings under 71R and 71 T of the *WMA 2000* into and out of Phillips Creek, Mooki River, Quirindi Creek, and Warrah Creek water sources within the Namoi Unregulated Rivers EMU are allowed, with a conversion factor applied provided that the water sharing plan for the other water source allows for the trade to occur. Similarly, once water sharing plans are established across the remainder of the unregulated water sources in the Namoi Water Management Area, trading opportunities may exist between all of these water sources, provided that the dealing rules in their respective plan allow for trade into the water source.

The indicative rules for trades into water sources and within the Peel Valley unregulated water sources were determined using the macro classification approach which in many cases, due to the high instream values, resulted in recommendations allowing no trades into the water source. Both the Lower Peel Tributaries and Goonoo Goonoo Creek water sources allow trade from another water source into specified management zones, as long as there is no net gain of entitlement volume held within the management zone. Trading within each water source is permitted except where management zones restrict trades to protect environmental assets. A summary of the trading rules for the unregulated water sources is included in Table 14. The net socio-economic affect of these rules compared to current rules is considered to be positive, as they provide new trading opportunities between the Peel unregulated water sources and other water sources within the Namoi Unregulated Rivers Extraction Management Unit.

A policy on trading into high flows is currently being developed for inland areas. The plan enables this to be implemented, pending the outcomes of the policy development process.

Table 13: Access rules for unregulated water sources in the Peel Valley

Water source / Management zone	Revised classification /stream type	Goal for access rules	Indicative rules (Cease to Pump = CtP)	Peel IRP recommended rule	Basis
Chaffey Peel River	G Gaining	Stop any further degradation of instream values.	CtP to maintain a specific depth of flow at end of water source. Consider specific flow rule for instream values. CtP to allow flows at or below the 95th percentile to pass end of water source (specified by height or volume). Consideration of special cases.	CtP based on 95%ile in Peel River at Taroona gauge - equal to or less than 2 ML/day and CtP when there is no visible flow at the pump site.	As per indicative rule to allow 95%ile at EOS. The existing access rules on the identified licences in this management zone are not considered adequate to protect instream values.
Chaffey Chaffey Tributaries				CtP when there is no visible flow at the pump site.	Inadequate gauging so local pump site rule recommended[1]. This management zone has few licences with low levels of extraction limiting the risk to other users and the environment. Limited trading within the water source was also recommended so not to further increase extraction preventing any increased risk to instream values that occur in this upstream management zone that has higher instream values.
Goonoo Goonoo Creek Downstream Boiling Down Creek	G Highly Connected	Stop any further degradation of instream values.	CtP for licences upstream of a strategic site once water disappears at the site. CtP when water is not observed at pump site, or Specific flow rule for instream values. Consideration of special cases.	CtP based on zero flow at Timbumburi gauge (equal to 0.55m on Timbumburi gauge @ commencement of the WSP) and CtP when there is no visible flow at upstream Calala Lane bridge	CtP in draft plan was based on 95%ile flow at Meadows Lane gauge, this has been changed to no flow at Timbumburi gauge in response to submissions received highlighting that Meadows Lane gauge is not a good location to measure low flows in the creek. The visible flow at pump site rule for this management zone in draft plan is not required as upstream and downstream gauges are specified
Goonoo Goonoo Creek Upstream Boiling Down	G Gaining		CtP to maintain a specific depth of flow at end of water source. Consider specific flow rule for instream values. CtP to allow flows at or below the	CtP when there is no visible flow at the pump site.	Inadequate gauging so local pump site rule recommended[1]. This management zone has few licences with low levels of extraction limiting the risk to other users and the environment. Limited trading within the water source was also recommended so not to

Water source / Management zone	Revised classification /stream type	Goal for access rules	Indicative rules (Cease to Pump = CtP)	Peel IRP recommended rule	Basis
Creek			95th percentile to pass end of water source (specified by height or volume). Consideration of special cases.		further increase extraction preventing any increased risk to instream values that occur in this upstream management zone that has higher instream values.
Upper Peel River Tributaries Dungowan Creek	B Highly Connected	Rules to encourage extraction to shift from high environmental impact to lower impact	CtP once the presence of water is not observed at the end of water source, or Specific flow rule relating to instream values.	**Upstream reach:** CtP when there is no visible flow at Thortons Road Bridge and CtP when there is no visible flow at the pump site. **Downstream reach:** CtP to when there is no visible flow at Thortons Road Bridge and CtP when there is no visible flow at the pump site. Amend the visible flow at the pump site rule to zero flow at end of system if gauge installed in lower section of Dungowan Creek.	CtP in draft plan was based on visible flow at the pump site with an amendment clause to change to no flow at the end of Dungowan Creek if a gauge is installed. In response to submissions received claiming that visible flow at the end of Dungowan Creek is not representative of flows in Dungowan Creek upstream of Thortons Road bridge, this management zone has now been split into 2 reaches, upstream and downstream of Thortons Road bridge. Inadequate gauging so local pump site rule recommended for licences downstream of Thortons Road bridge1. Until such time as a gauge is installed.
Upper Peel River Tributaries Duncans Creek and Other Tributaries	B Gaining		CtP to maintain specific depth of flow at end of water sources. Specific flow rule for instream values, and / or CtP to allow flows at or below the 90th percentile to pass end of water sources (specified by height or volume). Environment to receive high proportion of daily flow (i.e. 70%)	CtP when there is no visible flow at the pump site.	Inadequate gauging so local pump site rule recommended[1]. This management zone has few licences with low levels of extraction limiting the risk to other users and the environment. Limited trading within the water source was also recommended so not to further increase extraction preventing any increased risk to instream values that occur in this upstream management zone that has higher instream values

Water source / Management zone	Revised classification /stream type	Goal for access rules	Indicative rules (Cease to Pump = CtP)	Peel IRP recommended rule	Basis
Lower Peel River Tributaries Moore Creek	E Losing	Rules to encourage extraction to shift from high environmental impact to lower impact	No pumping from pools where there is no visible inflow and outflow. CtP to maintain a visible flow at a specific site , or Specific flow rule for instream values.	**Upstream of Slippery Rock** CtP when there is no visible flow in Moore Creek: • at the road crossing at the Scout Camp, or • at Slippery Rock located at Daruka Recreation Reserve Commence to pump only once there has been 24 hours visible flow at Slippery Rock Amend the visible flow rule at Slippery Rock to zero flow at Slippery Rock if a gauge is installed at this location. **Downstream of Slippery Rock** CtP when there is no visible flow in Moore Creek: • at Slippery Rock located at Daruka Recreation Reserve and • no visible flow at pump site. Amend the visible flow rule at Slippery Rock to zero flow at Slippery Rock if a gauge is installed at this location.	The addition of a commence to pump condition after 24hrs of visible flow at Slippery Rock for licences upstream of Slippery Rock is the result of an extensive licence condition review.. This condition will allow for some replenishment of Pools downstream of Slippery Rock whilst maintaining reasonable access for upstream users. The visible flow at pump site rule for licences upstream of Slippery Rock in draft plan is not required as upstream and downstream gauges are specified.
Lower Peel River Tributaries Lower Peel Tributaries	E Gaining		CtP to maintain a specific depth of flow at end of water source. Special flow rule for instream values. CtP to allow flows at or below the	CtP when there is no visible flow at pump site.	Inadequate gauging to adopt a 95th percentile Cease to Pump at the end of system so local pump site rule recommended[1].

Water source / Management zone	Revised classification /stream type	Goal for access rules	Indicative rules (Cease to Pump = CtP)	Peel IRP recommended rule	Basis
			95th percentile to pass end of water source (specified by height or volume).		
Cockburn River Cockburn River	B Highly Connected	Rules to encourage extraction to shift from high environmental impact to lower impact.	CtP once the presence of water is not observed at the end of water source, or Specific flow rule relating to instream values.	CtP at 0.25m at Kootingal Gauge and CtP when there is no visible flow at rock bar, 700m upstream of the confluence of the Cockburn and Peel Rivers. Amend the visible flow rule at rock bar rule to zero flow at the rock bar if a gauge is installed at this location.	Recommended based on the indicative rule identified through the classification process and a recent licensing review undertaken by NSW Office of Water on access conditions in the Cockburn [3] The visible flow at pump site rule for this management zone in draft plan is not required as upstream and downstream gauges are specified.
Cockburn River Cockburn River Tributaries	B Gaining		CtP to maintain specific depth of flow at end of water sources. Specific flow rule for instream values, and / or CtP to allow flows at or below the 90th percentile to pass end of water sources (specified by height or volume). Environment to receive high proportion of daily flow (i.e. 70%).	CtP when there is no visible flow at pump site.	Inadequate gauging to adopt a 90th percentile Cease to Pump at the end of system given the proximity of the gauges to the extraction points, so local pump site rule recommended[1]. This management zone has very few licences with low levels of extraction limiting the risk to other users and the environment. Limited trading within the water source was also recommended so not to further increase extraction preventing any increased risk to instream values that occur in this upstream management zone with higher instream values.

1: The installation of new gauges is being prioritised across the State. In these instances access rules based on visible flow at the pump site is recommended as no other suitable flow reference points other than the pump site are currently available.

3: See “Cockburn River access rules” for further information.

Table 14: Dealings (trading) rules for Peel unregulated water sources

Water source (WS)	Management zone (MZ)	Revised classification	Indicative rule	Peel IRP recommended rule (trade within the water source)	Basis	Peel IRP recommended rule (change of water source) (i.e. Trades into these water sources)	Basis
Chaffey	Peel River	A	Trades are not allowed into or upstream of water source	Trade permitted into MZ	Limited trading within water source so not to further increase extraction in upstream tributaries with higher instream values.	No trade in	No trade into water source to prevent increased risk to instream values and encourage trade out.
	Chaffey Tributaries			No trade into MZ			
Goonoo Goonoo Creek	Downstream Boiling Down Creek	I	No net gain, trades are allowed into or upstream of water source	Trade permitted into MZ	Limited trading within water source so not to further increase extraction in upstream tributaries with higher instream values	No net gain	Downstream MZ rules to prevent increased risk to instream values and protect existing users. No trade into upstream MZ so not to further increase extraction with higher instream values.
	Upstream Boiling Down Creek			No trade into MZ		No trade in	
Upper Peel River Tributaries	Dungowan Creek	C	Trades are not allowed into or upstream of water source	No trade into MZ	Limited trading within water source so not to further increase extraction in Dungowan Creek and other areas with higher instream values.	No trade in	No trade into water source to prevent increased risk to instream values and encourage trade out.
	Duncans Creek and Other Tributaries			No trade into MZ			
Lower Peel River Tributaries	Moore Creek	F	No net gain, trades are allowed into or upstream of water source	No trade into MZ	Limited trading within water source so not to further increase extraction in some tributaries that already have extraction issues impacting on other users and the environment.	No trade in	No net gain trade into water source to prevent increased risk to instream values and protect existing users.
	Lower Peel Tributaries			Trade permitted into MZ		No net gain	
Cockburn River	Cockburn River	C	Trades are not allowed into or upstream of water source	Trade permitted into MZ	Trade downstream for preservation of ecological value in the top of the watercourse and security of reliability to existing users.	No trade in	No trade into water source to prevent increased risk to instream values and protect existing users.
	Cockburn River Tributaries			No trade into MZ			

Peel Alluvium

Background

The Peel Alluvium includes the alluvial aquifers occurring adjacent to the Peel Regulated River and the unregulated Attunga Creek, Moore Creek, Cockburn River, Dungowan River, Duncans Creek, and Goonoo Goonoo Creek. These alluvial aquifers are contained within the alluvial deposits comprising a wide range of sediment derived materials. The Peel Alluvium is shallow, and is generally not much greater in total thickness than 15m. It consists of gravels, sands, clays, silts and cobbles up to 150 mm in diameter. The top one to four metres is generally clay rich with the major water bearing sediments underlying this clay layer (O'Rourke, 2009). In the alluvium of the unregulated rivers, groundwater is largely derived from rainfall. The Peel Valley experiences variable rainfall over time and groundwater levels in these areas of alluvium respond rapidly to climatic conditions. In the unregulated alluvial management zones, the storage is limited and when the groundwater level falls below the bed of the river, the river runs dry. Attunga Creek, Moore Creek and Duncans Creek are ephemeral. Goonoo Goonoo Creek, Dungowan Creek and the Cockburn River have more persistent flows (O'Rourke, 2009).

Areas of the Peel Alluvium adjacent to the Peel, Cockburn and Dungowan Rivers as well as Goonoo Goonoo Creek have been classified as being 'highly connected' to surface waters for planning purposes whereas areas of the Peel Alluvium adjacent to Duncans, Attunga and Moore Creek have been classified as 'less highly connected' to surface waters for planning purposes (refer 'Managing surface water and groundwater connectivity').

Hydrogeological modelling

A conceptual groundwater model was developed to evaluate the effect of pumping on highly connected regulated and unregulated rivers. Scenarios were run to identify how sensitive the model area was to changes in aquifer properties, pumping rates, bore distances from the river and recharge rates. A fully calibrated model (requiring observed data and more accurate aquifer properties) for this area has not been developed to-date.

The conceptual model was developed using Groundwater Vistas 4 / Modflow2000 platform and is represented by a single layer bounded on one side by an impermeable slope, on the opposite side by the river and with an impermeable layer below. The model area was divided into a spatial grid of constant elevation and the hydraulic head calculated for each cell and each stress period, over a total period of 365 days.

This hydrogeological model was used as a tool to evaluate impacts of an average annual pumping regime on the Peel Regulated River (Broadstock, 2009). A long-term pumping scenario at a rate equivalent to that permitted by the long-term average annual extraction limit for this water source shows that 49% of water pumped can be traced from the Peel Regulated River. This analysis is used as the basis for establishing a link between the available water determination of the Peel Regulated River and the Peel Alluvium (see 'available water determinations').

Key observations from the hydrogeological analysis

The results of the highly connected aquifer model show that:

- the main source of groundwater pumped under an average annual pumping regime effectively comes from the regulated river,
- up to 85 per cent of recharge to the unregulated alluvium is consumed through vegetation as evapotranspiration,
- increasing the pumping rate increases the impact on the river, and

- increasing the distance of the pumping bore from the river decreases the impact on the river (Broadstock, 2009).

Boundary definition

Peel Alluvium is found adjacent to the Peel Regulated River and numerous unregulated rivers within four of the five Peel Valley unregulated water sources. For the purposes of managing connectivity, boundaries between the alluvium connected to the Peel Regulated River and that connected to the unregulated rivers/creeks have been established, creating management zones. These management zones for the Peel Alluvium have been defined by closing off the 'neck' of the unregulated alluvial areas using cadastral boundaries, and where required, bore hydrographs to estimate hydraulic gradients. Note that the collective local knowledge of the Minister's Peel Advisory Group and the advice they provided during consultation resulted in a revision to the boundary between the Cockburn and the Peel alluvial management zones. The adopted management zone boundaries are described and shown in the figures contained in Appendix 11.

Water sharing rules

Managing extraction

Setting the long-term average annual extraction limit

In highly connected river - aquifer systems, extraction in one water resource area can reduce water availability in the other. The surface waters in these systems tend to be groundwater dependent and are most vulnerable during dry periods. Surface water extractions within the NSW's portion of the Murray-Darling Basin have been capped at those volumes that would have occurred under 1993/94 levels of development and management rules, following NSW becoming a signatory to the Murray-Darling Basin Ministerial Council Agreement, in 1995. The Murray-Darling Basin Ministerial Council Cap does not apply to groundwater. Subsequently, NSW has resolved that the long-term average annual extraction limit (LTAAEL) for highly connected and alluvial groundwater resources within NSW's portion of the Murray-Darling Basin, shall be set equal to current average usage. Any extraction beyond this level will result in additional impact on groundwater dependent ecosystems and other users of these connected water resources.

The installation of meters on all bores in the Peel Valley was not required until 1997/1998 and so it is reasonable to expect that there was a lag time before all meters were installed. Therefore, to remove any bias resulting from incomplete metering, any usage registered as zero in all years prior to activation has now been excluded when calculating average usage for the water source. Further, to address stakeholders' concerns that extractions during the period used in the initial calculation of the LTAAEL for the Peel Alluvium in the draft plan (1997/98 – 2007/08) was not fully representative of long-term climatic variability, the LTAAEL for the Regulated River has been matched to the IQQM simulated diversions to determine a period of time which most closely represents the long-term average viz.1998/99 to 2003/04. The same time period has now been used to define the appropriate historical data to obtain our best estimate of the current, climatically representative LTAAEL for the Peel Alluvium.

Submissions received during public exhibition also suggested that usage had been impacted by pumping restrictions that were in place during the metered period. However the Peel IRP found no apparent impact of the pumping restrictions in place between 2001/02 and 2005/06, with the highest extraction occurring during this period. The maximum recorded annual usage from the Peel Alluvium of 10,337 ML occurred in the 2002/03 water year, representing only 20 per cent of total entitlement volume.

The LTAAEL for the Peel Alluvium is therefore equal to 9,344 ML/year, defined by the sum of:

- average annual historical usage (1997/98-2003/04) from bores metered by State Water (excluding zero usage years prior to activation); plus
- an estimate of annual usage averaged over the period July 1993 to June 1999 from the *Water Act 1912* licences within Wallamoore Anabranch licences; plus
- an estimate of average annual usage by the current utilisation of basic landholder rights; plus
- an estimate of average annual usage from perpetual bores (currently with no volumetric entitlement).

Managing extraction to the LTAAEL

Extractions are managed to the LTAAEL, should growth in extraction above the LTAAEL be assessed to have occurred, an appropriate growth in use response will be taken. An alternate growth in use response to that generally applied to other groundwater sources is being applied for the Peel Alluvium. This is based on the State-wide policy, to set the LTAAEL for highly connected aquifer systems within the Murray-Darling Basin at current average usage. Therefore, the growth in use response described in the plan is one which allows for the 'peaks' and 'troughs' of usage above and below the average, over the period from which the LTAAEL has been defined, to be replicated. As such in the Peel Alluvium Water Source, the response is triggered if the average annual usage over a period of five years exceeds the LTAAEL by more than 15 per cent.

Note that in the draft exhibited plan it was proposed that the growth in use response would be triggered when the five-year rolling average usage was 20 per cent greater than the LTAAEL. With the review of usage data since public exhibition that defined the LTAAEL, the analysis was reviewed and this trigger was reduced to 15 per cent on the basis that the maximum deviation due to climatic variability in the metered period was significantly reduced and that the final estimate was refined to ensure it was climatically representative of the long term.

Mitigating the impact of a growth in use response on highly active users

In order to respond to a small breech in LTAEEL in the Peel Alluvium, if a purely mathematical approach was adopted the maximum AWDs would need to be reduced significantly, in order to return extractions back to the LTAAEL because there is typically a low level of utilisation of these licences. Since AWDs must be made uniformly across a licence category, a significant reduction in the maximum AWD would impact disproportionately on users who use a high proportion of their entitlement. In order to allow these licensees who use a higher proportion of their entitlement to adjust to these reduced maximum AWDs should a growth in use response be required, the Peel IRP endorsed the NOW recommendation that Supplementary Water Access Licences (SWALs) be issued with entitlements based on the *Water Act 1912* licence history of use. This history of use has been determined over the same period used to define the LTAAEL. The licences that would be issued with a SWAL and the history of use that will make up the share component of each of these licences are included in a schedule to the plan. These SWALs will only be issued should a growth in use response require AWDs to be reduced below 0.8 ML/share. The decision was made not to issue these licences at the start of the plan as this would then require licence holders to pay associated licence fees. Furthermore, a growth in use response may never be required and therefore creating, issuing and managing these licences within the licensing database would create potentially unnecessary work for NOW. The plan is structured so that amendments can be made that allow for these licences to be issued during the life of the plan if required.

There are two subcategories of SWALs, supplementary water access licences and supplementary water (general security) access licences, as there are two different methods of calculating their AWDs,

depending on location i.e. in the alluvium associated with the unregulated or regulated rivers, respectively. SWALs will not be tradable and will be cancelled (if issued at any time during the plan) in the last year of the plan (note that this is in year 10 under the existing *WMA 2000*). AWDs will only be made for these SWALs if there is a growth in use response between year 1 and year 9 of the WSP that reduces the maximum AWD below 0.8ML/unit share, in which case the AWD's will be determined depending on the year of the plan the growth in use response occurs:

- for supplementary water access licences between 0.2 and 0.9 ML/unit share, and
- for supplementary water (general security) water access licences [(0.5 x SWAL AWD) + {(0.5 x SWAL AWD) x (Peel Regulated River (general security) AWD)}].

AWDs will then be made to aquifer access licences and aquifer (general security) access licences so that the total AWDs for both these licences and the associated SWALs does not exceed the total available resource or maximum AWD, whichever is the lesser. For the SWALs issued as a growth-in-use adaptation strategy, the AWD will be gradually reduced in subsequent years after they have been issued.

The supplementary water access licences and supplementary water (general security) access licences issued must nominate the same work and use approvals as the associated aquifer access licence or aquifer (general security) access licence, and if issued the water pumped through these works will be debited first from the SWAL and then the aquifer access licence.

Managing connectivity

Consistent with State-wide policy, extraction from highly connected aquifer access licences that relate more closely to the Peel Regulated River will be managed annually i.e. via AWDs (see below 'available water determinations'), whilst highly connected aquifer access licences that relate more closely to Peel unregulated water sources will be managed daily, i.e. linked to unregulated river daily access rules (see below 'access rules'). Extraction from less connected aquifer access licences will not be linked to annual or daily surface water management rules.

The Peel IRP recommendation, included in the draft plan placed on public exhibition, was to treat the entire Peel Alluvium water source as being highly connected. Many submissions were received during public exhibition stating that it was inappropriate for the alluvium adjacent to the ephemeral streams to be treated as 'highly connected' because surface water flows only exist for a few short days after rain, hence groundwater pumping cannot significantly impact surface water flows. As such, additional analysis was undertaken to model flow duration of the streams adjacent to the Peel Alluvium to review the level of surface and groundwater connectivity for each of the alluvial management zones.

The results of the review showed that all management zones of the Peel Alluvium water source are connected; however some unregulated reaches do not have sufficient flow duration to be classified as 'highly connected' under the definition. Therefore, the Peel IRP endorsed that the Peel Alluvium adjacent to the Peel Regulated River, Cockburn River, Dungowan Creek and Goonoo Goonoo Creek be classified as 'highly connected', while Peel Alluvium adjacent to Duncans Creek, Attunga Creek and Moore Creek be classified as 'less highly connected'.

As a result of submissions from public exhibition of the draft plan, the State Groundwater Panel endorsed, also supported by the Peel IRP, that groundwater supply works located within 40m of the high bank of an unregulated creek/river should receive the same rules as bores located outside 40m for inland groundwater sources. It was noted that there are a small number of licences that fall into this category and so the application of this rule would have a large socio-economic impact on those individuals affected, for minimal environmental gain.

Therefore, in the highly connected management zones of the Peel Alluvium Water Source adjacent to unregulated rivers/ creeks, surface water cease to pump rules will apply to all groundwater works

(both inside and outside 40m from the high bank of an unregulated river/creek) following a lag time, while in less highly connected management zones of the Peel Alluvium Water Source adjacent to unregulated rivers/ creeks, groundwater extraction will not be linked to the surface water rules i.e. no cease to pump for groundwater works in less highly connected management zones of the Peel Alluvium Water Source. Note the rule regarding no new works within 40m of the high bank of rivers/ creeks for highly and less highly connected areas remains unchanged, i.e. that there is to be no new works within 40m of the high bank of a river / creek.

Protecting environmental values

The plan protects environmental values in the Peel Alluvium by reserving a proportion of recharge to the aquifer and the water within the groundwater storage of the aquifer as planned environmental water.

Hydrogeological modelling of the Peel Alluvium acknowledges that significant volumes of recharge to the water source are either accessed and removed by vegetation via evapotranspiration or are discharged as base flows to rivers, providing access to other users in these systems. Discharge from the Peel Alluvium is sufficient to support perennial flows in the lower ends of the Cockburn River and Goonoo Goonoo Creek, providing lateral connectivity between pools in these river reaches. Setting the LTAAEL at current average usage protects and maintains environmental water in this water source. Estimated rainfall recharge to the Peel Alluvium is 20,120 ML/year (Broadstock, 2009), therefore with an LTAAEL of 9,344ML, 54% of this recharge is reserved as planned environmental water. This approach of reserving a proportion of the recharge as planned environmental water ensures that the aquifer storage cannot be drawn down over the long-term.

Note that although no high priority groundwater dependent ecosystems have been identified within the Peel Alluvium, there are many River Red Gum communities identified on the floodplain of the Peel River that may at times, be dependent on groundwater. Many of these plant communities occur on buried prior river channels that still have some longitudinal connectivity with the river. More research will better quantify their degree of dependence on the groundwater resource. Some research has been conducted into the identification of invertebrates that live within the alluvial aquifer; however, no specific water requirements for these invertebrates have been established at this stage.

Water supply works approvals

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

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

Groundwater flow modelling with representative aquifer parameters was used to calculate water balances and also provided water table drawdowns at different distances under a 24 hour/day

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

The standard set of distance criteria then went to the State Groundwater Panel for approval. This Panel, when negotiating the final rules, weighed the social, environmental and economic impacts of extraction on groundwater sources to set an acceptable level of drawdown near critical sites and other water users. Since then, the standard rules have been further tailored as a result of further development of macro plans.

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

In the plan, regional hydrogeologists made draft recommendations on rules for the plan which were then compared against the standard rules. The Peel IRP then made a final decision as to the rules to be recommended in the plan, striving to remain consistent with the standard rules where possible while being sensitive to any unique attributes of the groundwater sources in the Peel Valley.

The plan details rules applying to water supply work approvals including:

- rules for amending water supply work approvals for replacement groundwater works,
- rules to minimise interference between neighbouring water supply works,
- rules for water supply works located near contaminated sources,
- rules for water supply works located near sensitive environmental areas, including rules to protect base flows in rivers and groundwater dependent ecosystems,
- rules to for water supply works located near groundwater dependent culturally significant sites, and
- rules for the use of water supply works located within restricted distances.

Following public exhibition, the State Groundwater Panel discussed the application of distance criteria in recognition of comments received and issues raised during public exhibition of the draft Peel plan. The State Groundwater Panel agreed that there should be a clause that allowed the Minister discretion to grant/ amend a water supply work approval at a lesser distance if satisfied that the location of a water supply work at this distance will not compromise the intent of the rules. This clause will help cater for the local circumstances raised in a number of submissions received during public exhibition where it may be desirable for an approval to be granted at a lesser distance in recognition of existing property rights, and small lot sizes. These exemption clauses have been included in the plan, including the agreed position of the State Groundwater Panel that replacement bores be exempt from all distance criteria. By exempting replacement bores from all distance criteria, existing property rights are acknowledged and the issues associated with the distance criteria resulting in difficulties for replacement of existing water supply works are addressed. This is consistent with the policy principles for setting the LTAAEL in alluvial aquifers i.e. that no worse than current impacts should occur.

Refer to the plan for the distance rules applying to each groundwater source covered by the plan.

Carryover and water accounts

The Peel Alluvium water source has a small storage volume and a large entitlement to LTAAEL ratio. As such, aquifer (general security) access licences in the regulated alluvial management zone and all local water utility and domestic and stock access licences shall not be permitted to carryover entitlement from one year to the next and the maximum amount of water permitted to be taken from this water source from these licences in any one water year, is equal to the water allocation accrued in the water access licence account, for that water year.

In recognition of surface and groundwater connectivity and as a result of submissions received during public exhibition, the Peel IRP recommended that aquifer access licences in the unregulated alluvial management zones of the Peel Alluvium have the same accounting rules as the unregulated water sources, i.e. three year accounting. Available water determinations combined with carryover will enable these licence holders to use up to twice their water allocation in a year provided that over a consecutive three year period they do not exceed the sum of their water allocations for those three years. See the example of unregulated river access licence three year accounting rules included previously.

Available water determination

The maximum AWD for a water source is used to manage growth in extractions above the LTAAEL, if growth is assessed to have occurred, then maximum AWDs will be reduced to respond to this growth i.e. a maximum AWD of less than one ML/unit share. AWDs are primarily used to credit water into a licence's water allocation account. AWDs for the Peel Alluvium water source will be applied differently for the Peel Regulated River Alluvium management zone and the Peel Alluvium unregulated management zones.

Note that if AWDs for the Peel Alluvium are reduced below 0.8 ML/unit share as a result of a response to growth in use, Supplementary Water Access Licences (SWALs) will be issued to provide those users with a history of extraction, time to adjust to the new rules. Water will first be credited to these SWALs, with the remainder shared between aquifer access and aquifer (general security) access licences, such that extraction returns to the LTAAEL.

Peel Alluvium unregulated management zones

For those aquifer access licences in the Peel Alluvium unregulated management zones, AWDs will credit water annually to accounts.

The AWD for Peel Alluvium aquifer access licences is equal to:

> *Max AWD for Peel Alluvium aquifer access and aquifer (general security) access licences.*

This is a major change for the crediting of water to the accounts of unregulated alluvium users, which is currently related to the announced allocation for the Peel Regulated River. The plan AWD rules for these management zones should have a positive effect on affected users, as they are no longer linked to water availability in the Peel Regulated River system. Water availability in the management zones that are considered to be highly connected will now be based on daily access rules, linked to the relevant highly connected unregulated water source/ management zone (see below 'access rules in highly connected groundwater management zones'). In the less highly connected management zones of the Peel Alluvium water source access will not be related to either regulated or unregulated surface water. Even though the separation of the AWD from water availability in the Peel Regulated River may be a positive effect, linking access rules to surface water in the highly connected management zones may counter this for those affected licences, through the loss of pumping days (see 'Impact of Water Sharing Rules').

Peel Regulated River Alluvium management zone

To recognise the connection between the Peel Alluvium and the Peel Regulated River, the AWD for licences within the Peel Regulated River Alluvium Management Zone (aquifer [general security] access licences) of the Peel Alluvium water source has two components:

- A river connectivity component (this is based on the percentage of the LTAAEL that is directly linked to reduced flows in the Peel Regulated River - see 'hydrogeological modelling') that will fluctuate in accordance with the availability of resources in the Peel Regulated River i.e. if resources prohibit a Peel Regulated River (general security) access licence AWD of greater than zero being made then that portion of the AWD for these licences would also be zero.
- A rainfall recharge component (this is based on the percentage of the Peel Alluvium water source LTAAEL from rainfall/ other sources recharge – see 'hydrogeological modelling') that will be consistently available on a long-term average basis.

The AWD for Peel Alluvium aquifer (general security) access licences is equal to:

51% of the AWD for aquifer access licences + 49% of the AWD for Regulated River (general security) access licences

The river connectivity component will be linked to the AWD for Peel Regulated River (general security) access licences. This is in recognition of the need to not increase Peel Regulated River losses during periods of reduced surface water availability. If these losses were allowed to exacerbate, then this potentially impacts future allocations for high priority surface water licences (i.e. town water supplies and high security licences). Linking AWDs therefore protect against increasing losses from the Peel Regulated River to the Peel Alluvium, during times of reduced allocations for general security access licences in the Peel Regulated River.

The linking of the AWD for licences within the Peel Regulated River management zone i.e. aquifer (general security) access licences to the AWD for the Peel Regulated River is not a major change from pre plan management in this water source. The Peel Alluvium announced allocations were set 25 per cent higher than the announced allocation for the Peel Regulated River, which meant a minimum AWD of 25 per cent with a maximum of 100 per cent. The effect of the new plan rules for Peel Regulated River Alluvium users is considered to be positive, as the minimum AWD they will now receive, assuming there is not a growth in use response in place, will be 51 per cent.

Access rules in highly connected groundwater management zones

Daily flow access conditions will not apply to licences in the highly connected Peel Regulated River Alluvium management zone or to licences in those management zones which are considered to be less highly connected. This is both consistent with the State wide management of connectivity i.e. linked rules for highly connected management zones only, and the management of highly connected regulated alluvial systems across the State, whereby annual management is deemed more appropriate than daily management, for these linkages (see above 'Available Water Determinations').

Daily flow access conditions are applied to the highly connected unregulated management zones of the Peel Alluvium water source. Groundwater cease to pump rules relate to the river flow in the relevant unregulated water source, with a time lag of either 14 or 28 days. The lag has been introduced to recognise the lesser level of connection between surface and groundwater as the distance from the river and travel time of water within the aquifer increases and the storage capacity of the aquifer also increases. In effect, this combination of factors results in an increased time lag between the time of extraction and the time of he resulting impacts on surface water sources, in these areas.

The plan provides for a staged approach to the change in access rules, to help limit the immediate adverse social and economic impacts. In essence, this enables water users time to prepare for and adapt to the new rules. Where daily access rules are applied in the Peel Alluvium, the new rules shall only be implemented from year 4 of the plan. Note that in some cases, current management systems are insufficient to apply these rules immediately. A summary of the access rules are included in Table 15.

The application of cease to pump restrictions on Peel Alluvium highly connected unregulated management zones is the most significant change from the pre plan management that are now contained in the plan rules (see section 'Impact of water sharing rules').

Note that as a result of submissions received during public exhibition of the draft plan, modifications have been made to the rules for access to the Peel Alluvium water source. The cease to pump and flow reference point for the Downstream Boiling Down Creek management zone in the unregulated river Goonoo Goonoo Creek Water Source, has influenced the access conditions for the Goonoo Goonoo Creek Alluvial Management Zone i.e. licences within Goonoo Goonoo Alluvial Management Zone must now cease to pump after 14 consecutive days of zero flow at the Timbumburi gauge (0.55m at the commencement of the plan). Also, changes have been made to the management of connectivity based on submissions received during public exhibition, specifically, works within 40m of the high bank of an unregulated river/creek will receive the same access conditions as works outside 40m. Finally, in response to submissions received during public exhibition of the draft plan, a review of flow duration in the unregulated tributaries of the Peel has led to the re-classification of Duncans Creek, Attunga Creek and Moore Creek Alluvial Management Zones as being 'less highly connected', and as such they will no longer have unregulated surface water cease to pump access rules applied.

Exemptions to access rules in highly connected groundwater management zones

Those activities that are considered critical to human needs or animal health requirements are not subject to the cease to pump rules above. Although the level of extraction is small relative to entitlement, it is in direct competition for environmental water requirements at its most critical time. Licences which are not subject to the cease to pump rules include:

- domestic supply through a domestic and stock access licence (first 3 years of the WSP only),
- town water supply, until major augmentation of the schemes infrastructure occurs,
- fruit washing,
- cleaning of dairy plant and processing equipment for the purpose of hygiene,
- poultry washing and misting, or
- cleaning of enclosures used for intensive animal production for the purposes of hygiene.

The plan provides an estimate of the water requirements for domestic and stock basic landholder rights within each of the water sources, noting that these rights may increase during the life of the plan. The plan cannot limit or restrict these rights, but the *WMA 2000* itself provides the Minister with the authority to impose restrictions on basic landholder rights, through the reasonable use guidelines that are currently under development by the NSW Office of Water.

Note that the exemption from the cease to pump rules for domestic and stock (domestic only) access licences for the first 3 years of the plan is the result of current State policy, driven by water planning in coastal regions. The applicability of this rule to inland NSW is the subject of ongoing policy development, consequently, the plan may be amended to ensure it remains contemporary with State-wide policy.

Trading of access entitlement

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

The Minister's *Access Licence Dealing Principles Order 2002* currently prohibits the trade of entitlement from a groundwater source to a surface water source. Trades are only permitted between sources where there is a hydrologic connection; hence trades between the Peel Alluvium and Peel Fractured Rock are not permitted and no trades are allowed into or out of the Peel Alluvium water source.

Within the water source, trading rules are based on the application of the relevant highly connected surface water dealings rules. The plan does not allow for trades between management zones in the Peel Alluvium water source, however, there are no trading restrictions placed on trades within each management zone.

Table 15: Access rules for highly connected Peel Alluvium management zones

Management zone	Access rules – Cease to Pump (CtP)[3,5]	Basis
Goonoo Goonoo Creek Alluvium	CtP after 14 consecutive days of zero flow at Timbumburi gauge (0.55m at the commencement of this plan)	The impact of groundwater pumping is spread across the highly connected alluvial aquifer, and it is the storage capacity of the aquifer, which draws most of its recharge from the Peel Regulated River [1], that allows groundwater users to continue to pump despite there being no visible flow in the unregulated creek/river. The delayed cease to pump for groundwater users is instituted to protect base flows in the unregulated stream [2]. The groundwater access rules are lagged from the surface water access rules, which have been updated as a result of public exhibition (see Table 13)
Dungowan Creek Alluvium	CtP after 14 consecutive days of zero flow at a gauge at the end of the system, when management systems installed to allow implementation [4]	
Cockburn River Alluvium	CtP after 28 consecutive days of flow below 0.25m at Kootingal gauge	In the Cockburn River Alluvium the greater storage capacity of the aquifer based on thickness and width of alluvium means a longer time delay is recommended i.e. a larger volume can be taken for a longer period of time with the same magnitude of impact to other management zones.
Peel Regulated River Alluvium	Not applicable	Managed on an annual basis through linked AWDs with the Peel Regulated River water source, not daily access rules.

1: The main source of groundwater pumped under all scenarios is the Peel Regulated River, Broadstock (2009).

2: For unregulated reaches of the Peel Alluvium 15 per cent of discharge is to the river, the remainder is consumed by evapotranspiration, Broadstock (2009).

3: Time delays have been determined based on analytical State-wide modelling. Once river flow has dropped below the CtP level, after the specified period e.g. 14 days aquifer access licences would be required to cease to pump. Once the flow returns to over the CtP the delay time is reset. When flow is reduced to below the CtP again then the delay period starts again.

4: These rules can only be implemented when there are adequate management systems in place to record the visible flow conditions at the flow reference points on the unregulated system and store that information in an easily accessible form for licence holders. As such there will be no daily access rules for the Dungowan Creek Alluvium Management Zone until management systems are installed.

5: These rules may not apply to works for domestic and stock, local water utility, town water supply, food safety or essential dairy care purposes (see 'Exemptions to access rules in highly connected groundwater management zones').

Peel Fractured Rock

Background

Peel Fractured Rock water source covers the remaining groundwater within the Peel Valley, not covered by the Peel Alluvium water source. The entire Peel Fractured Rock water source has been classified as being 'not highly connected' to surface waters for planning purposes (refer 'Managing surface water and groundwater connectivity').

Risk assessment approach to determining sustainable limits

The groundwater 'macro planning' process is the current approach of the NSW Office of Water to developing water sharing plans for non-highly connected groundwater sources and is described in the paper 'Assessment of Sustainable Limits for Groundwater Sources in NSW' (Bish et al 2006). The macro approach is a risk-based approach based on best available information that gives a relative assessment for groundwater sources across the State and provides rules for water access and for managing water supply works that relate to groundwater extraction. The process uses simple assessments ('high', 'medium' and 'low') to indicate different levels of risk. The adopted approach helps to clarify a range of values and risks, indicating where an optimal balance between extraction and retention of groundwater in an aquifer might be. In some areas, natural assets need strong protection; in others there is more socio-economic reliance on groundwater for extraction and less ecological dependence. The broad scale relative assessments allowed the most appropriate provisions to be developed for inclusion in WSPs.

The environmental values of the Peel Fractured Rock Water Source were weighed up against the socio-economic dependence and consideration was given to the possibility of any actions that could be taken to reduce (mitigate) the risk to the environmental values. As a result, the 'sustainability factor' was determined for the water source. This factor then went towards determining the volume of average annual recharge which is reserved as environmental water and the volume available for extraction. Recommended groundwater sharing rules were also then developed for the water source and endorsed by the Peel IRP. An outline of the planning process for groundwater is detailed in Figure 9, including the risk assessment steps for all macro plans.

Recharge calculations

Recharge is the volume of water that infiltrates into an aquifer. It is expressed as a volume in megalitres per year. Recharge usually comes from rainfall and from surface water, such as river flows. The recharge calculation for the Peel Fractured Rock Water Source is the basis for determining the volume of groundwater reserved as planned environmental water and the volume that is potentially available for extraction.

Recharge is calculated on long-term average annual figures. Depending on available information it may include a number of sources of recharge; in the case of the fractured rock aquifer, it is based on rainfall only i.e. the calculation does not include river recharge, side slope or upward recharge. It is calculated based on a percent of infiltration of average annual rainfall over the water source area.

The average annual rainfall recharge for the Peel Fractured Rock Water Source is as displayed in Table 16. The recharge figure for high conservation value areas within the water source is treated separately from the rest of the recharge in that 100 per cent of this recharge is considered planned environmental water, while the recharge from the remainder of the water source is available for sharing on the basis of the sustainability factor.

Note that for the purposes of defining recharge and dedicating 100 per cent of recharge from areas of high conservation value areas to planned environmental water, high conservation value areas include – National Park, nature reserves, historic sites, Aboriginal sites, State conservation areas and Karst conservation areas.

Table 16: Average annual rainfall recharge for Peel Fractured Rock

Peel Fractured Rock	Area (ha)	Mean annual rainfall (mm)	Infiltration (%)	Average Annual rainfall (ML/year)	Average Annual Rainfall Recharge (ML/year)
Non-high conservation value area	449,076	793	4	3,560,889	142,435
High conservation value area only	287	793	4	2,281	91
Total	449,363	793	4	3,563,170	142,526

Average Annual Rainfall (ML/year) = [Water source area (ha) x mean rainfall (mm)] / 100

Average Annual Rainfall Recharge (ML/year) = Average Annual Rainfall (ML/year) x % Infiltration rate

Risk assessment

The aquifer risk assessment considers the risk that groundwater extraction places on the groundwater source and its high priority groundwater dependent ecosystems and identifies risks to ecological, water quality and aquifer integrity assets. The socio-economic risk assessment looks at the dependence of local communities on groundwater extraction in terms of the risk to financial and sociological assets. An overall risk valuation is attained for the groundwater source, which is equal to the highest value attained on any criterion.

These risk assessments were completed for the Peel Fractured Rock Water Source as per Appendix 12. Further details are provided in Appendix 13 which assists the assessors with more information regarding each question asked on the risk assessment form. The risk assessment for the Peel Fractured Rock Water Source shows a moderate risk to both aquifer and socio-economic assets.

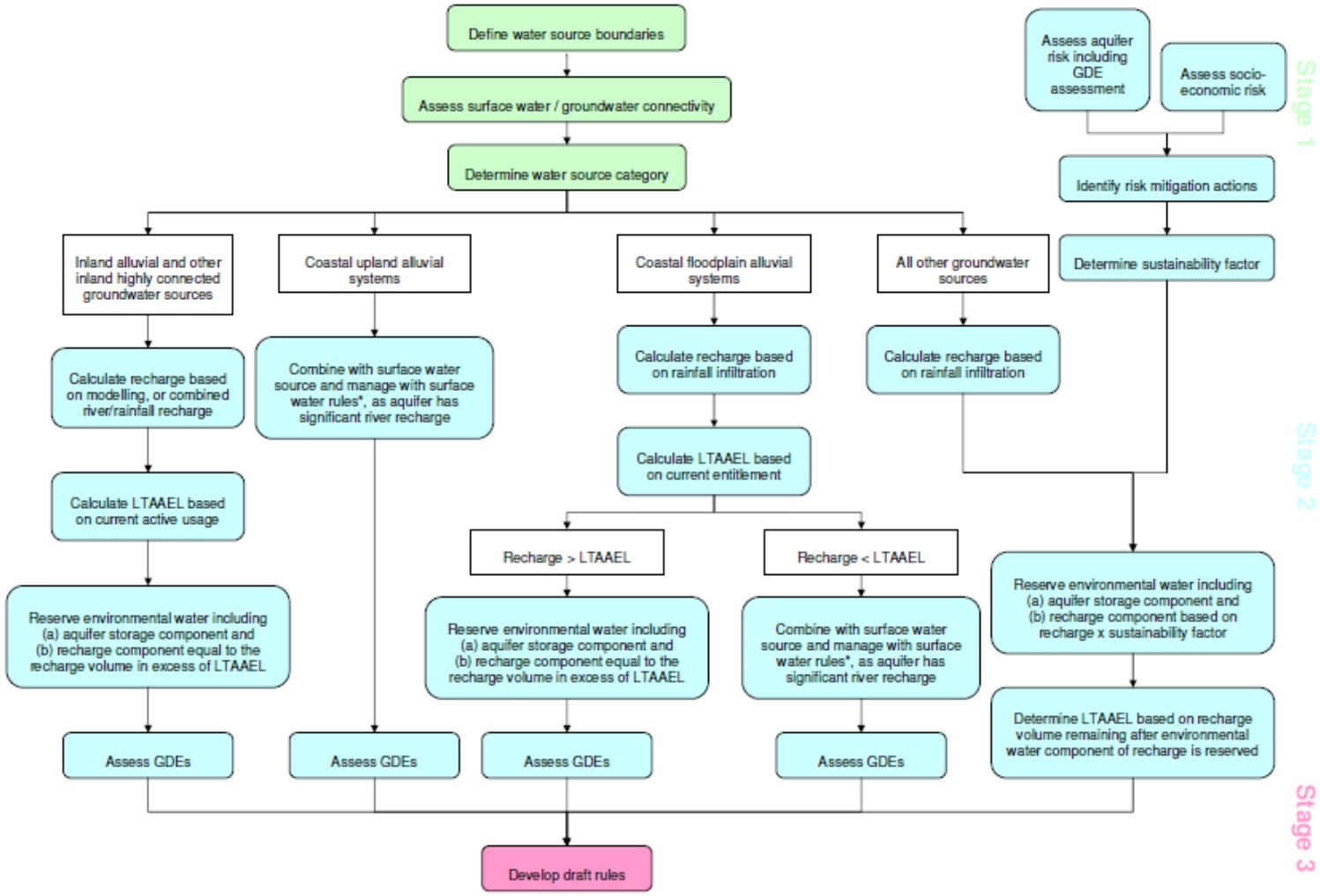
Mitigation measures, applied through rules in the water sharing plan, can reduce the impact of extraction on a groundwater source. For example, a groundwater source which is at high environmental risk may have its risk reduced to medium or low if the effect of extraction can be successfully mitigated. The Peel Fractured Rock did not have mitigation measures applied due to the need to maintain flow persistence in unregulated streams and because infrastructure to manage mitigation is not expected to be available in the medium term as current extraction pressure indicates that it is not a priority.

Sustainability factor

The recharge calculated for the non-high conservation areas of each groundwater source is split between the environment and water potentially available for extraction. The sustainability factor determines the percentage of recharge in these parts of each groundwater source that is reserved as planned environmental water. The remaining percentage is potentially available for extraction.

The Peel Fractured Rock Water Source has a sustainability factor of 50 per cent which means that 50 per cent of the rainfall recharge for the non-high conservation areas in the water source will be planned environmental water and 50 per cent will potentially be available for extraction. Appendix 14 shows the sustainability factor matrix and the Peel Fractured Rock Water Source position on this matrix.

Figure 9: Groundwater planning process



* where surface water source is unregulated, see the report to assist community consultation "Macro water sharing plans: the approachfor unregulated rivers" available at www.water.nsw.gov.au

Water sharing rules

Managing extraction

The percentage of water potentially available for extraction is termed the 'long-term average annual extraction limit' (LTAAEL) and is expressed in megalitres per year (ML/year). The LTAAEL for the Peel Fractured Rock Water Source is as expressed in Table 17; this is considered the estimated sustainable limit for the water source.

Table 17: Recharge and extraction limit for the Peel Fractured Rock

Water source	Average Annual Rainfall Recharge Non-high conservation areas (ML/year)	Sustainability factor	LTAAEL (ML/year)
Peel Fractured Rock	142,435	50 %	71,218

Average Annual Rainfall Recharge (ML/year) = Average Annual Rainfall (ML/year) x % Infiltration rate
LTAAEL = Rainfall Recharge (ML/year) x sustainability factor

Note that the Peel Fractured Rock Water Source contains water locations of variable yield and quality and there is no guarantee of individual works accessing sufficient yields of adequate quality for production purposes.

A growth in use response will be triggered if average annual usage over three years from the Peel Fractured Rock Water Source exceeds the LTAAEL by more than five per cent. This is the NSW default growth in use trigger for 'not highly connected' groundwater systems. This growth in use will be managed by reductions to the maximum available water determination for the water source.

Unassigned water

The sum of entitlements within the Peel Fractured Rock Water Source is less than the LTAAEL set for the water source, which may indicate that this water source has unassigned water. A NSW policy on release of this water within the Murray Darling Basin, however, is currently being developed. A portion of this water may be made available for new access licences through a controlled allocation order made under section 65 of the *WMA 2000*, should a decision be made by the State to do so. Definition of the portion of water that may be considered to be made available will be in accordance with State policy.

Managing connectivity

As the Peel Fractured Rock Water Source is being treated as a 'not-highly connected' aquifer system, licensed access will not be linked to the access conditions of adjacent unregulated water sources, nor will it have AWDs which reflect the water availability in any surface water systems.

As a result of submissions from public exhibition of the draft plan, the State Groundwater Panel endorsed, also supported by the Peel IRP, that groundwater supply works located within 40m of the high bank of an unregulated river/creek should receive the same rules as bores located outside 40m for inland groundwater sources. It was noted that there are a small number of licences that fall into this category and so the application of this rule would have large socio-economic impacts on those individuals affected, for minimal environmental gain.

Therefore, in less highly connected water sources such as the Peel Fractured Rock Water Source, groundwater extraction will not be linked to the surface water rules i.e. no access rules related to unregulated surface water cease to pumps for groundwater works. Note the rules regarding no new

works within 40m of the high bank of rivers/ creeks for highly and less highly connected areas remain unchanged.

Protecting environmental values

The water set aside for the environment, or 'planned environmental water' is calculated by adding the environmental water for high conservation value areas to the component of non-high conservation area recharge set aside for the environment. The planned environmental water for the Peel Fractured Rock Water Source is set out in Table 18.

Table 18: Planned environmental water for the Peel Fractured Rock water source

Water source	Average annual rainfall recharge (ML/year)	Percentage reserved for environment (100% -sustainability factor)	Planned environmental water (ML/year)
Peel Fractured Rock excluding high conservation area	142,435	50 %	71,218
Peel Fractured Rock high conservation area only	91	100%	91
TOTAL			71,309

Planned environmental water = Non-high conservation value area recharge (ML/year) x (100% - sustainability factor) + Environmental water for high conservation value areas (ML/year)

Additional protection for environmental assets is also afforded through specific rules for granting or amending water supply works approvals and managing existing works within these groundwater sources which take into account any local impacts, or key features such as GDEs. The distance rules (see below) cover new bores, stipulating a buffer zone around high priority GDEs. Existing bores are not affected by the buffer zones and are able to continue operating, i.e. within the existing conditions of their access licences.

High priority groundwater dependent ecosystems

The process for identification and scheduling of GDEs was outlined previously in this document in the Developing the plan - Other considerations -

Protecting environmental values section. The GDE identification process for the plan identified two types of GDEs, karst areas and springs, in the Peel Fractured Rock Water Source these are listed in Schedule 4 to the plan. The springs were identified by interrogating NSW Government data of GDEs. The Karst areas were identified by the Karst Conservation Unit of the Department of Environment, Climate Change and Water. The process for identifying Karst areas is described by Williams et. al.,(2007). These are high-priority GDEs as they are highly dependent upon groundwater with high conservation value. The groundwater dependence of vegetation communities within the Peel Valley has not yet been determined. It is expected that some of these vegetation communities may be listed as high priority GDEs within the term of the plan. While not listed in Schedule 4, base flows in streams are another type of GDE, they are protected by the distance rules as well as the LTAAEL for this water source.

Almost all vegetation in the Peel Valley will have some dependence on groundwater. Some of the uplands areas will have vegetation dependent on water in the unsaturated zone above the water table, as distinct from vegetation that is dependent on groundwater that occurs below the water table which occurs in the lower part of the valley. It should be noted that the groundwater table moves naturally over at least eight metres in some areas of this valley so ecosystem diversity will change with climatic conditions. Future work on identification and analysis of GDEs will assist in classifying the priority of these vegetation communities and their level of groundwater dependence. The schedule of high priority GDEs in the plan can be amended to include additional high priority GDE after year 5 of the plan.

Water supply works approvals

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

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

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

The standard set of distance criteria then went to the State Groundwater Panel for approval. This Panel, when negotiating the final rules, weighed the social, environmental and economic impacts of

extraction on groundwater sources to set an acceptable level of drawdown near critical sites and other water users. Since then, the standard rules have been further tailored as a result of further development of macro plans.

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

In the plan, regional hydrogeologists made draft recommendations on rules for the plan which were then compared against the standard rules. The Peel IRP then made a final decision as to the rules to be recommended in the plan, striving to remain consistent with the standard rules where possible while being sensitive to any unique attributes of the groundwater sources in the Peel Valley.

The plan details rules applying to water supply work approvals including:

- rules for amending water supply work approvals for replacement groundwater works,
- rules to minimise interference between neighbouring water supply works,
- rules for water supply works located near contaminated sources,
- rules for water supply works located near sensitive environmental areas, including rules to protect base flows in rivers and groundwater dependent ecosystems,
- rules to for water supply works located near groundwater dependent culturally significant sites, and
- rules for the use of water supply works located within restricted distances.

Following public exhibition, the State Groundwater Panel discussed the application of distance criteria in recognition of comments received and issues raised during public exhibition of the draft Peel Plan. The State Groundwater Panel agreed that there should be a clause that allowed the Minister discretion to grant/ amend a water supply work approval at a lesser distance if satisfied that the location of a water supply work at this distance will not compromise the intent of the rules. This clause will help cater for the local circumstances raised in a number submissions received during public exhibition where it may be desirable for an approval to be granted at a lesser distance in recognition of existing property rights, and small lot sizes. These exemption clauses have been included in the plan, including the agreed position of the State Groundwater Panel that replacement bores be exempt from all distance criteria. By exempting replacement bores from all distance criteria, existing property rights are acknowledged and the issues associated with the distance criteria resulting in difficulties for the replacement of existing water supply works are addressed. This is consistent with the policy principles for setting the LTAAEL in alluvial aquifers i.e. that current impacts are acceptable.

Refer to the plan for the distance rules applying to each groundwater source covered by the plan.

Carryover and water accounts

As the Peel Fractured Rock Water Source contains many discrete aquifers with small storages and because available water determinations are unlikely to be less than 1ML/unit share (i.e. unlikely that there will be a growth-in-use response required due to the relatively low level of activation relative to the LTAAEL), no carryover of entitlement from one year to the next has been allowed. The maximum amount of water permitted to be taken from this water source in any one water year, is the water allocation accrued in the water access licence account for that water year.

Available water determination

The maximum AWD for a water source is used to manage growth in extractions, above the long-term average annual extraction limit i.e. if growth is assessed to have occurred then the maximum AWD will be reduced to less than 1 ML/unit share in order to respond to this growth and bring it back into line with the LTAAEL.

Available water determinations are primarily used to credit water into a licence's water allocation account. The AWD for groundwater access licences in the Peel Fractured Rock Water Source will be 1 ML/ unit share, unless a growth in use response is required.

Trading of access entitlement

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

In most groundwater sources covered by macro plans trading is allowed within a groundwater source, but no trading is allowed into or out of the groundwater source. This is to ensure that any groundwater source cannot be further degraded as a result of trading into that water source.

For the Peel Fractured Rock Water Source, no trades are allowed into the water source, based on lack of hydrologic connection. There are no restrictions on trade within the water source; however each trade application undergoes a minimal harm assessment.

Impact of water sharing rules

The water sharing rules in the plan were designed such that they would have minimal socio-economic impact. While this is the case, it is impossible to eliminate all socio-economic impacts when improving environmental outcomes and as a result there are some impacts of the rules. The following approach was used to better understand those impacts and to target resources to analyse those rules that are considered to have a high risk of negative impacts.

Step 1 - Preliminary risk based rapid assessment in the regional context over the whole plan area was undertaken by NSW Office of Water. This rapid assessment compared current water sharing arrangements to the proposed arrangements under the draft water sharing plan and identified rules that have the potential to cause negative socio-economic impact.

Step 2 – Rapid assessment presented to the Peel Interagency Regional Panel for review and to direct requests for more detailed analysis, where sufficient data is available to undertake further analysis.

The main areas of the rules that were identified as having possible negative socio-economic impacts included:

- growth in use managed by adjusting the maximum AWD in the Regulated Peel River, Peel Alluvium and the Peel unregulated river water sources.
- access restriction through the introduction of unregulated surface water cease to pump access conditions for aquifer access licences in the Cockburn River, Goonoo Goonoo Creek and Dungowan Creek Management Zones of the Peel Alluvium.
- access restriction through the introduction of cease to pump access conditions on all unregulated river licences.
- a minimum AWD for high security users in the Regulated Peel River which is 10 per cent lower than any announced allocation made under the *Water Act 1912*, to date.

There are other areas of the rules also likely to have socio-economic impacts, although these are likely to be to a lesser extent than those above.

Step 3 – Conduct more detailed economic evaluation for areas of high risk, i.e. more likely have a negative economic impact as a result of the implementation of the WSP.

Detailed economic evaluation at the sub-regional level was undertaken to look at the economic impact of lost pumping opportunity through the linking of the ‘highly connected’ alluvium in the Cockburn River and Goonoo Goonoo Creek Alluvium Management Zones to the unregulated river cease to pump access rules. This was identified as the area most likely to have negative economic impacts.

A report was published describing the economic impact of the changes to alluvial groundwater access rules for the Goonoo Goonoo Creek and Cockburn River alluvial management zones and was released during public exhibition (Flavel and Bari, 2009). A large number of submissions were received during public exhibition, highlighting that this economic assessment had a number of perceived shortcomings.

After public exhibition, the assessment and accompanying report was updated to incorporate concerns raised in submissions (where appropriate) for the Goonoo Goonoo Creek Management Zone only, as the initial report indicated a net positive impact in the Cockburn River Alluvium Management Zone and so the proposed updates would have only increased this positive impact.

The Dungowan Creek Alluvium is also classified as highly connected, and will have surface water access rules applied when a gauge is installed. The economic impacts in this alluvial management zone were unable to be assessed, because there is insufficient historical gauging and flow data to quantify access. Although, as Dungowan Creek is predominantly a perennial stream, it is likely that the

impacts in the Dungowan Creek Alluvial Management Zone shall be similar to those in Goonoo Goonoo Creek and Cockburn River Alluvium Management Zones.

The updated economic analysis for the Goonoo Goonoo Creek Alluvial Management Zone concludes that it is unlikely that there will be a significant net impact of the proposed rule change on producers in the management zone, or the region (Flavel and Bari, 2010). This final report has been made publicly available on the NSW Office of Water website.

Step 4 – Mitigating strategies for adjustment.

Mitigating strategies for adjustment were considered, particularly where there was perceived to be a lower risk of negative impact on the regional economic basis but a high risk for social impact on an individual basis.

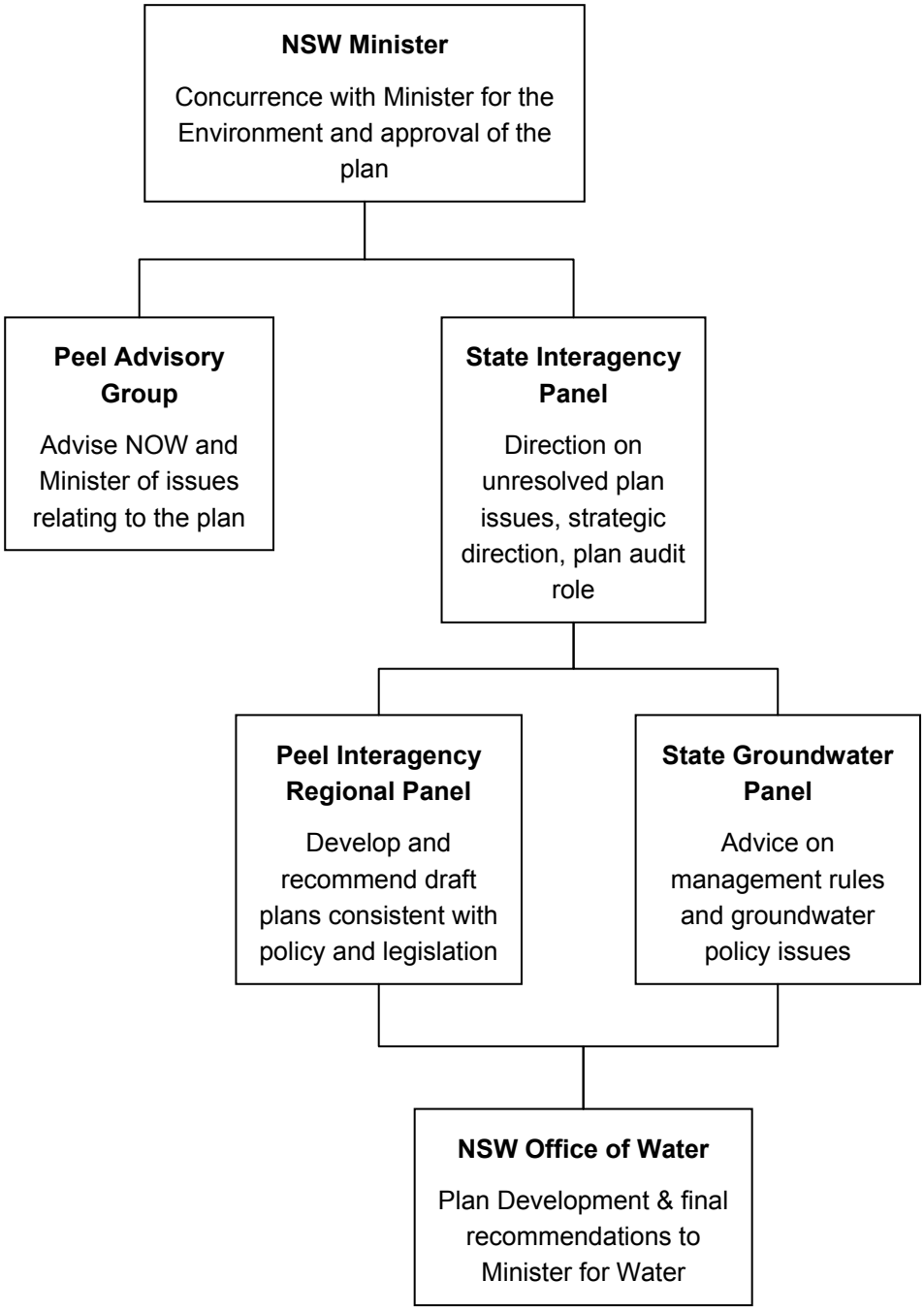
Some examples of this are:

- Mitigating rules developed as strategies to reduce the likelihood of a growth in use response, including:
- trading out of Peel Regulated River licences to the Lower Namoi Regulated River.
- Mitigating rules developed as strategies to allow adjustment to the impact of a response to growth in use, including:
- Adoption of a “reactive” growth-in-use assessment and response strategy in the Peel regulated river, i.e. once growth is actually evident and assessed to have occurred, rather than a “proactive” growth-in-use response, which would be based on assumed growth in extractions that the modelling would assume has occurred as a result of an enlarged Chaffey Dam.
- development of supplementary water access licences in the Peel Alluvium Water Source to allow time for individuals to adjust, should a significant growth in use response be required to return extractions to the LTAAEL.
- Delayed implementation of some rules (e.g. not until year 4 of the plan) to allow individuals time to adjust.

Consultation

A flow chart detailing the communication flow between project groups and stakeholders is shown below in Figure 10.

Figure 10: Flow chart of project groups and stakeholders for Peel water sharing plan development



Before the plan was drafted, key stakeholders were consulted as part of 'issues analysis' sessions, designed to clarify the fundamental outcomes sought by stakeholder groups in a water sharing plan for the Peel Valley. The recommended draft rules from the Peel IRP were also supplied to the Minister's Peel Advisory Group (PAG) at a number of key stages during plan development. The PAG

subsequently offered advice to the Minister throughout the development of these rules on issues specific to water users and other stakeholder groups in the Peel Valley. Formal public exhibition[7] of the plan ensured wider public consultation, after which the Peel IRP recommended amendments to the draft plan based on submissions received. Ultimately, the plan was submitted to the Minister for Water to seek concurrence with the Minister for Climate Change and the Environment and the plan was made 23 April 2010.

Issue analysis

An early round of consultation, 'issue analysis', was conducted prior to the Peel IRP developing and recommending draft water sharing rules.

Each of the 'issue analysis' sessions allowed the NSW Office of Water to further explore the issues and expectations from stakeholder groups to identify the fundamental outcomes that each group is seeking from the plan and why. The outcomes of these sessions then informed the development of draft plan rules by the Peel IRP.

Issues analysis sessions were offered to numerous water user groups, Tamworth Regional Council, Indigenous individuals/ organisations and environmental interest groups, however only water users and Tamworth Regional Council accepted.

Targeted consultation through the Peel Advisory Group

The Minister for Water established the Peel Advisory Group (PAG) to directly advise his office on the many complex issues relevant to a water sharing plan for the Peel Valley. The PAG met three times prior to the public exhibition of the draft plan, with much of its discussion centred on complex issues such as:

- the management of connectivity between surface and groundwater sources
- determining sustainable levels of water extraction within the Peel Valley
- consideration of "sleeper" licences – or inactive entitlements – and any potential impacts of trading rules on the existing irrigation industry
- access rules for the Peel unregulated and groundwater water sources.

The Minister received advice from the PAG on the recommended rules that went into development of the draft plan. This advice both informed the development of the draft and lead to the inclusion of Minister's notes seeking specific comment during public exhibition on sections in the draft plan that were of concern to stakeholders represented on this group. Minister's notes were included to seek feedback on the Cockburn management zone cease-to-pump and flow reference point, proposed supplementary water access licences in the Peel Regulated River Water Source, the impact of linking unregulated river cease-to-pumps to the access conditions in highly connected alluvial groundwater and inter-valley trading between the Peel Regulated River and the Namoi Regulated River.

Public exhibition

Public exhibition of the draft plan is required by the *WMA 2000* to be held for at least 40 days, but in the Peel due to the complexity of the issues and in response to stakeholder demand, the Minister decided to hold public exhibition for an extended 74 day period during October-December 2009. The objectives of this consultation were:

[7] Public exhibition is the formal exhibition of a draft WSP where the Minister invited submissions on the draft plan and sought comment on a range of key issues.

- to provide background to stakeholders as to why the plan was being developed, how it had been developed, 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 would be implemented, and
- to seek feedback from stakeholders and the general community about the proposed water sharing rules.

Two public meetings were held during the public exhibition period in Tamworth. A total of 96 submissions were received as a result of public exhibition.

Refining water sharing rules as a result of public exhibition

The Peel IRP reviewed all submissions as well as matters raised at public meetings and as a result made changes to the draft exhibited plan rules in the final plan. Appendix 15 outlines the changes to the draft exhibited plan rules as a result of this public consultation.

Further consultation with the Peel Advisory Group

The Peel Advisory Group (PAG) met to discuss the revised recommendations from the Peel Interagency Regional Panel (IRP) following their consideration of submissions received during public exhibition of the draft Peel WSP.

Formal correspondence was received from Tamworth Regional Council, Namoi Water (on behalf of Peel Irrigators) and Peel Valley Water Users. For the most part, the concerns raised in this correspondence resonated with the respective submissions made during public exhibition. Note that all submissions received during public exhibition were carefully considered by the Peel IRP with appropriate changes made to the draft WSP.

Notwithstanding the above, it was considered that some of the concerns raised by the PAG were still not adequately addressed. The following changes to the WSP submitted for publishing were made post the Peel IRP meeting to help address the final PAG concerns:

- Refinement of the Peel Alluvium Water Source LTAAEL:
- all zero usage years prior to activation were removed when calculating average usage, and
- a period of climatic representativeness was inferred using the Peel IQQM for the regulated river, and average usage was calculated over this more representative period.
- Change to the AWD provisions for local water utility, high security and domestic and stock licences in the Peel Regulated River Water Source to:
- stipulate that AWDs of less than 100% or 1ML/unit/share may only be made when no AWD for general security is made i.e. zero allocation, and
- remove the words ‘wherever possible’ so that a minimum AWD is ‘guaranteed’ for local water utility, high security and domestic and stock licences under the WSP i.e. 70% of share components for local water utility.
- Change to the flow reference point for the unregulated Cockburn River Management Zone:
- the downstream flow reference point for the Cockburn River Management Zone remained at the rock bar 700m upstream of the Cockburn Rivers confluence with the Peel River, and
- an amendment provision was added to alter the cease-to-pump at the rock bar from visible flow to zero flow when a gauge is installed at this location.

- Change to the boundary between the Cockburn and the Peel Regulated Alluvial Management Zones so that it follows Nundle Road, Back Kootingal Road and Cross Park Road.
- Ability to amend the cease-to-pump and flow reference points for unregulated Moore Creek Management Zone if data collected and analysed by NSW Office of Water reveals that there is a more appropriate way to describe access, an amendment clause was added to allow this to occur.

Adaptive management

Adaptive management is an important part of a WSP. 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. Adaptive management is a requirement of both the *WMA 2000* and the National Water Initiative, and has been allowed for during the life of the plan through amending provisions and establishment of "limits of change" to the plan.

Where adaptive management is specifically allowed for during the life of the plan through amendment provisions, further studies may be undertaken within agencies or by external organisations which may assist in informing the review of plan provisions.

Monitoring the plan performance

A Monitoring, Evaluation and Reporting (MER) Framework is being developed. This framework will be developed in collaboration with key stakeholders and will be consistent with the monitoring, evaluation and review (MER) needs of the Natural Resources Commission and the National Water Commission. The intention is that the framework can be applied to existing WSPs and macro WSPs to enable the development of a specific MER plan.

Performance indicators

The plan includes a number of performance indicators that will be monitored over the 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.

Plan review

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

The MER 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) as having this responsibility.
- 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, natural resource standards and targets in the relevant catchment management area. The Natural Resources Commission will call for public submissions when undertaking its review.
- An annual review of implementation programs, if programs have been established.
- The application of information from the relevant monitoring and evaluation programs to inform progress against the relevant State-wide targets and requirements of the National Water Commission under the National Water Initiative.

Implementation

Implementation programs

An implementation program may be established that sets out the means by which the objectives of the plan are to be achieved. If an implementation program is established it would be reviewed annually to determine whether it is being effective in implementing the water sharing provisions. The results of a review would be included in the NSW Office of Water's Annual Report.

Monitoring water extractions

Each WSP establishes the relevant mandatory conditions for extraction, including that all licences undertake measurement of extraction. The NSW Office of Water will develop a measurement of extractions strategy to meet the objectives of the NSW Water Extraction Monitoring Policy.

Measurement of extractions may be via meters or other forms of monitoring devices fitted to approved works, or via alternate monitoring systems, in order to provide water extraction estimates. Different types of devices will be required depending on the nature of the water supply work installation, the size of the work, and the affect that the operation of the work may have on the water source and other water users.

Under the Water Use Monitoring Program assessment of water sources is being undertaken across the State to identify priority areas of measurement of extractions and to determine the most suitable measurement options. It is likely that this will be implemented in high priority areas initially, with roll out to all water sources over time, as appropriate.

Note: Decisions regarding the timetable for introduction of measurement of extractions are still under consideration. In the interim, water users are encouraged to use other forms of self-measurement to assist them to extract water in compliance with their licence conditions, which will be developed from the relevant plan provisions. Water users may install flow meters of their own volition. Meters need to meet new national water meter standards and be installed in accordance with the manufacturer's specifications.

Compliance

The NSW Office of Water will undertake compliance activities as necessary to enforce each individual's licence conditions, which are developed based on the provisions of the plan once it is implemented. Some reliance is placed on local water users to identify inappropriate or unlawful behaviour and report this to the NSW Office of Water. Reports may be made by calling 1800 633 362 or emailing watercompliance@dwe.nsw.gov.au (refer to the NSW Office of Water website www.water.nsw.gov.au).

Bibliography

Albertson, D. 2009, (unpub.) Draft Peel water sharing plan: Department Environment Climate Change & Water input, Department of Environment, Climate Change and Water, Armidale NSW.

Australian Bureau of Statistics 2006, Census CDATA online, 2006 Census of Population and Housing, Accessed via http://www.abs.gov.au, July 2009.

Bish, S., Gates, G., Gill, J., Williams, R.M. 2006, 'Assessment of Sustainable Limits for Groundwater sources in New South Wales', 10th Murray-Darling Basin Groundwater Workshop, Murray-Darling Basin Commission, Canberra.

Broadstock, B. 2009, (unpub.) Impact of groundwater pumping on a river systems - A conceptual model of a shallow highly connected aquifer-stream system: regulated and un-regulated rivers (DRAFT), NSW Office of Water, Parramatta.

Broadstock, B. and Chowdury, S. 2009 (unpub.) Flow duration assessment for unregulated reaches in the Peel River basin (DRAFT) – Managing alluvial unit.

Bureau of Meteorology 2009, 'Historical Observations', Climate data online. Accessed via http://www.bom.gov.au, July 2009.

CSIRO 2007, Water availability in the Namoi [electronic resource]: a report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project. CSIRO, Clayton South Vic.

Department of Environment and Conservation 2005 (unpub.), Methodology for Surface Water Classification Assessments

Department of Land and Water Conservation 1995, DLWC, Integrated Quantity-Quality Model (IQQM) Reference Manual, Department of Land and Water Conservation, Sydney, NSW

Department of Natural Resources 2006, Groundwater Dependent Ecosystems: Assessment, Registration and Scheduling of High Priority. Manual to Assist Groundwater Macroplanning, Department of Natural Resources, Sydney NSW.

Department of Natural Resources 2006, Macro water sharing plans: the approach for unregulated rivers. Report to assist community consultation, Department of Natural Resources, Sydney NSW.

Driml, S. O'Sullivan, D., Hanna, R., 2005, 'River Economics-problems, progress and potential', Proceedings of the 8th River Symposium

Flavel N. and Bari M., 2009, Economic assessment relating to the draft water sharing plan for the Peel Valley: Changes to the alluvial groundwater access rules for Cockburn River and Goonoo Goonoo Creek., NSW Office of Water, Sydney

Flavel, N,. Bari, M,. 2010, Economic assessment of proposed Goonoo Goonoo Creek alluvial groundwater access rules, NSW Office of Water, Sydney

Foster, N. 1999, (unpub.) A Preliminary Assessment of the Commence-to-flow levels of Wetlands of the Lower Namoi Valley, Department of Land and Water Conservation.

Foster, N. and Lewis, A. 2009, (unpub.) Ecological features for the Regulated Peel River, Prepared for Peel Interagency Regional Panel, Department of Water and Energy, NSW.

Kalaitzis, P., 1996 (unpub.) Groundwater Allocation and Status Report for the Alluvial Groundwater Resources of the Peel Valley New South Wales (GWMA 005). Department of Land and Water Conservation, NSW.

Lambert, G. and Short, A. 2004, Namoi River Styles Report, Nation Action Plan for Salinity and Water Quality

Lamontagne, S. and Cook P.G. 2006, Estimation of hyporheic exchange in a subtropical stream using bromide and SF6 injection and 222Rn disequilibrium. Client Report to D. Berhane NSW Department of Infrastructure, Planning and Natural Resources, CSIRO Land and Water Science

Murray-Darling Basin Commission 2008, Evaluation of the connectivity between surface water and groundwater in the Murray-Darling basin – Report prepared for the Murray-Darling Basin Commission, by Resource and Environmental Management, Canberra, ACT, Australia

Namoi Catchment Management Authority 2007, Namoi Catchment Action Plan Part A Policies and Procedures for Quality Natural Resource Management and Part B Natural Resource Management Plan, Namoi CMA, (n.p.)

New South Wales Environment Protection Agency 1999, Water quality and river flow interim environmental objectives: guidelines for river, groundwater and water management committees: Namoi River Catchment. NSW EPA, Sydney NSW Australia ISBN 0731302419.

O'Rourke, M. 2009, (unpub.) Peel Valley Groundwater Management Area 005 Groundwater Status Report – 2009 Status Report No. 2, NSW Office of Water, NSW.

Tamworth Regional Council 2005, State of the Environment Report 2004 – 2005, Tamworth Regional Council, NSW.

Tamworth Regional Council 2006, Tamworth and Districts Early History Accessed via http://www.tamworth.nsw.gov.au, July 2009

Tamworth Regional Council 2008, Drought Management Plan, rev. 5, Tamworth Regional Council, NSW.

Tamworth Regional Council 2009, Community Profile: 2006 and 2001 Enumerated Census information for Tamworth Regional Council, Tamworth Region. Accessed via http://www.tamworth.nsw.gov.au, July 2009

Tomlinson, M. 2008, A Framework for Determining Environmental Water Requirements for Alluvial Aquifer Ecosystems, PHD Thesis, University of New England.

URS 2008, Securing Tamworth's Water Supply: A Scoping Study (funded by Namoi CMA), Namoi CMA, NSW.

URS 2009, Scoping Study Towards a Peel River Water Sharing Plan – Opportunities and Constraints (funded by Namoi CMA), Namoi CMA, NSW.

Water Conservation and Irrigation Commission NSW 1970, Water Resources of the Peel Valley. Survey of thirty-two NSW river valleys. no. 17, Water Conservation and Irrigation Commission NSW

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 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 (traded) 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.

Conversion factor: The adjustment factor that is to be applied to share components when they are cancelled and reissued in a different water source and vice versa, or as a different category. It is designed to allow movement of water from one water source to another or from one licence category to another whilst minimising the impacts on third parties of such movements. These impacts result in that the value of a unit of share component (in terms of the average water allocations) that result from it may vary from one water source to another or from one licence category to another.

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 an activity, for example 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 one of the *Threatened Species Conservation Act 1995* or Schedule 4 of the *Fisheries Management Act 1994*.

Environmental contingency allowance (ECA): A volume of water held in storage from which releases are made for particular environmental purposes or in response to particular environmental circumstances.

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 average annual extractions.

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 the range of flows in a stream are likely to be equalled or exceeded.

Flow gauging station: A device used to measure the height of water levels in 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 WSP.

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

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

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

In-stream refuge habitat: Stream habitat containing pools that retain water for longer periods of time during drought and low flow. In-stream biota will migrate to these more permanent habitats to survive.

Integrated Quantity/Quality Model (IQQM): A numerical hydrologic computer model that simulates a river basin's behaviour on a daily time step, based on inflows to the system, configuration of the major infrastructure, routing and losses of flows through the system and irrigation extractions to meet crop water requirements. It also models the processes of available water determinations, uncontrolled flow, supplementary water announcements and irrigator planting decisions. This model is used to analyse and compare the outcomes of proposed water sharing options or assess potential growth-in-use over long-term climatic sequences (> 100 years).

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: Water sharing 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 water sharing plans covering most of the remaining water sources in NSW.

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

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

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

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

Uncontrolled flow: Is flow, in excess of that needed to meet the environmental provisions of the plan, basic landholder rights and water orders placed by Regulated River (general security) access licences and higher priority access licences in a water source. These flows originate from tributary inflows below a dam, dam spills or stimulus flow/ ECA water (once its environmental objectives have been met).

Uncontrolled flow event: A continuous period during which the taking of water from uncontrolled flows in accordance with section 85A of the *WMA 2000* and the rules in the plan by a regulated river (general security) access licence is permitted in all or part of a regulated river water source.

Sustainable yield: That proportion of water (in ML) which is allowed to be extracted from groundwater after considering the aquifer's ability to recharge and the needs of the environment.

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

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

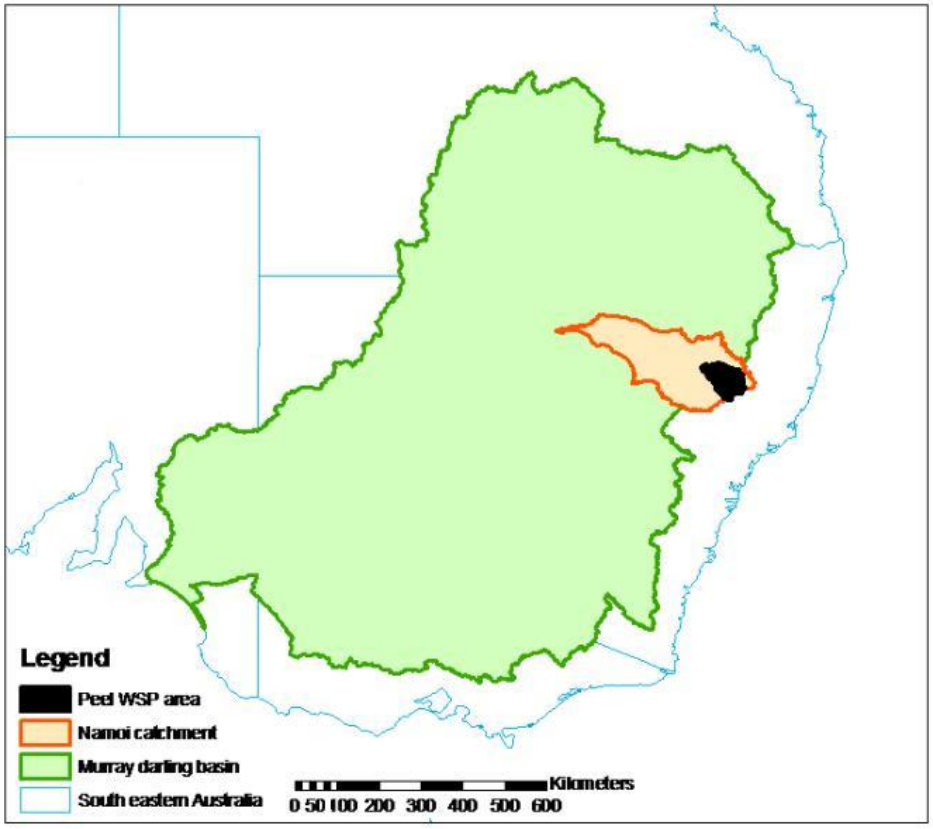
Water sharing plan (WSP): A plan made under the *Water Management Act 2000*, which sets out the rules for sharing water between the environment and water users within whole or part of a water management area or water source.

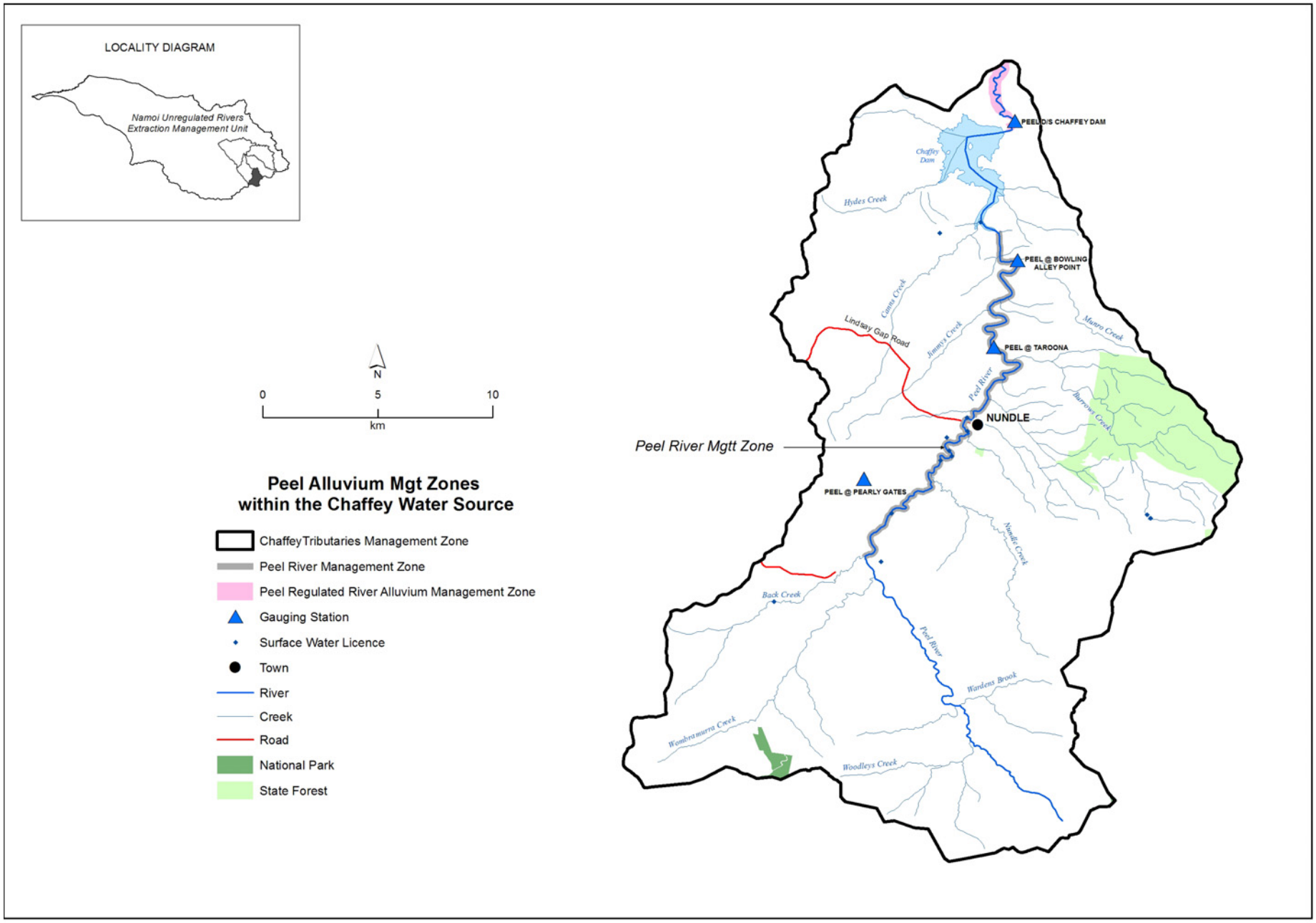
Water year: The 12 months running from 1 July to 30 June.

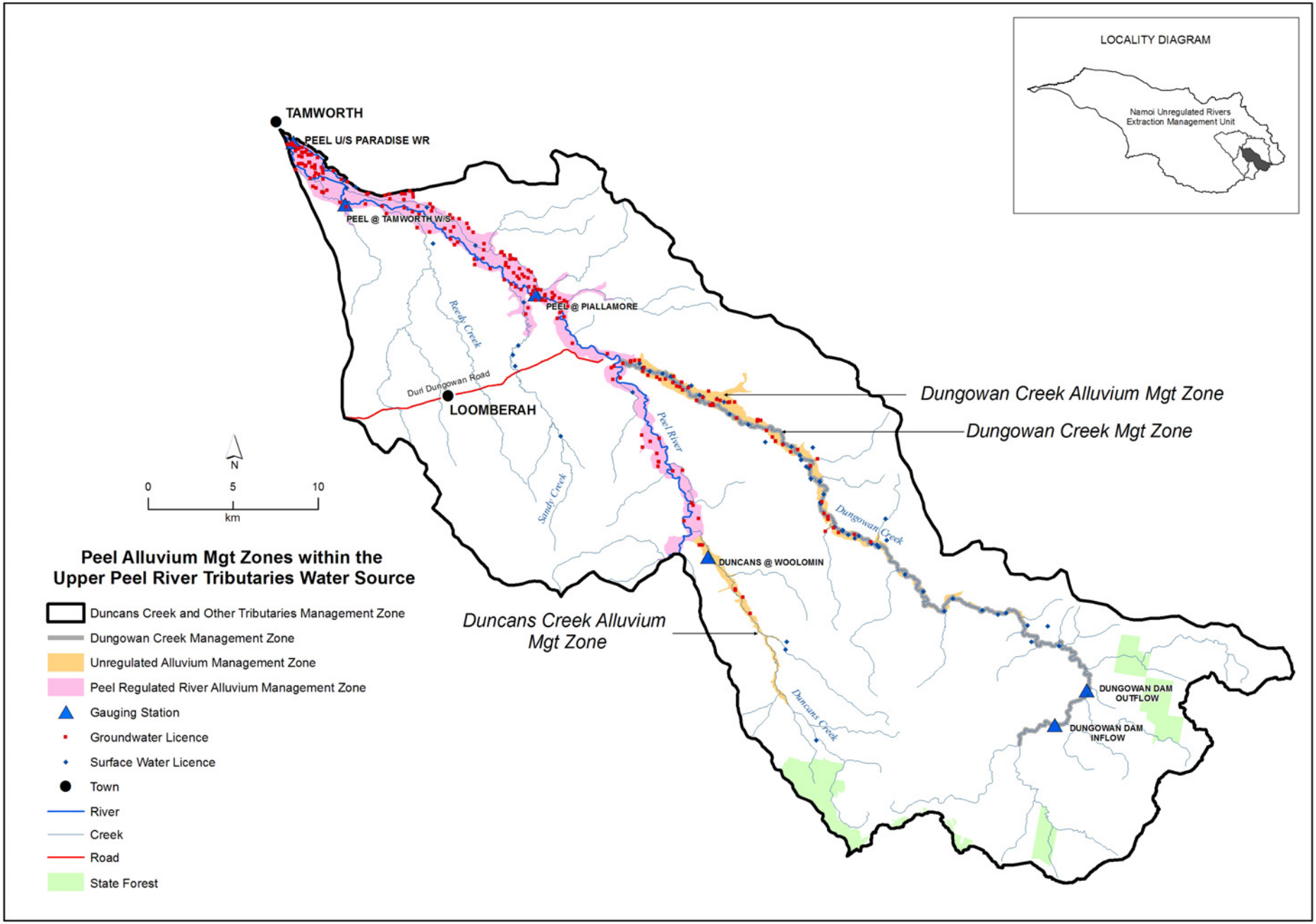
Appendices

Appendix 1: Water sharing plan maps

Plan Area




LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit
N
0
5
10
km
Peel Alluvium Mgt Zones within the Chaffey Water Source
ChaffeyTributaries Management Zone
Peel River Management Zone
Peel Regulated River Alluvium Management Zone
Gauging Station
Surface Water Licence
Town
River
Creek
Road
National Park
State Forest
Peel River Mgtt Zone
PEEL D/S CHAFFEY DAM
Chaffey Dam
Hydes Creek
PEEL @ BOWLING ALLEY POINT
Lindsay Gap Road
Cows Creek
Jimmys Creek
PEEL @ TAROONA
Munro Creek
Peel River
NUNDLE
Burrows Creek
PEEL @ PEARLY GATES
Nundle Creek
Back Creek
Peel River
Wardens Brook
Wombramurra Creek
Woodleys Creek


LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit
TAMWORTH
PEEL U/S PARADISE WR
PEEL @ TAMWORTH W/S
PEEL @ PIALLAMORE
Reedy Creek
Duri Dungowan Road
LOOMBERAH
Peel River
Sandy Creek
Dungowan Creek
DUNCANS @ WOOLOMIN
Duncans Creek
DUNGOWAN DAM OUTFLOW
DUNGOWAN DAM INFLOW
Dungowan Creek Alluvium Mgt Zone
Dungowan Creek Mgt Zone
Duncans Creek Alluvium Mgt Zone
N
0
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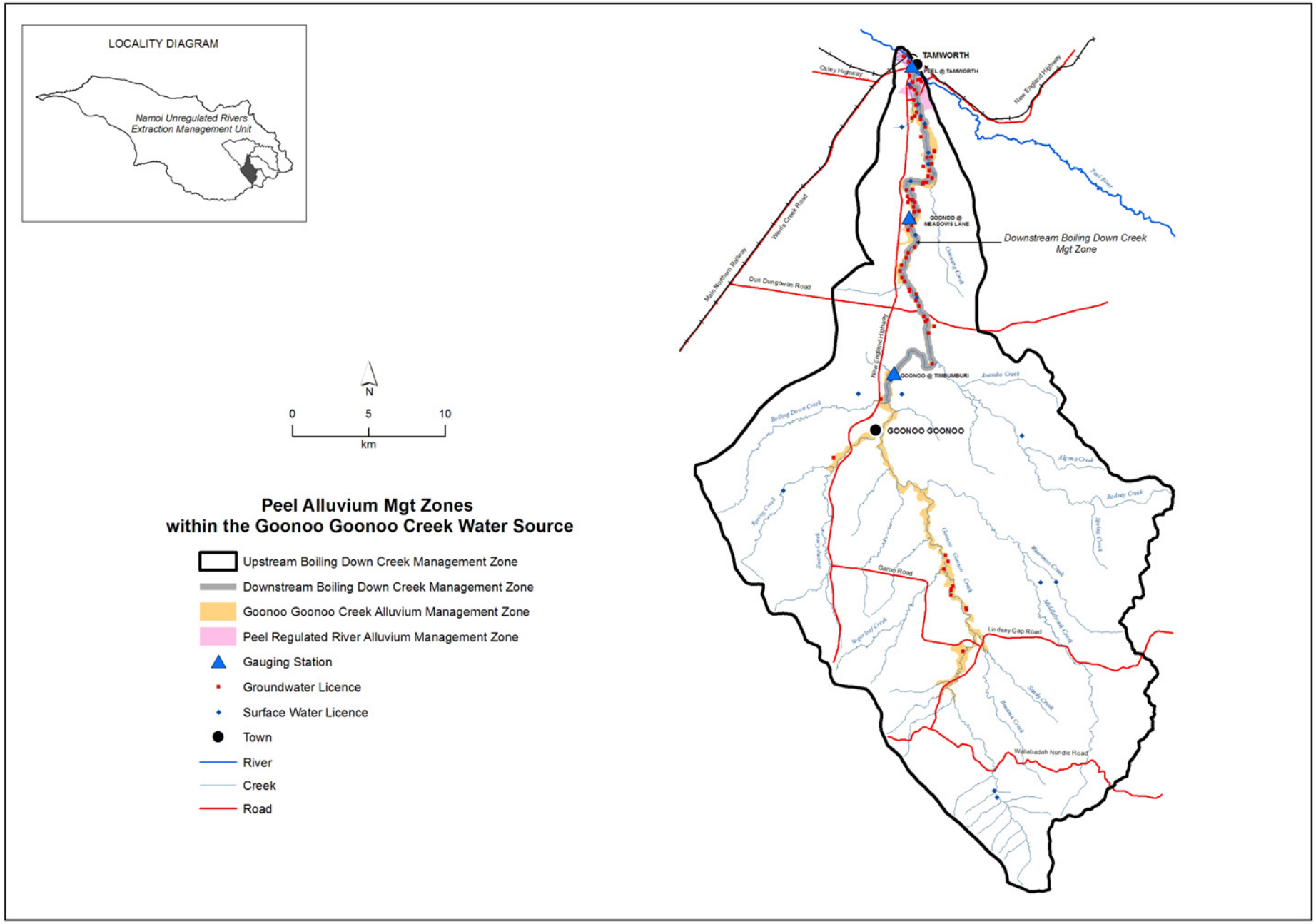
km
Peel Alluvium Mgt Zones within the Upper Peel River Tributaries Water Source
Duncans Creek and Other Tributaries Management Zone
Dungowan Creek Management Zone
Unregulated Alluvium Management Zone
Peel Regulated River Alluvium Management Zone
Gauging Station
Groundwater Licence
Surface Water Licence
Town
River
Creek
Road
State Forest


LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit
N
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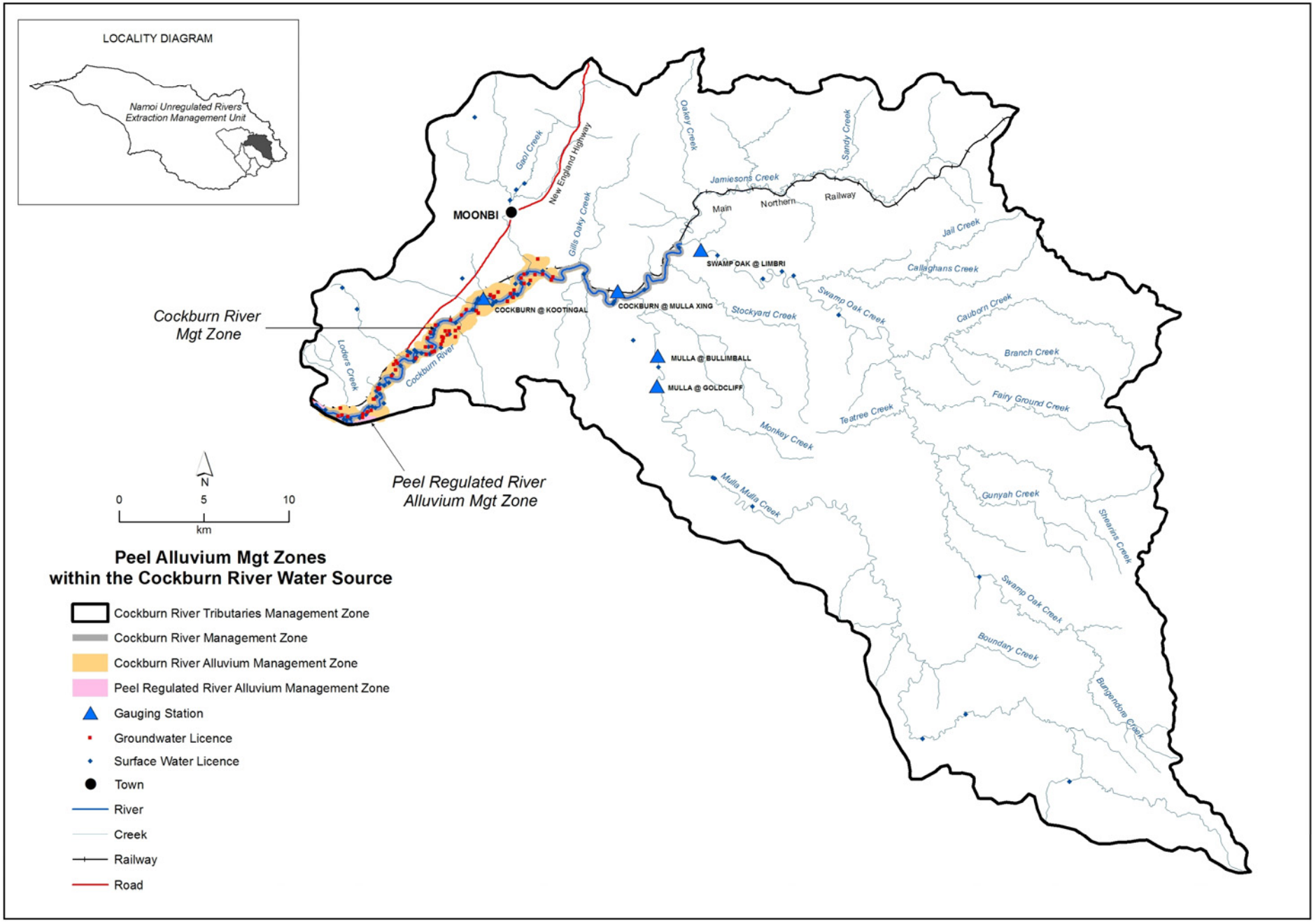
km
Peel Alluvium Mgt Zones
within the Goonoo Goonoo Creek Water Source
Upstream Boiling Down Creek Management Zone
Downstream Boiling Down Creek Management Zone
Goonoo Goonoo Creek Alluvium Management Zone
Peel Regulated River Alluvium Management Zone
Gauging Station
Groundwater Licence
Surface Water Licence
Town
River
Creek
Road
TAMWORTH
PEEL @ TAMWORTH
Oxley Highway
New England Highway
Peel River
GOONOO @ MEADOWS LANE
Downstream Boiling Down Creek Mgt Zone
Weeta Creek Road
Main Northern Railway
Duri Dungowan Road
GOONOO @ TIMBUMBURI
GOONOO GOONOO
Boiling Down Creek
Ironbo Creek
Algona Creek
Rodney Creek
Spring Creek
Swamp Creek
Garoo Road
Lindsay Gap Road
Sandy Creek
Wallabadah Nundle Road


LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit
MOONBI
Gaol Creek
New England Highway
Gills Oaky Creek
Oakey Creek
Sandy Creek
Jamiesons Creek
Main Northern Railway
Jail Creek
Callaghans Creek
SWAMP OAK @ LIMBRI
COCKBURN @ KOOTINGAL
COCKBURN @ MULLA XING
Stockyard Creek
Swamp Oak Creek
Cauborn Creek
Branch Creek
Fairy Ground Creek
Teatree Creek
Monkey Creek
Mulla Mulla Creek
Gunyah Creek
Sheerins Creek
Swamp Oak Creek
Boundary Creek
Bungendore Creek
MULLA @ BULLIMBALL
MULLA @ GOLDCLIFF
Loders Creek
Cockburn River
Cockburn River Mgt Zone
Peel Regulated River Alluvium Mgt Zone
N
0
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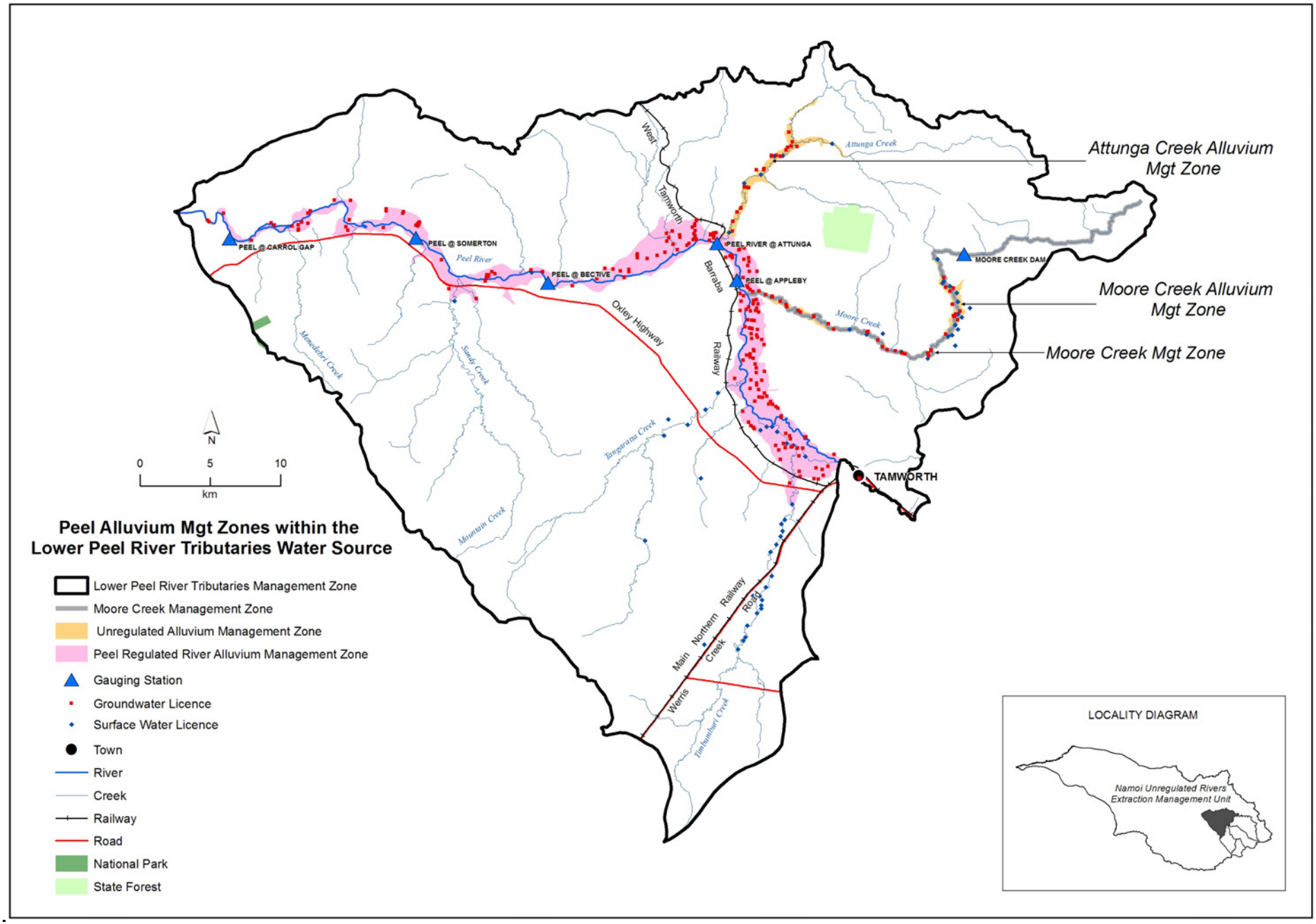
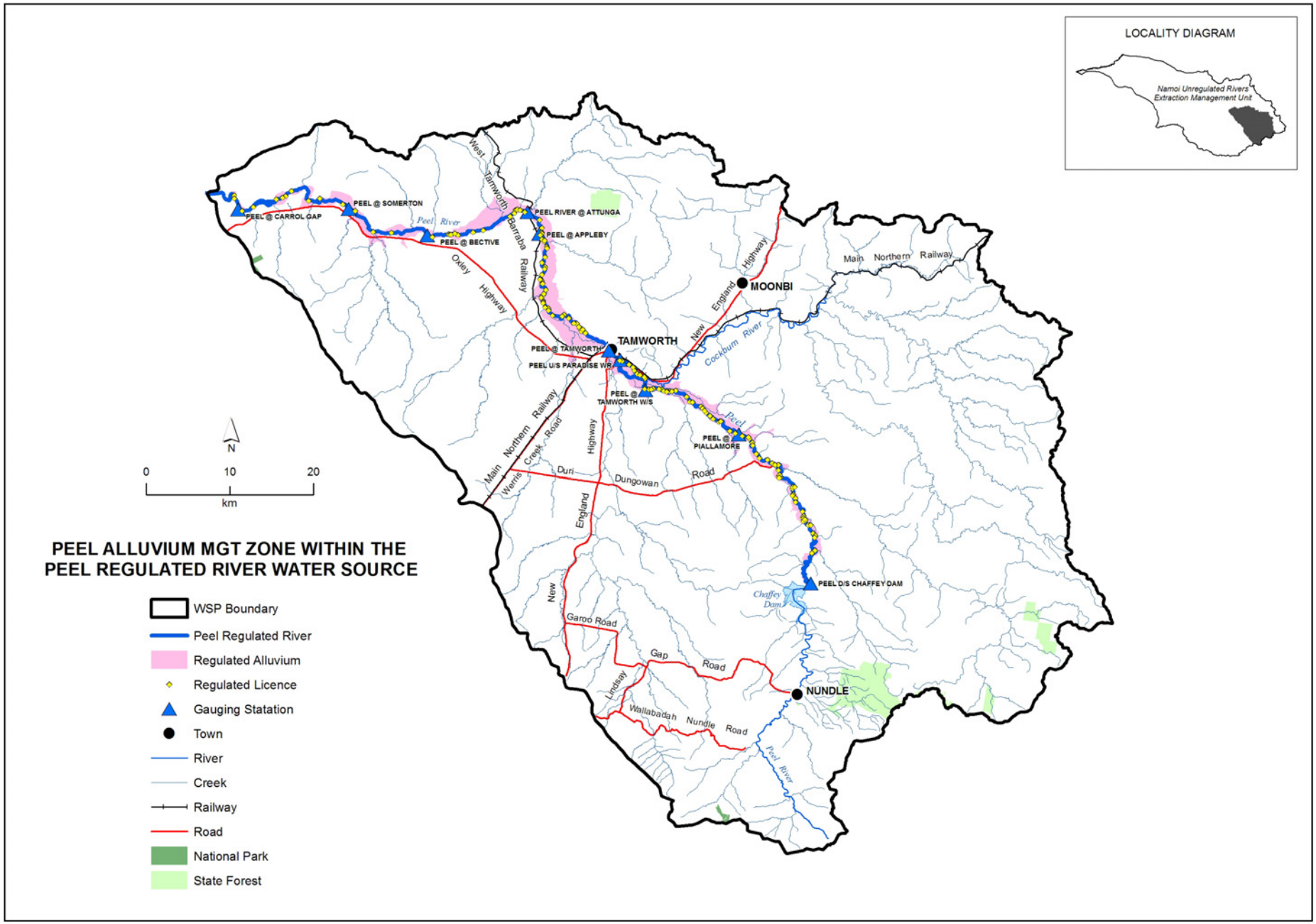
10
km
Peel Alluvium Mgt Zones within the Cockburn River Water Source
Cockburn River Tributaries Management Zone
Cockburn River Management Zone
Cockburn River Alluvium Management Zone
Peel Regulated River Alluvium Management Zone
Gauging Station
Groundwater Licence
Surface Water Licence
Town
River
Creek
Railway
Road


Attunga Creek Alluvium Mgt Zone
Moore Creek Alluvium Mgt Zone
Moore Creek Mgt Zone
PEEL @ CARROL GAP
PEEL @ SOMERTON
PEEL @ BECTIVE
PEEL RIVER @ ATTUNGA
PEEL @ APPLEBY
MOORE CREEK DAM
TAMWORTH
Peel River
Attunga Creek
Moore Creek
West Tamworth
Barraba
Railway
Oxley Highway
Menedahri Creek
Sandy Creek
Tangaratta Creek
Mountain Creek
Main Northern Railway
Creek
Road
Werris
Timbumburi Creek
N
0 5 10
km
Peel Alluvium Mgt Zones within the Lower Peel River Tributaries Water Source
Lower Peel River Tributaries Management Zone
Moore Creek Management Zone
Unregulated Alluvium Management Zone
Peel Regulated River Alluvium Management Zone
Gauging Station
Groundwater Licence
Surface Water Licence
Town
River
Creek
Railway
Road
National Park
State Forest
LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit


LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit
PEEL @ SOMERTON
PEEL @ CARROL GAP
PEEL @ BECTIVE
PEEL RIVER @ ATTUNGA
PEEL @ APPLEBY
PEEL @ TAMWORTH
PEEL U/S PARADISE WR
PEEL @ TAMWORTH W/S
PEEL @ PIALLAMORE
PEEL D/S CHAFFEY DAM
TAMWORTH
MOONBI
NUNDLE
Peel River
West Tamworth Barraba Railway
Oxley Highway
Main Northern Railway
New England Highway
Cockburn River
Main Northern Railway
Werris Creek Road
Duri Dungowan Road
New England Highway
Chaffey Dam
Garoo Road
Gap Road
Lindsay Wallabadah Nundle Road
N
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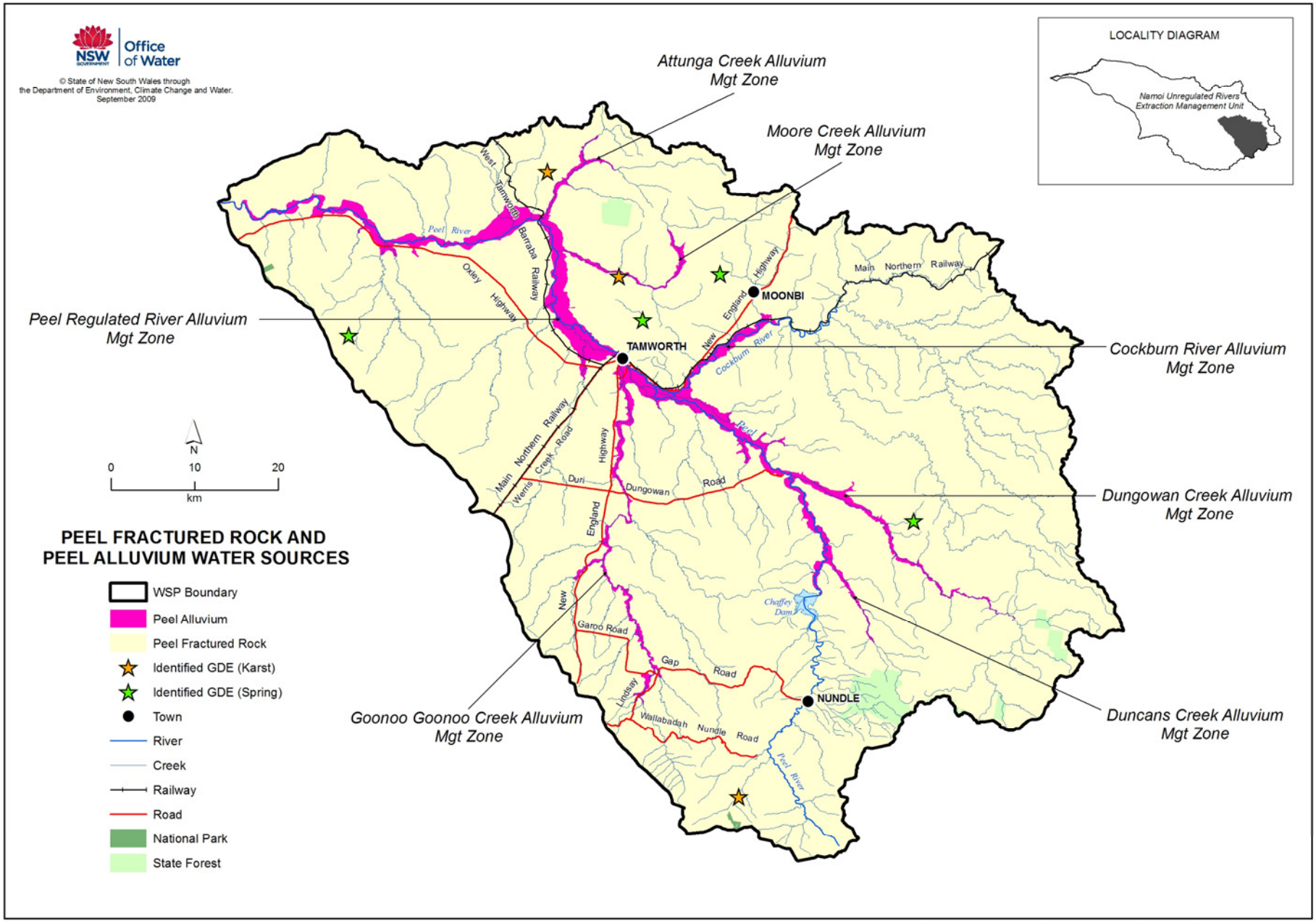
km
PEEL ALLUVIUM MGT ZONE WITHIN THE PEEL REGULATED RIVER WATER SOURCE
WSP Boundary
Peel Regulated River
Regulated Alluvium
Regulated Licence
Gauging Statation
Town
River
Creek
Railway
Road
National Park
State Forest


NSW Office of Water
© State of New South Wales through the Department of Environment, Climate Change and Water. September 2009
LOCALITY DIAGRAM
Namoi Unregulated Rivers Extraction Management Unit
Attunga Creek Alluvium Mgt Zone
Moore Creek Alluvium Mgt Zone
Peel Regulated River Alluvium Mgt Zone
Cockburn River Alluvium Mgt Zone
Dungowan Creek Alluvium Mgt Zone
Goonoo Goonoo Creek Alluvium Mgt Zone
Duncans Creek Alluvium Mgt Zone
TAMWORTH
MOONBI
NUNDLE
Peel River
Cockburn River
Chaffey Dam
Oxley Highway
Barraba Railway
Main Northern Railway
New England Highway
Duri
Dungowan Road
Garoo Road
Gap Road
Wallabadah Nundle Road
Lindsay
Creek Road
Wemis
N
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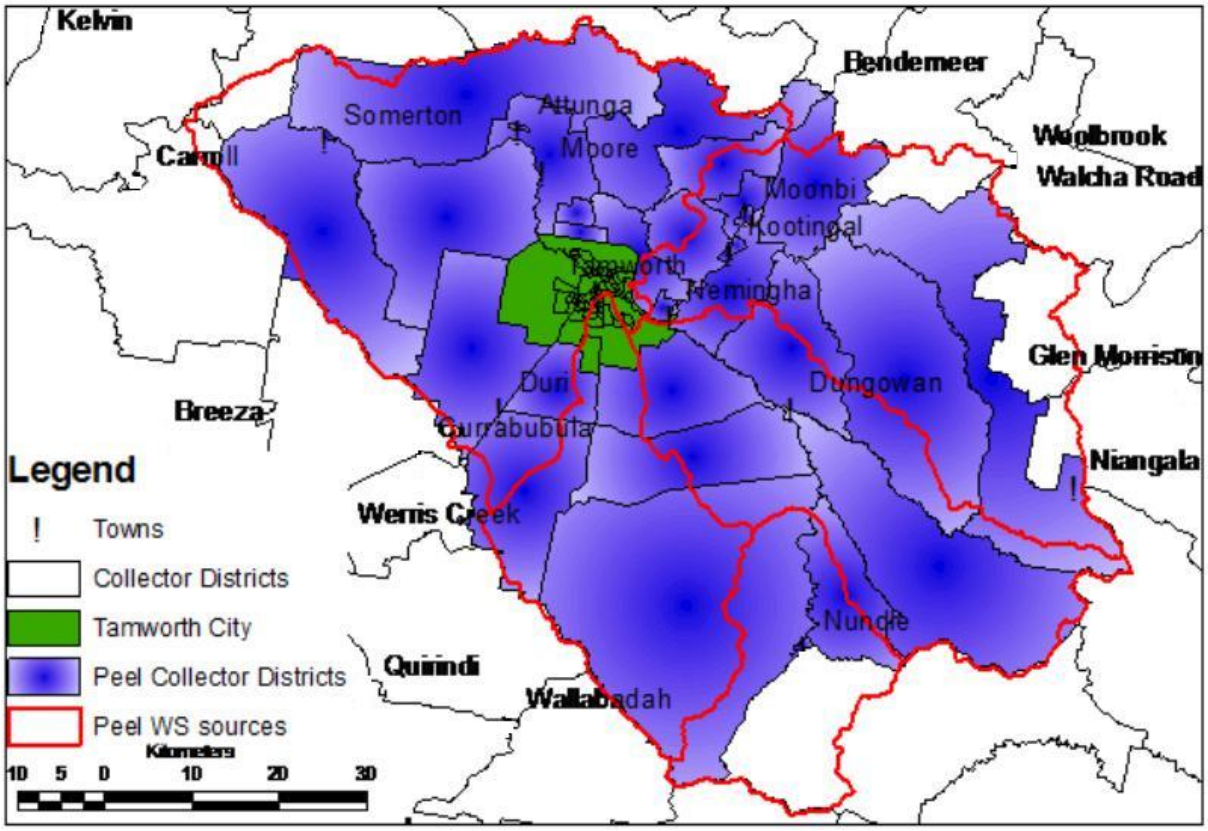
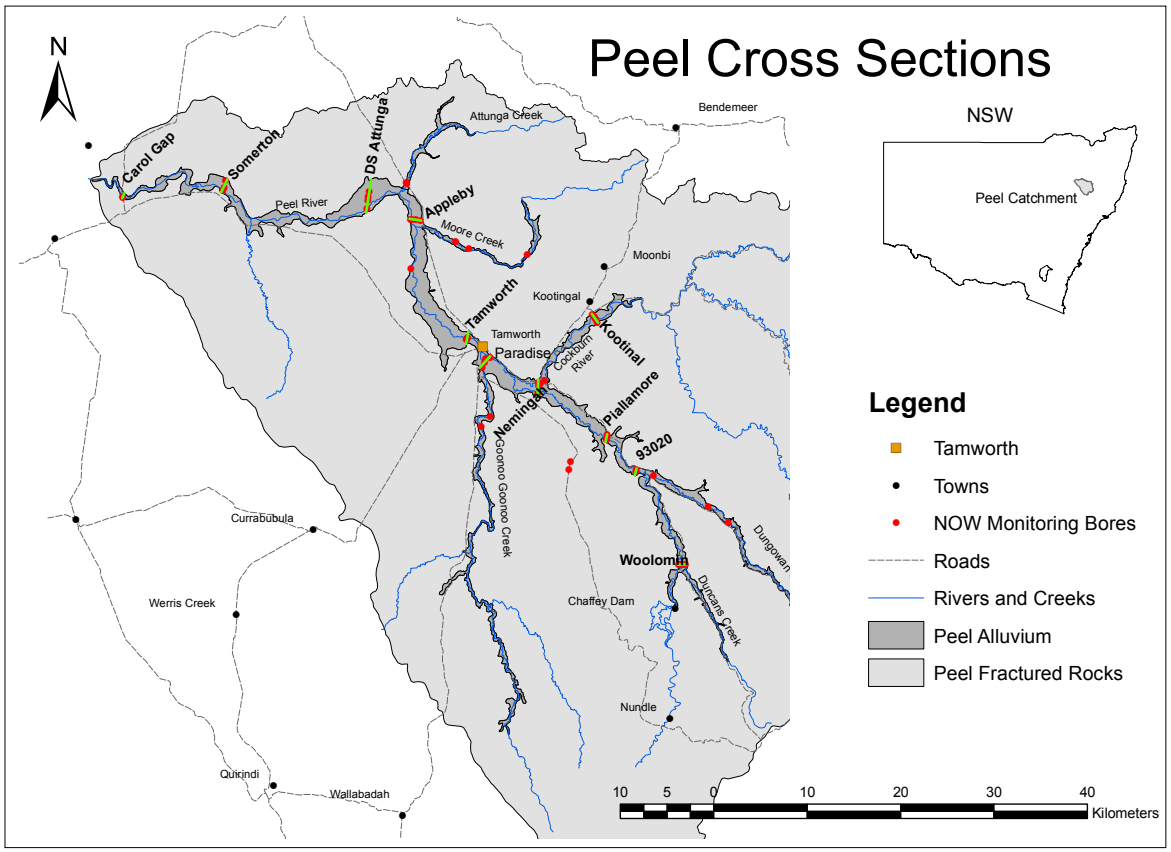
km
PEEL FRACTURED ROCK AND PEEL ALLUVIUM WATER SOURCES
WSP Boundary
Peel Alluvium
Peel Fractured Rock
Identified GDE (Karst)
Identified GDE (Spring)
Town
River
Creek
Railway
Road
National Park
State Forest
Eva CieckoV:\DWE TECH SUPPORT REQUEST\Peel WSP\Peel WSP_Sept 2009\Fractured_Rock.mxd

Appendix 2: Method for estimating population and employment statistics

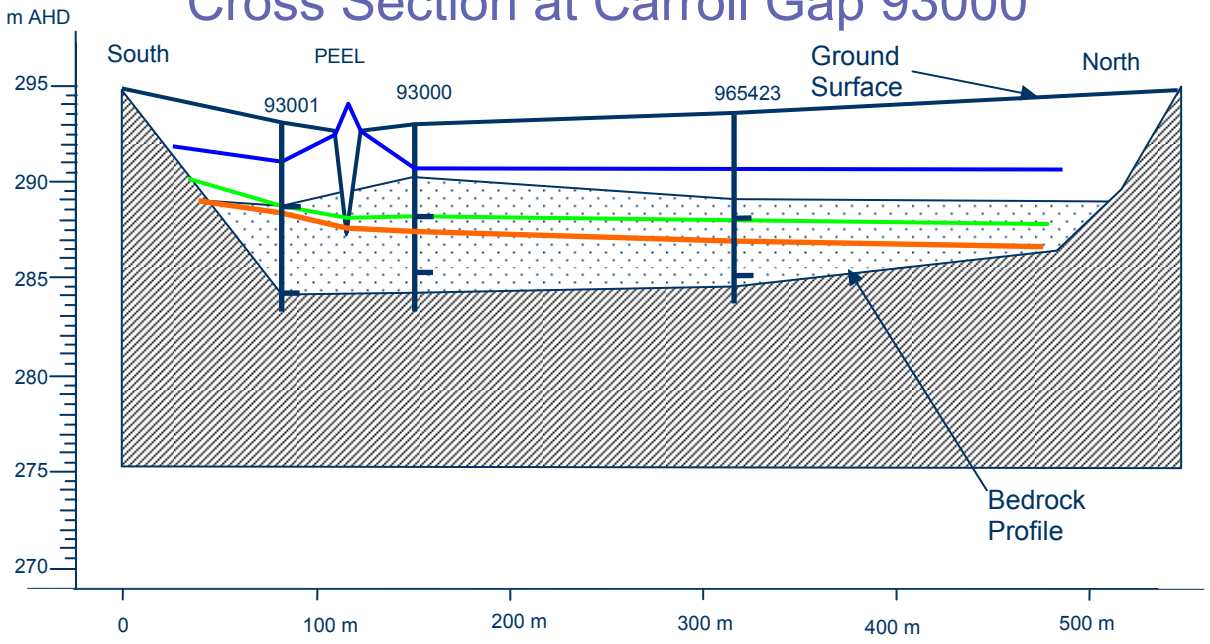
Population and employment statistics have been adapted from the Australian Bureau of Statistics Population and Housing Census 2006. Specifically, collection district area (blue) data has been overlayed on the plan area (red outlined areas) to estimate population statistics (see below). Collection districts have been included on the basis of their centroid lying within the boundaries of the plan area. Given that collection districts consist of only about 225 individuals and that collection districts included closely fit the plan area, estimated population statistics are likely to be representative of the actual population.



Appendix 3: Peel Alluvium cross sections and groundwater levels



Cross Section at Carroll Gap 93000



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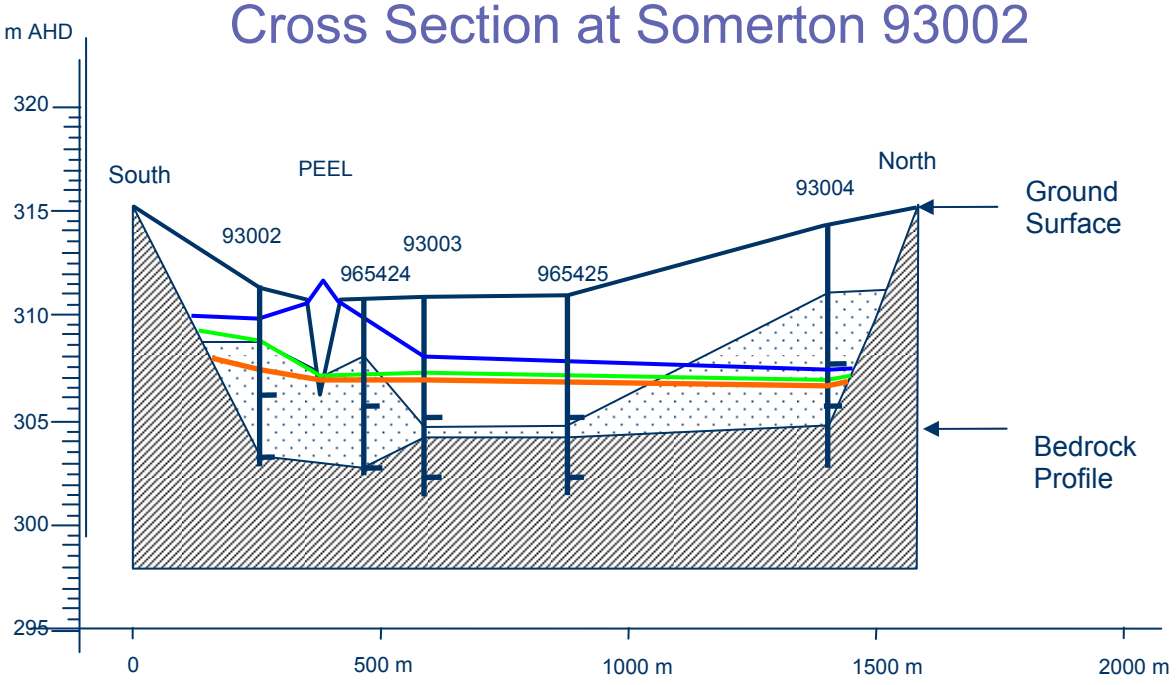
Vertical ~ 1:250

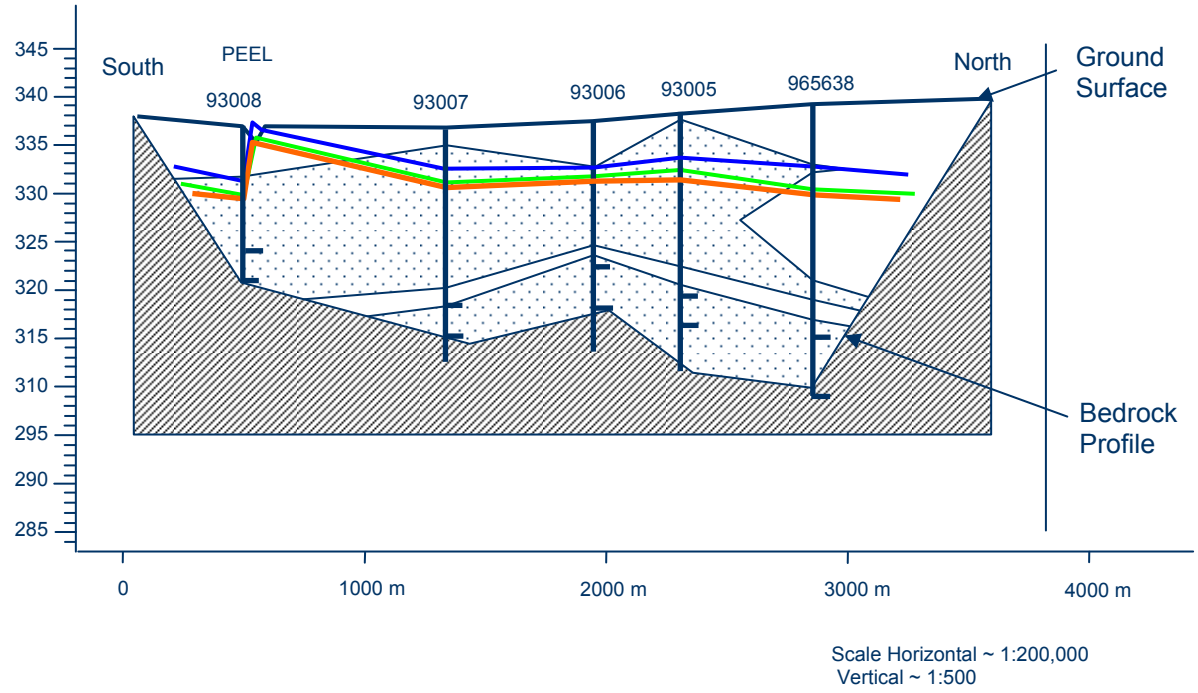
Cross Section at Somerton 93002



Legend
Max GW Level
Average GW Level
Min GW Level
Gravel
Bedrock

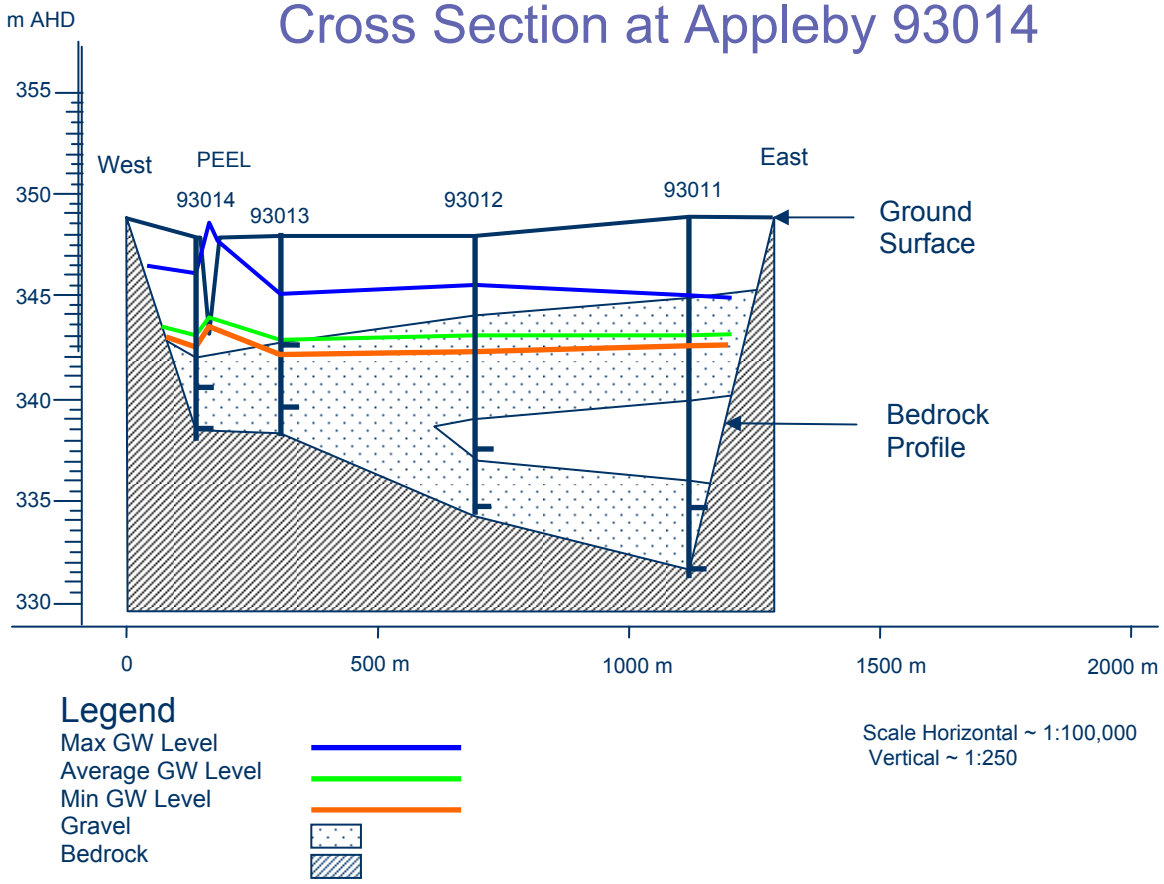
Scale Horizontal ~ 1:100,000
Vertical ~ 1:250

Cross Section Downstream of Attunga 93005

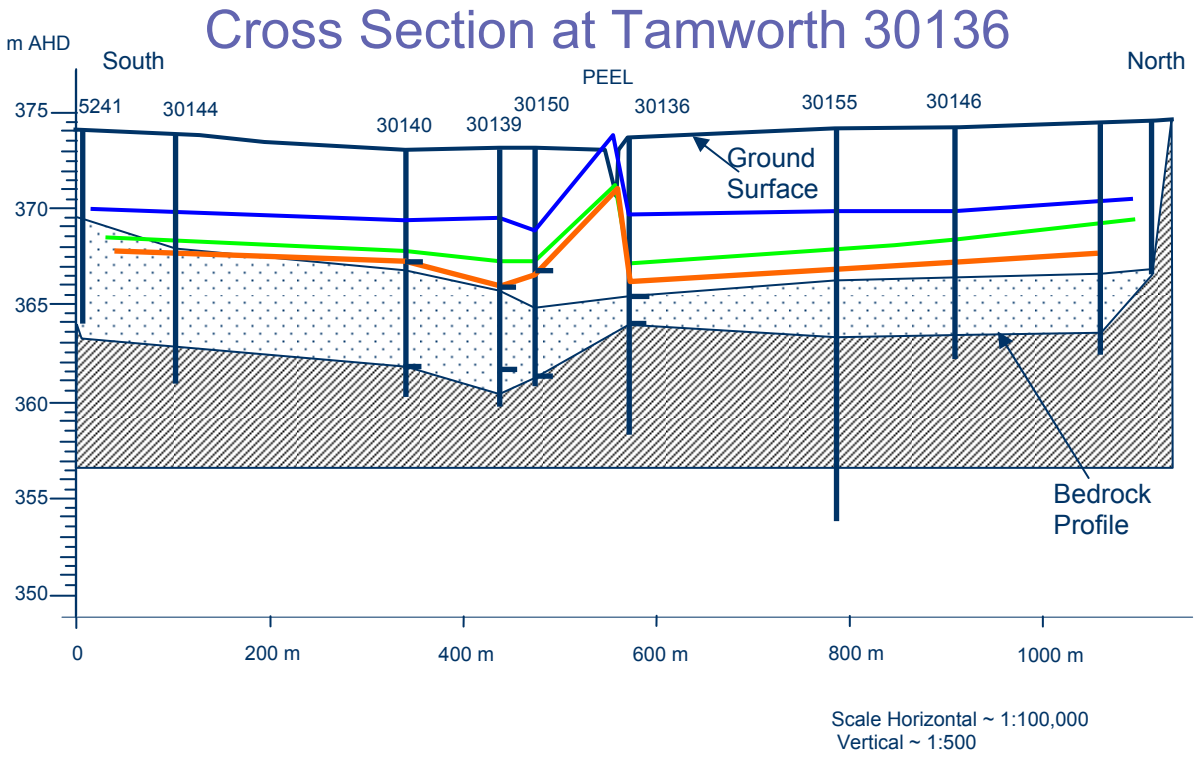


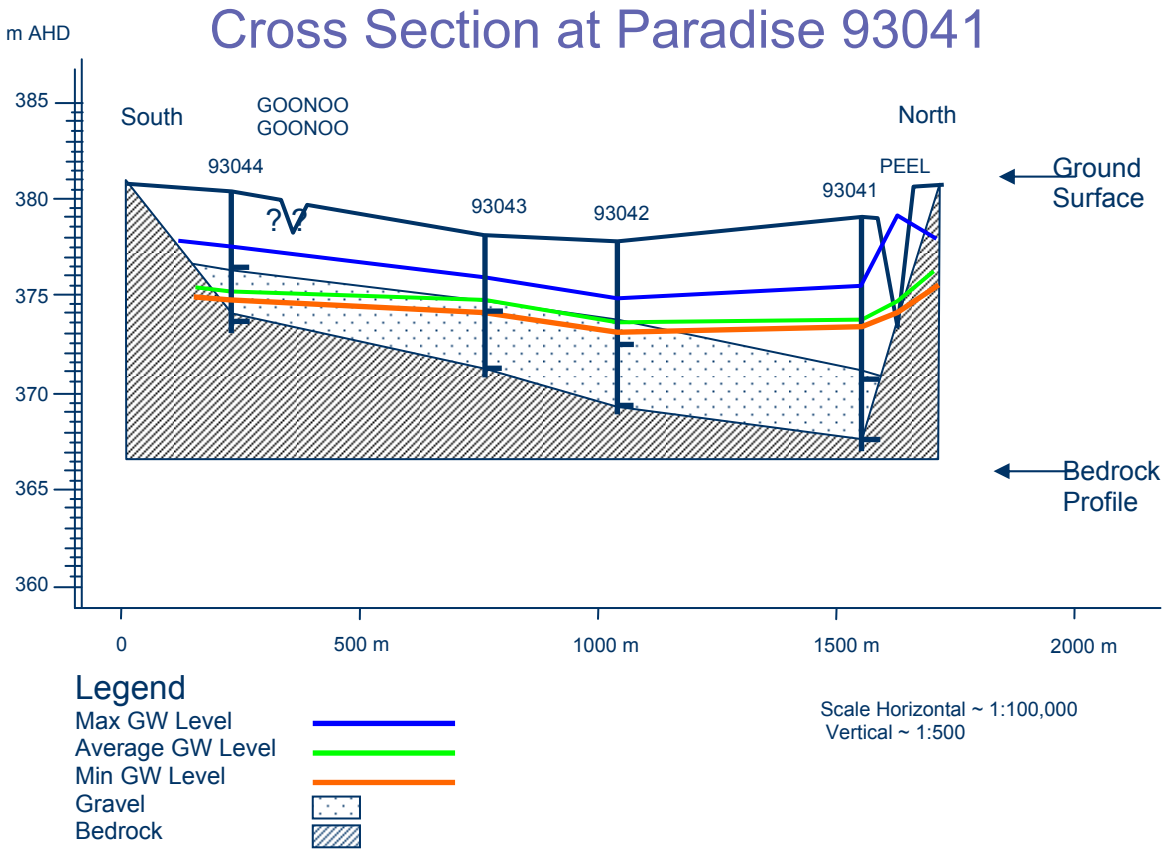
Scale Horizontal ~ 1:200,000
Vertical ~ 1:500

Cross Section at Appleby 93014

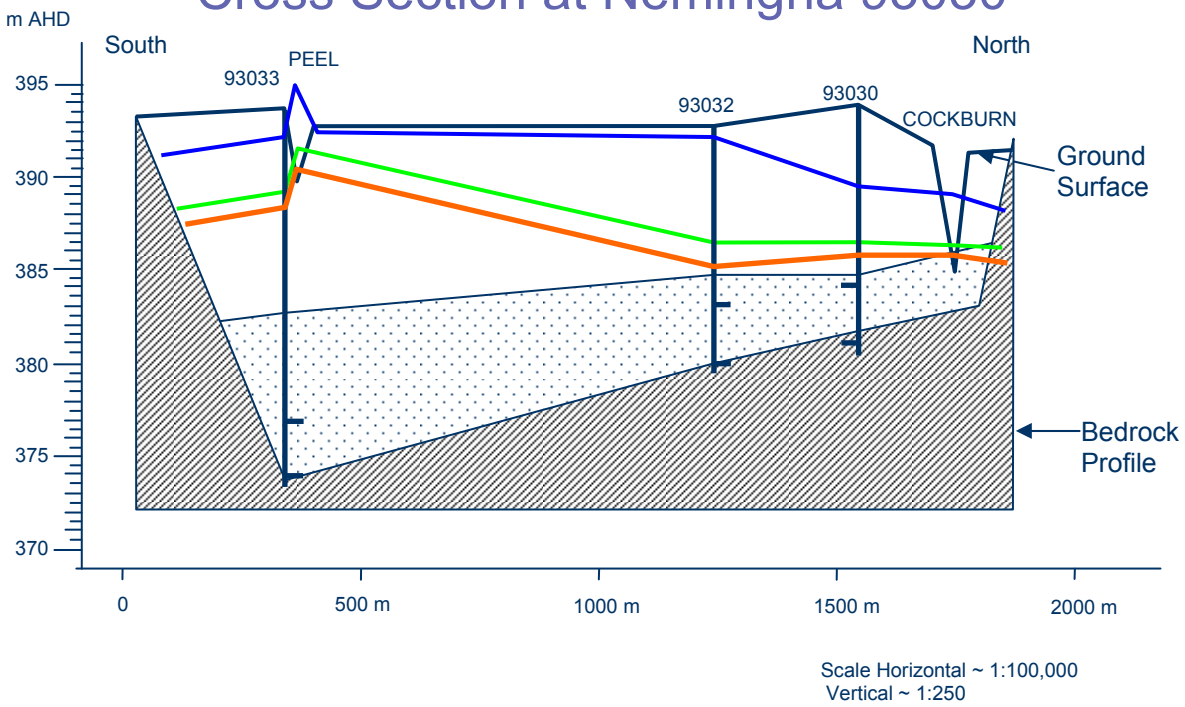


Scale Horizontal ~ 1:100,000
Vertical ~ 1:250


Cross Section at Tamworth 30136
m AHD
South
North
PEEL
5241
30144
30140
30139
30150
30136
30155
30146
Ground Surface
Bedrock Profile
375
370
365
360
355
350
0
200 m
400 m
600 m
800 m
1000 m
Scale Horizontal ~ 1:100,000
Vertical ~ 1:500

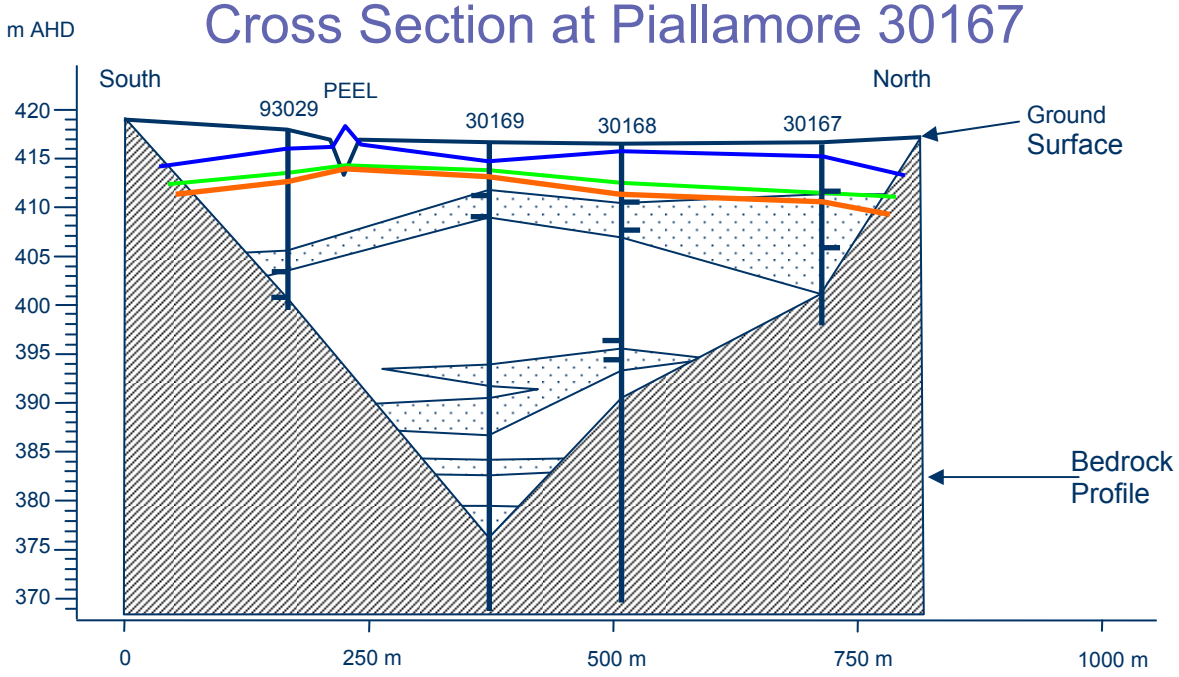

Cross Section at Paradise 93041
m AHD
South
GOONOO
GOONOO
North
PEEL
93044
93043
93042
93041
??
Ground Surface
Bedrock Profile
385
380
375
370
365
360
0
500 m
1000 m
1500 m
2000 m
Legend
Max GW Level
Average GW Level
Min GW Level
Gravel
Bedrock
Scale Horizontal ~ 1:100,000
Vertical ~ 1:500

Cross Section at Nemingha 93030



Scale Horizontal ~ 1:100,000
Vertical ~ 1:250

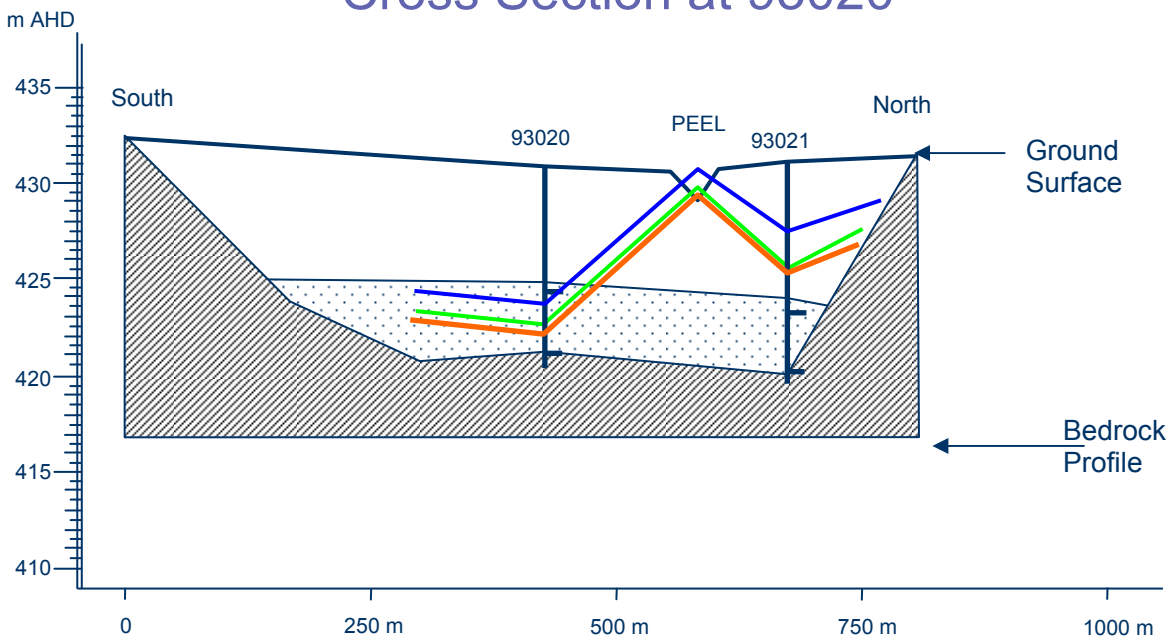
Cross Section at Piallamore 30167



Legend
Max GW Level
Average GW Level
Min GW Level
Gravel
Bedrock

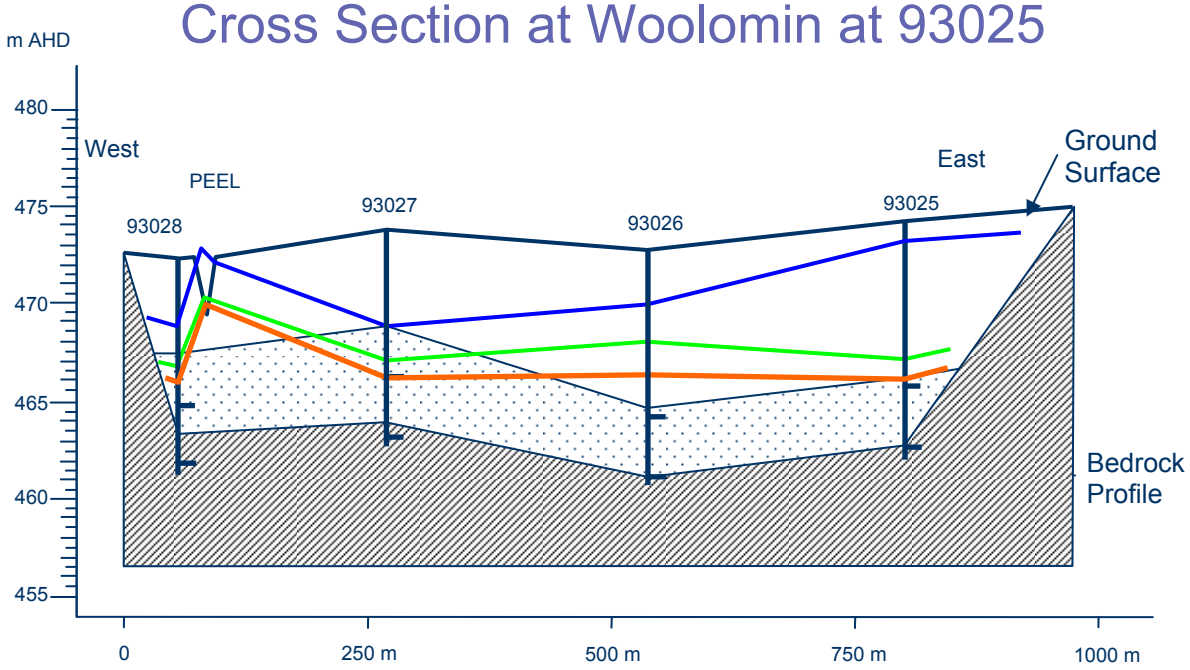
Scale Horizontal ~ 1:50,000
Vertical ~ 1:500

Cross Section at 93020



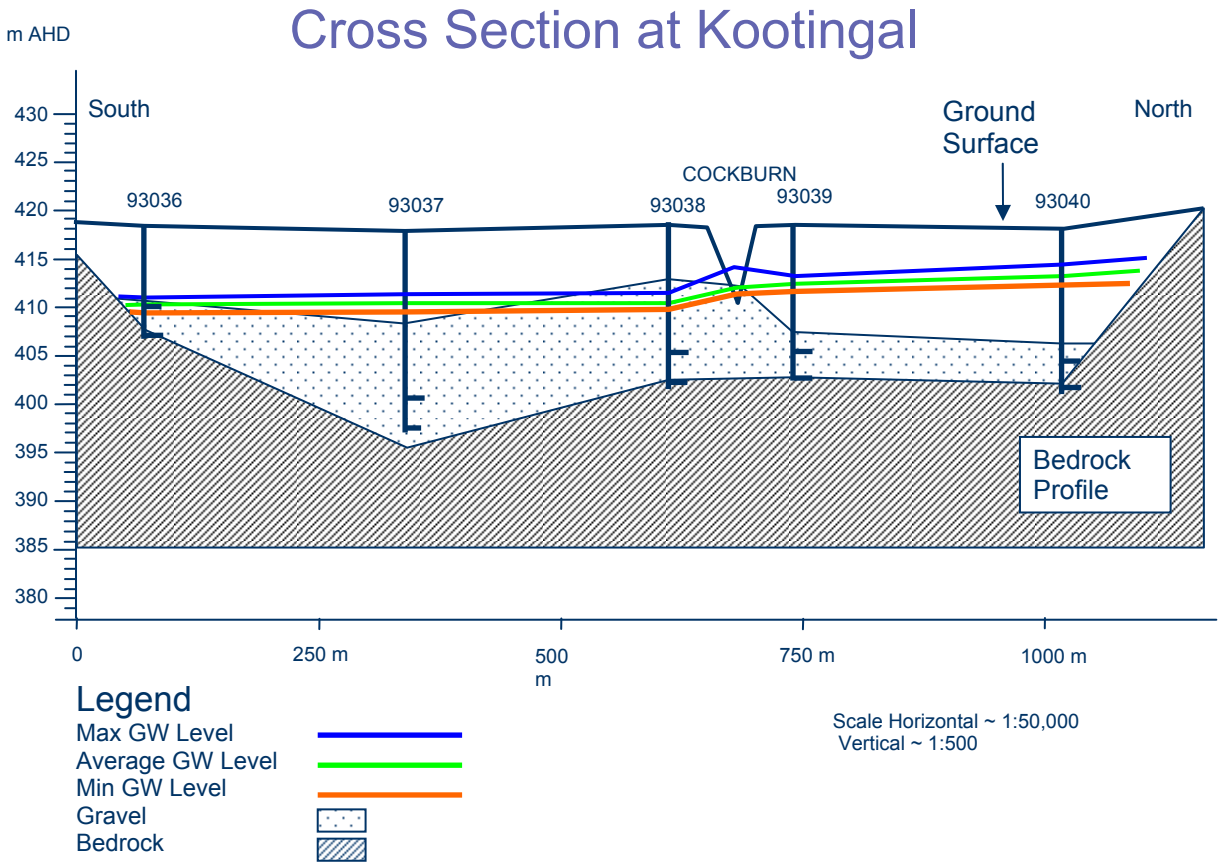
Scale Horizontal ~ 1:50,000
Vertical ~ 1:250

Cross Section at Woolomin at 93025



Legend
- Max GW Level
- Average GW Level
- Min GW Level
- Gravel
- Bedrock

Scale Horizontal ~ 1:50,000
Vertical ~ 1:250


Cross Section at Kootingal
m AHD
South
North
Ground Surface
COCKBURN
93036
93037
93038
93039
93040
430
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420
415
410
405
400
395
390
385
380
Bedrock Profile
0
250 m
500 m
750 m
1000 m
Legend
Max GW Level
Average GW Level
Min GW Level
Gravel
Bedrock
Scale Horizontal ~ 1:50,000
Vertical ~ 1:500

Appendix 4: Peel Interagency Regional Panel and support staff- membership and expertise

Membership and Expertise

Name	Agency	Role	Expertise
Peel IRP			
Anna Bailey	NOW	Agency Representative	Surface water and groundwater management, planning/ policy development and implementation, across the State with particular emphasis on northern inland areas.
Pam Welsh	IIN	Agency Representative	Broad experience in NSW Primary Industries, regional input into water reforms, agriculture, catchment management and land use/strategic planning.
Joshua Gilroy	DECCW	Agency Representative	Broad experience in inland NSW natural resource management and conservation, including the management of environmental water in regulated and unregulated systems.
Sally Egan	Namoi CMA	CMA Observer	Broad experience in catchment management, program development/ implementation and project management, including, soil conservation, land/ biodiversity management and riparian restoration. Community liaison and engagement.
Peter Christmas	NOW	Technical Support / Alternative Representative	Extensive experience in water management and implementation including regulated river operations and local knowledge.
Andrew Scott	IIN	Technical Support / Alternative Representative	Natural resource management, sustainable agriculture focus.
Daryl Albertson	DECCW	Technical Support / Alternative Representative	DECCW Environmental Water Manager, aquatic and wetland ecology.
Support Staff			
Daniel Connor	NOW	Plan Coordinator	Natural resource management, water management and planning.
Emily Turner	NOW	Planning Support	Chemical Engineer.
Gary Coady	NOW	Planning Support	Extensive experience in water management policy and planning.
Rob O'Neill	NOW	Policy and Planning Support	Extensive experience in water management policy and planning.
Mark Harris	NOW	Plan Writer, Legal, Policy and Planning Support	Extensive experience in water management policy and planning.
Ashleigh Mayo	NOW	Plan Writer, Policy Support	Environmental science.
Michelle Blazek	NOW	Legal Advice	Lawyer
Neal Foster	NOW	Technical Support	Aquatic ecology, local knowledge of flow requirements for freshwater biota.
Martin O'Rourke	NOW	Technical Support	Hydrogeologist, local knowledge.
Michael Williams	NOW	Technical Support	Hydrogeologist / groundwater modelling.
Brooke Broadstock	NOW	Technical Support	Hydrogeologist / groundwater modelling.

Name	Agency	Role	Expertise
Shahadat Chowdhury	NOW	Technical Support	Hydrologist/ IQQM.
David Thomas	NOW	Licensing Support	Licensing Officer, Tamworth.
Dennis Milling	NOW	Licensing Support	Licensing Manager, Northern NSW.

Appendix 5: Identified threatened species

It is important to note that the macro water sharing planning 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 threatened species (excluding threatened species of fish) that are known (K) or expected (E) to occur in each water source. For threatened species of fish, a score of 1 means that the species is present but is not in a key location and a score of 2 means that the species is present in a key location.

	Chaffey	Goonoo Goonoo Creek	Upper Peel River Tributaries	Lower Peel River Tributaries	Cockburn River
Fish Species					
Silver Perch	1	1	1	1	1
River Snail				1	
Murray Cod	1	1	1	1	1
Eel-tail catfish					1
Frog Species					
Booroolong Frog (Litoria booroolongensis)	K	K	K	K	K
Davies Tree Frog (Litoria daviesae)	K		K		K
Glandular Frog (Litoria subglandulosa)	K		K		K
Sphagnum Frog (Philoria sphagnicola)	K		K		K
Stuttering Barred Frog (Mixophyes balbus)	K		K		K
Birds					
Australasian Bittern (Botaurus policiloptilus)	K	K	K	K	K
Blue - billed Duck (Oxyura australis)	K	K	K	K	K

Regent Honeyeater (Xanthomyza phrygia)	K	K	K	K	K
Other Fauna					
Bells' Turtle (Elseya bell)				K	K
Greater Broad - nosed Bat (Scoteanax rueppellii)	K	K	K	K	K
Wet Flora Species					
Dungowan Starbush			K		
Endangered ecological communities					
Lower Darling Aquatic Community		K	E	E	E
Upland Wetlands of the Drainage Divide of the New England Tablelands Bioregion.	K				K
Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregion				K	
Threatened populations					
Tusked Frog (Adelotus brevis) population in the Nandewar and New England Tablelands Bioregion.	K		K		K

Disclaimer

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

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

These assessments should not be used for any purpose other than classification of catchment management units as part of the Macro water sharing planning process.

Appendix 6: Identified high priority groundwater dependent ecosystems

Identified high priority groundwater dependent ecosystems in the Peel Valley

Name	GDE Type	Groundwater source	Corresponding Unregulated Surface water source
Black Spring	Spring	Peel Fractured Rock	Upper Peel River Tributaries
Black Spring	Spring	Peel Fractured Rock	Cockburn River
Bundys Spring	Spring	Peel Fractured Rock	Lower Peel River Tributaries
Crawney Pass	Karst	Peel Fractured Rock	Chaffey
Jacks Camp Spring	Spring	Peel Fractured Rock	Lower Peel River Tributaries
Moore Creek	Karst	Peel Fractured Rock	Lower Peel River Tributaries
Sulcor	Karst	Peel Fractured Rock	Lower Peel River Tributaries

Appendix 7: Instream wetland features of the Peel Regulated River

Location	Wetland features	Flow requirements	Comments
Peel River – Chaffey Dam to Dungowan Creek	Instream benches and instream gravel point bars. These features in this zone are in generally good condition with little grazing impacts.. Good source of litter and organic matter. Extensive instream pool habitats	Low level in-stream benches require volumes of approximately 500ML/day to inundate Higher level benches require between 1000 and 2,000 ML/day to inundate. Benches higher in elevation in the reach directly downstream of Chaffey Dam require flows greater than the discharge capacity of dam outlet. Inundation of these occur only when dam spills. Some benches further downstream require volumes of 2,000 – 4000ML/day to inundate.	Mountainous to low hilly countryside with some floodplain development near Woolomin and Dungowan. Peel River channel generally confined due to topography. Upstream reaches of Peel River directly downstream of Chaffey Dam narrowing and becoming invaded by riparian vegetation due to regulation and lack of high velocity flows. Gravel in stream becoming immobile and encrusted with filamentous algal mats during summer. **Riverine vegetation** Various sedges, rushes and reeds on waters edge. Bank vegetation includes Casuarina cunninghamiana, Angophora floribunda, Eucalypt woodland (red gum), Callitris, Figs, Lomandra, Blackthorn, and various shrubs and grasses. **Water Birds** - Straw – necked ibis often observed on floodplain areas in this zone.
Peel River - Dungowan Creek to Cockburn River	Instream benches and instream gravel point bars.. These features in this zone are in generally good condition with little grazing impacts. Good source of litter and organic matter. Extensive instream pool habitats Groundwater connection to potentially Groundwater Dependent vegetation (red gums) on floodplains via buried prior stream channels.	Low level in-stream benches require volumes of approximately 500ML/day to inundate Higher level benches require between 1000 and 2,000 ML/day to inundate. Some benches further downstream require a range of volumes between of 2,000 – 10000ML/day to inundate and are only generally wetted during natural flood events..	Low hilly countryside and less confining than upstream reaches of above zone. The Peel River channel is wider and deeper due to the influence of tributary inflows of Dungowan Creek and other smaller systems. Instream gravel bars generally mobile and important habitat. Bench formation due to gravel deposition more common. Piallamore anabranch is an important habitat area in this zone but is generally only filled by significant natural flooding or by overland flows. There is generally very active channel and bed sediment transport occurring. The Peel River has been very confined on floodplain upstream of confluence with Cockburn River due to construction of levee. Velocity of flow in these reaches are generally increased with insignificant bench formation occurring. **Riverine Vegetation** – River red, river oaks and willows. Narrow strip of remnant along the banks. **Floodplain vegetation** – rough-barked apple in association with river red gum. Red Gum communities that occur in this area may be to some degree Groundwater Dependent, relying on connection to the river via buried prior stream channels and aquifers. A well developed floodplain system is present in this zone. **Water Birds** - Straw – necked ibis observed in these watercourses in April 1991.
Peel River – Cockburn River to Appleby	Small flood runners and anabranches, instream benches and terraces. Point gravel bars. Extensive instream pool habitats Groundwater connection to potentially Groundwater Dependent vegetation (red gums) on floodplains via buried prior stream channels.	Low level in-stream benches require volumes of approximately 500ML/day to inundate Higher level benches require between 1000 and 2,000 ML/day to inundate. Some benches further downstream require a range of volumes between of 2,000 – 10000ML/day and some terraces / floodrunners between 10,000 and 20,000 ML/day to inundate and are only wetted during natural flood events.	This zone of the Peel River is characterised by a well formed floodplain and the formation of an anabranch system directly downstream of Tamworth. Although defined as Unregulated, the Peel Anabranch is a major habitat area, however, it is highly degraded due to long-term innappropriate gravel extraction operations. A sheet-pile weir has been constructed at its upstream end to prevent in- channel regulated flows from entering the anabrach channel. The Peel River is joined by a number of major tributaries in this zone. Goonoo Goonoo being the largest contributor and Tangaratta, Timbumburi, Moore and Attunga Creeks (although being generally ephemeral streams) providing inflows. The most significant barrier to fish passage in the Peel after Chaffey Dam, the Jewry Street crossing is located directly downstream of Tamworth and upstream of the Peel Anabranch entrance. Altered vegetation cover and associated land use changes have included incision by bed lowering (probably associated with headward extension of headcuts) and subsequent channel expansion. Prospects for channel recovery are constrained by the limited amounts of Large Woody Debris (LWD) present in degraded reaches. The continuing decline of *Eucalyptus camaldulensis* on upper banks further restricts natural inputs of LWD in the medium to long term.

			Riverine Vegetation – *Casuarina cunninghamiana, Eucalyptus camaldulensis, Angophora floribunda, Osage orange, Salix sp., Phragmites,* sedges, reeds, various grasses and weeds. Many areas where riparian vegetation has been removed or is not regenerating. Vegetation constriction of the channel also occurs, particularly near Oxley Vale, where 'rafting' or log jams have occurred in the past. **Floodplain vegetation** – generally utilised for crops (lucerne) and grazing. Rough-barked apple in association with river red gum. Red Gum communities that occur on the floodplain in this area may be to some degree Groundwater Dependent, relying on connection to the river via buried prior stream channels and aquifers. Riparian vegetation in this zone is often poorly represented due to poor land management practices. **Water Birds** - Straw – necked ibis and cattle egrets observed feeding on the floodplain.
Peel River – Appleby to Somerton	Small flood runners and anabranches, instream benches and terraces. Point gravel bars. Extensive instream pool habitats Groundwater connection to potentially Groundwater Dependent vegetation (red gums) on floodplains via buried prior stream channels.	Low level in-stream benches require volumes of approximately 500ML/day to inundate Higher level benches require between 1000 and 2,000 ML/day to inundate. Some benches further downstream require a range of volumes between of 2,000 – 10000ML/day and some terraces / floodrunners between 10,000 and 20,000 ML/day to inundate and are only wetted during natural flood events.	This zone of the Peel River is generally characterised by an extensive complex of small anabranches on the floodplain and benches/terraces within the river channel. The Peel channel is in many locations within this zone very degraded. Loss of instream pools and vertical riverbanks due to riverbed erosion, altered vegetation cover and associated land use changes (probably associated with headward extension of headcuts) and subsequent channel expansion. Prospects for channel recovery are constrained by the limited amounts of Large Woody Debris (LWD) present in degraded reaches. **Riverine Vegetation** – *Casuarina cunninghamiana, Eucalyptus camaldulensis, Angophora floribunda, Osage orange, Salix sp., Phragmites,* sedges, reeds, various grasses and weeds. Many areas where riparian vegetation has been removed or is not regenerating. Narrow strip of remnant along the banks. **Floodplain vegetation** – rough-barked apple in association with river red gum. **Water Birds** - Straw – necked ibis observed in these watercourses in April 1991.
Peel River _ Somerton to Namoi River	Instream benches and terraces. Point gravel bars. Small wetland area and lagoon near Somerton connected to Peel during very high flows or from overland flows. Groundwater connection to potentially Groundwater Dependent vegetation (red gums) on floodplains via buried prior stream channels.	Low level in-stream benches require volumes of approximately 500ML/day to inundate Higher level benches require between 1000 and 2,000 ML/day to inundate. Some benches further downstream require a range of volumes between of 2,000 – 10000ML/day and some terraces / floodrunners between 10,000 and 20,000 ML/day to inundate and are only wetted during natural flood events.	The Peel River enters a zone where the channel becomes more confined and dominated by higher relief topgraphy and bed rock substrate. The Peel channel directly downstream of Somerton is in many locations very degraded. Loss of instream pools and vertical riverbanks due to riverbed erosion, altered vegetation cover and associated land use changes (probably associated with headward extension of headcuts) and subsequent channel expansion. Prospects for channel recovery are constrained by the limited amounts of Large Woody Debris (LWD) present in degraded reaches **Riverine Vegetation** – River red gum, river oaks and willows. Many terrestrial weeds Narrow strip of remnant along the banks. **Floodplain vegetation** – rough-barked apple in association with river red gum. **Water Birds** - Straw – necked ibis and cattle egret observed often o feeding on floodplain

Appendix 8: Peel Integrated Quantity and Quality Model

The Peel Integrated Quantity and Quality Model (Peel IQQM) relies on calibration against historical stream flow, rainfall, dam operation and water extraction activities. The model can then be used to:

- create 'natural' stream flow sequence by removing dams and estimated extraction
- assess reliability for different categories of licences under current and full development
- assess the interaction between the unregulated rivers, groundwater and the Peel Regulated River
- assess the likely improvement to the environment and impact on users of flow rules.

The IQQM cannot forecast flows or flood levels, determine the state of the catchment in the future, assess the impacts of catchment change, or assess the effectiveness of individual farm cropping practices or operation.

The Office developed and calibrated an IQQM for the Peel River from Chaffey Dam to Carroll Gap. This models the operation of the dams and tributaries to meet water demands of town, environmental, domestic, and stock and irrigation use. The model assessed long-term behaviour on 117 (1892 to 2008) years of historical climate data and outputs data on a daily time step. Tamworth's water needs were modelled by a climatically adjusted daily pattern regression model and irrigation needs were calibrated on past practices and determined by soil moisture conditions.

The major hydrologic processes modelled by the Peel IQQM include

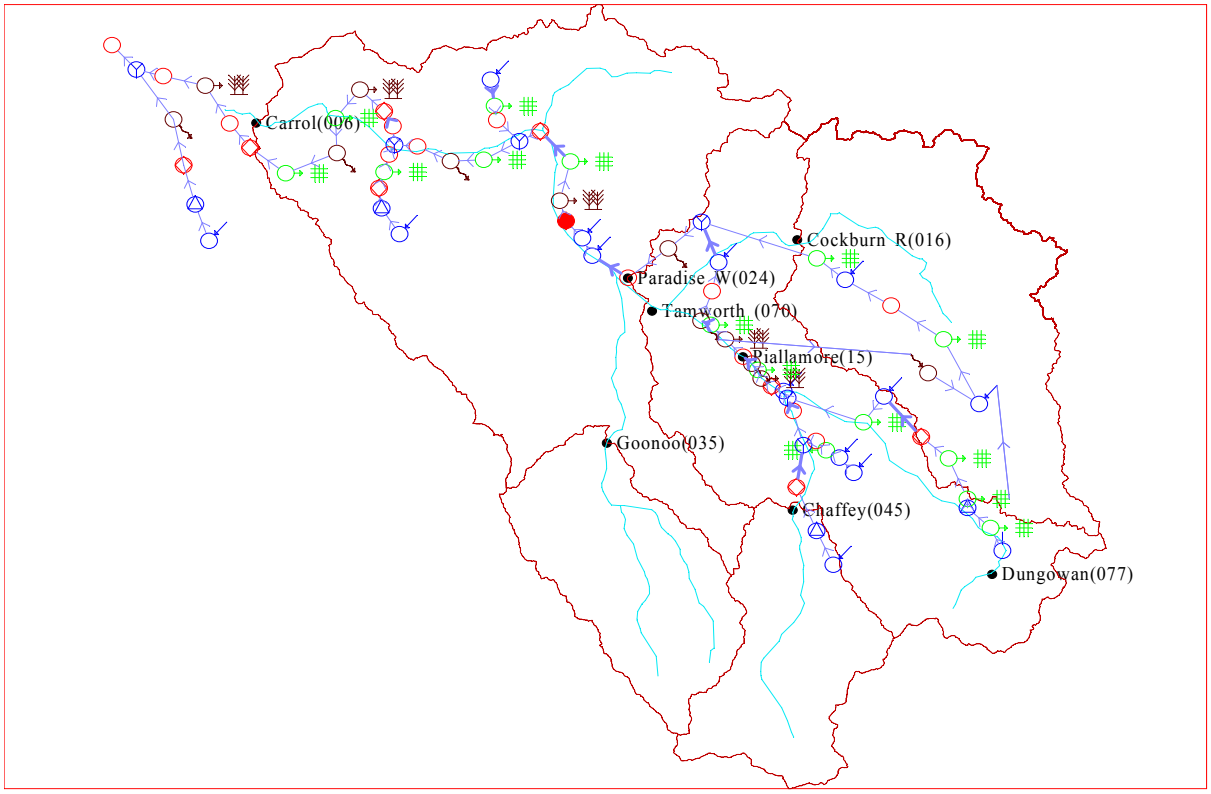
- dam and gauged inflows (historical data gap filled and extended)
- ungauged inflows (estimated)
- Dungowan and Chaffey Dam infrastructure and operations
- water orders, dam releases and routing of flows in the Peel River
- Regulated River Irrigation areas, crop demands, water orders and pumped diversions
- Tamworth water supplies demands, orders and diversions
- stock and domestic diversions
- environmental flows needs
- surplus flow management
- river losses or unexplained differences (lumping seepage, evaporation, over bank flows, un-measured extractions and measurement errors)
- the Office Resource Assessment.

Major hydrologic processes not modelled include

- water diversions on tributaries
- land use change
- surface water – groundwater interaction (partially represented with loss nodes)
- conjunctive use of surface water and groundwater on farms for irrigation of area planted.

The model represents the Peel River systems using nodes and links. Nodes represent locations along the river where flow enters, is stored, extracted, lost or measured; while links are used to model the movement of water between nodes (see below).

Configuration of the Peel model



Types of input data collected for the Peel IQQM consisted of:

- rainfall (BOM data gap filled and extended)
- evaporation (BOM data gap filled and extended)
- inflows (gauged data gap filled and extended)
- groundwater (not specifically used in model)
- crop type and irrigated area (surface water data from survey)
- stock and domestic extractions (observed diversions)
- town water diversions (observed diversions)
- storage information (State Water and NOW data)
- resource assessment parameters (NOW).

The aim is to achieve the best match possible between the modelled output and the observed data over a given period of record. The model calibration is performed over a period when data is available and there is sufficient climatic variability. Recent improvements include the data update to 2008 including recalibration of flows during recent drought conditions, addition of the drought index to the model to better represent river losses in dry and wet conditions. Further, the estimation of Dungowan Dam inflows has been improved with the addition of extra data.

The Peel IQQM has been independently audited and effectively accredited (waiting final sign off) by the Murray-Darling Basin Authority for undertaking auditing of the Murray-Darling Basin Cap.

Appendix 9: Environmental flow rule modelling scenarios

General

1. This appendix list the environmental flow scenarios considered by the Peel Interagency Regional Panel. NSW Office of Water ran many additional scenarios. All scenarios tested and their results will be available in a published report during public exhibition of the plan.
2. All stimulus releases shown below are referred to in terms of their peak flow, each includes:
    - 1 day rising stage
    - 1 day at peak flow (ML/day)
    - 5 day recession stage

Current Chaffey Dam

IQQM Run N100

Natural conditions (no dam, no extraction)

IQQM Run R107

Current Chaffey Dam conditions, i.e. current water sharing arrangements prior to the plan.

1. Stimulus Flow Rule

IQQM Run W41

Release 500 ML/day during period March-August if no discharge greater than 500ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

IQQM Run W42

Release 1200 ML/day during period March-August if no discharge greater than 1200ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

2. Translucent Flow Rule

IQQM Run W35

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day between the months Oct-Feb inclusive, then release 50 per cent of the daily inflows as a translucent flow. This release would be made up to the Dam’s release valve capacity and after all orders and losses are accounted.

3. Transparent Flow Rule

IQQM Run W36

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day between the months Oct-Feb inclusive, then release 100 per cent of the daily inflows as a transparent flow. This release would be made up to the Dam’s release valve capacity and after all orders and losses are accounted.

4. No Debit / Supplementary Access Trigger

IQQM Run W53

Allow access to no-debit/ supplementary water when flows exceed 500ML/day at Carroll Gap

Share flows above 500ML/day between users and the environment at 50:50

5. Environmental contingency allowance

IQQM Run W55

Create a conditional 2 GL environmental contingency allowance in Chaffey Dam.

When Chaffey Dam reaches 50 GL capacity, all inflows are reserved as Environmental Water. When inflows have totalled 2,000 ML this volume is available for release as environmental water. Assume in each water year where the ECA is available that it is completely used within that year. There is no carryover of environmental water from one water year to the next.

IQQM Run W56

ECA conditions as per run W55, with full growth in Tamworth Regional Council diversions to entitlement, i.e. 16, 400 ML.

Enlarged Chaffey Dam

IQQM Run W07

Enlarged Chaffey Dam (100 GL) with current water sharing arrangements.

1. Stimulus Flow Rule

IQQM Run W43

Release 500 ML/day during period March-August if no discharge greater than 500ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

IQQM Run W44

Release 1200ML/day during period March-August if no discharge greater than 1,200ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

2. Translucent Flow Rule

IQQM Run W37

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day between the months Oct-Feb inclusive, then release 50 per cent of the daily inflows as a translucent flow. This release would be made up to the Dam’s release valve capacity and after all orders and losses are accounted.

IQQM Run W38

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day, then release 50 per cent of the daily inflows as a translucent flow. This release would be made up to the Dam’s release valve capacity and after all orders and losses are accounted.

3. Transparent Flow Rule

IQQM Run W39

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day between the months Oct-Feb inclusive, then release 100 per cent of the daily inflows as a transparent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W40

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day, then release 100 per cent of the daily inflows as a transparent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

4. Combination Stimulus Flow Rule and Translucent Flow Rule

IQQM Run W45

Release 500 ML/day stimulus flow during period March-August if no discharge greater than 500ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day between the months Oct-Feb inclusive, then release 50 per cent of the daily inflows as a translucent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W46

Release 500 ML/day stimulus flow during period March-August if no discharge greater than 500ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day, then release 50 per cent of the daily inflows as a translucent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W47

Release 1200 ML/day stimulus flow during period March-August if no discharge greater than 1,200ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day between the months Oct-Feb inclusive, then release 50 per cent of the daily inflows as a translucent

flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W48

Release 1200 ML/day stimulus flow during period March-August if no discharge greater than 1,200ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 1,000 ML/day, then release 50 per cent of the daily inflows as a translucent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

5. Combination Stimulus Flow Rule and Transparent Flow Rule

IQQM Run W49

Release 500 ML/day stimulus flow during period March-August if no discharge greater than 500ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day between the months Oct-Feb inclusive, then release 100 per cent of the daily inflows as a transparent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W50

Release 500 ML/day stimulus flow during period March-August if no discharge greater than 500ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day, then release 100 per cent of the daily inflows as a transparent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W51

Release 1200 ML/day stimulus flow during period March-August if no discharge greater than 1,200ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day between the months Oct-Feb inclusive, then release 100 per cent of the daily inflows as a transparent

flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

IQQM Run W52

Release 1200 ML/day stimulus flow during period March-August if no discharge greater than 1,200ML/day has occurred at Piallamore in the preceding 90 days and the Dam's capacity is greater than 50GL.

AND

Capture all inflows when the Dam's storage level is less than 50GL.

When the Dam's storage level is greater than 50GL, and its inflows are greater than 500 ML/day, then release 100 per cent of the daily inflows as a transparent flow. This release would be made up to the Dam's release valve capacity and after all orders and losses are accounted.

6. Environmental contingency allowance

IQQM Run W57

Create an ECA, designed to mimic the impacts of IQQM Run W52. In this case the ECA is 5 GL, with the following conditions:

- Water to be credited to the ECA account at the same rate as general security allocations to licences.
- The ECA is subject to annual accounting with no carryover.
- The ECA is made independent of dam spill events, i.e. its account balance is not reset when the dam spills.
- If releasing the total combined consumptive orders and the ECA is limited by valve capacity, consumptive water orders have a higher priority for release than environmental water

IQQM Run W58

ECA conditions as per run W55, with full growth in Tamworth Regional Council diversions to entitlement, i.e. 16, 400 ML.

Appendix 10: Final classification summary

Value matrix

	Low hydrologic stress or hydrologic risk	**Medium hydrologic stress or hydrologic risk**	**High hydrologic stress or hydrologic risk**
High In-stream Values	A Chaffey	B	C Cockburn River Upper Peel River Tributaries
Medium In-stream Values	D	E	F Lower Peel River Tributaries
Low In-stream Values	G	H	I Goonoo Goonoo Creek

Risk matrix

High Risk to In-stream Values	A	B Cockburn River Upper Peel River Tributaries	C
Medium Risk to In-stream Values	D	E Lower Peel River Tributaries	F
Low Risk to In-stream Values	G Chaffey Goonoo Goonoo Creek	H	I
	Low dependence on extraction	**Medium dependence on extraction**	**High dependence on extraction**

Appendix 11: Peel Alluvium management zone boundaries definition

Peel Alluvium management zones boundaries definition

Peel Alluvium management zone	From	To	Justification
Peel Regulated River	Chaffey Dam	Junction of the Peel and Namoi Rivers	Regulated length of the Peel River
Attunga Creek	Southern boundary of Lot 62 DP753834 and Lot 9 DP923273 See figure 1	Upstream as far as the unregulated alluvials extend	Cadastre at end of Attunga Creek
Moore Creek	Upstream of the centre line of Manilla Road See figure 2	Upstream as far as the unregulated alluvials extend	Manilla road is a known easily marked boundary near the end of Moore Creek
Cockburn River	Upstream of a line from where the Nundle Road crosses the eastern edge of the alluvial aquifer, west along Nundle Road, then south-east along Back Kootingal Road, south-south-east along Cross Park Road then north along the eastern boundary of Lot 1 DP 91192, then north-east across the Cockburn River, then north along the eastern boundary of Lot 204705, then north across the Armidale Road and then north along the eastern boundary of Lot 2 DP 204705 to the edge of the northern side of the alluvial aquifer. See figure 3	Upstream as far as the unregulated alluvials extend	The collective local knowledge of the Minister Peel Advisory Group advised that this is the most appropriate place to define the boundary
Dungowan Creek	South along the centre line of Nundle Road from the junction of Ogunbil Road. See figure 4	Upstream as far as the unregulated alluvials extend	Nundle road is a know easily marked boundary near the end of Dungowan Creek
Duncans Creek	North East along the centre line of Davis Street then south east along the centre line of Jones Street and the north east along through Lot 7010 DP1024740 See figure 5	Upstream as far as the unregulated alluvials extend	David Street and Jones Street are easily marked boundaries near the end of Duncans Creek
Goonoo Goonoo Creek	East along the centre line of Scott Road and then south along Goonoo Goonoo Creek See figure 6	Upstream as far as the unregulated alluvials extend	Scott Road and Goonoo Goonoo Creek are easily marked boundaries at the end of Goonoo Goonoo Creek

Figure 1: Junction between Attunga Creek Alluvium and Peel Regulated River Alluvium

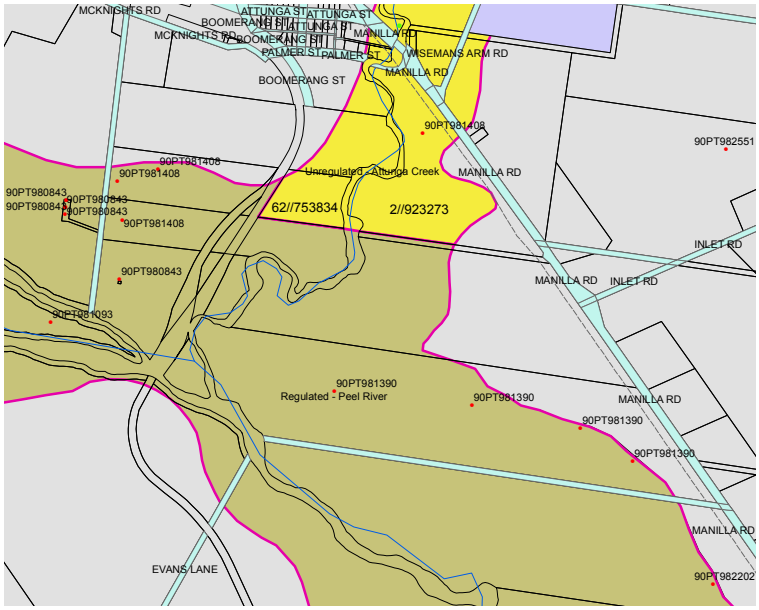


Figure 2: Junction between Moore Creek Alluvium and Peel Regulated River Alluvium

Figure 3: Junction between Cockburn River Alluvium and Peel Regulated River Alluvium

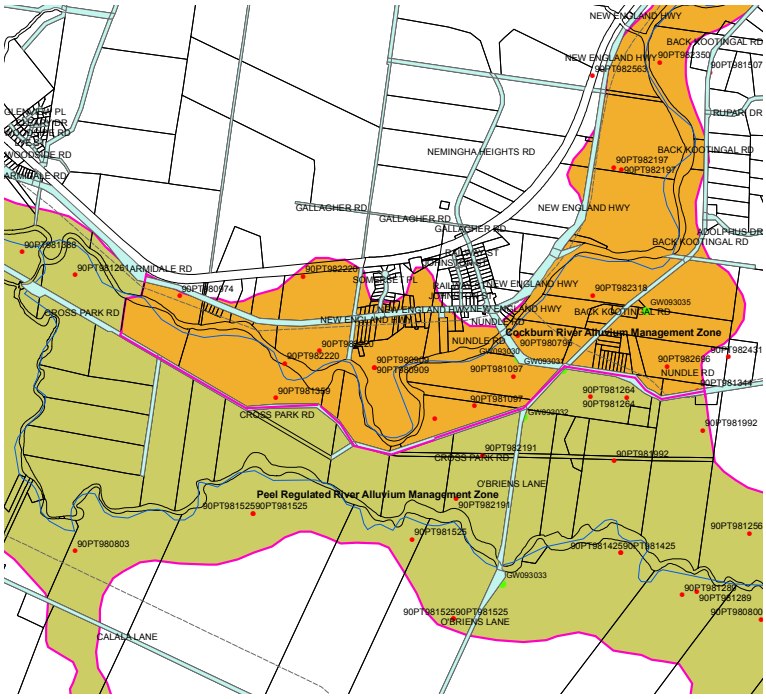


Figure 4: Junction between Dungowan Creek Alluvium and Peel Regulated River Alluvium

Figure 5: Junction between Duncans Creek Alluvium and Peel Regulated River Alluvium

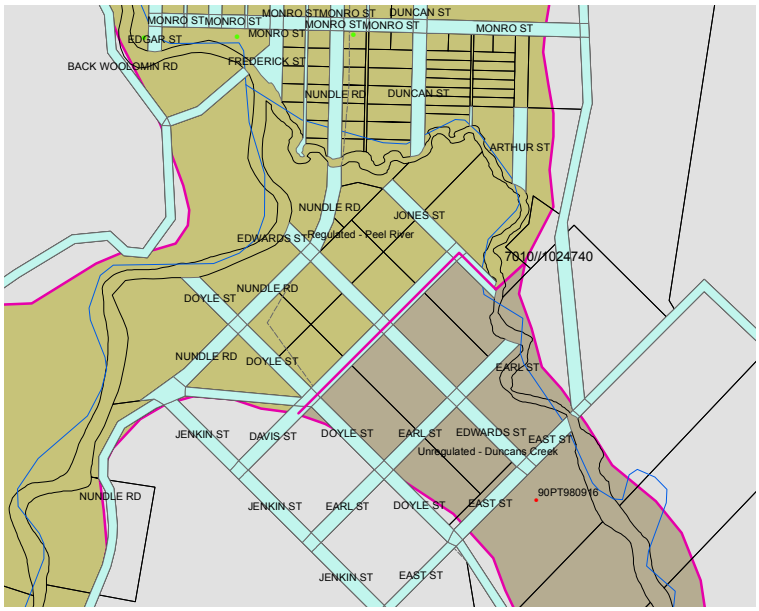
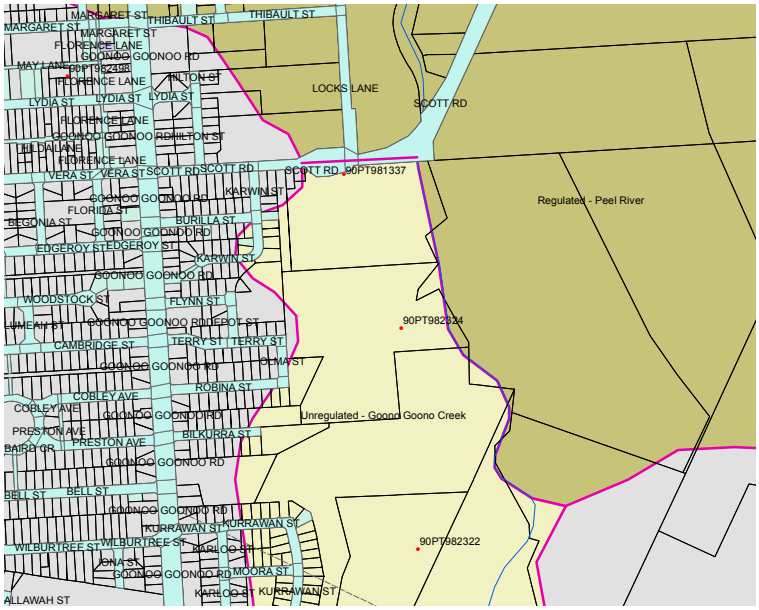


Figure 6: Junction between Goonoo Goonoo Creek Alluvium and Peel Regulated River Alluvium



Appendix 12: Peel Fractured Rock water source risk assessments

Risk assessment for aquifer assets

Geological Province:	Fractured Rock					
Groundwater source Name:	Peel Fractured Rock					
GWMA Number:	819					
	Risk			Method and Source	Mitigation Action	Relevant WSP Rules
	High	Moderate	Low			
Ecological Asset						
What will be the risk of a change in groundwater levels on GDE's?		X		A reduction in groundwater levels will result in reduced spring activity and impact on base flow for tributaries. Moore Creek Caves Karst system.	monitoring of groundwater levels in the fractured rock, coupled with appropriate groundwater management and modelling	
What will be the risk of a change in the timing of groundwater level fluctuations on GDE's?		X		Extraction will coincide with dry periods that will impact on ponds and springs.	monitoring of groundwater levels in the fractured rock, coupled with appropriate groundwater management and modelling	
What will be the risk of changing base flow conditions on GDE's?		X		Extraction will coincide with dry periods that will impact on ponds and springs.	monitoring of groundwater levels in the fractured rock, coupled with appropriate groundwater management and modelling	
Water Quality Asset						
What is the risk of changing the chemical conditions of the water source?			X	Inert aquifer, pulling down GW levels will not result in change in WQ condition		
What is the risk on the water source by a change in the freshwater/salt water interface?				N/A		
What is the likelihood of a change in beneficial use of the water source?			X	Risk to change in BU due to bacteriological contamination, contaminated sites etc.		BU= raw drinking water, irrigation, industry.
Aquifer Integrity Asset						
What is the risk of substrate				consolidated materials		

compaction			X			
Risk Valuation		X				
Mitigation Effect on Sustainability Factor		N/A		Not mitigating due to the need to maintain flow persistence in unregulated streams. Infrastructure to manage mitigation is not expected to be available in the medium term		
Risk	Moderate					

Risk assessment for socio economic assets

Geological Province:	Fractured Rock					
Groundwater source Name:	Peel Fractured Rock					
GWMA Number:	819					
	Risk			Method and Source	Other Management Tools	Relevant WSP Rules
	High	Moderate	Low			
Financial Asset						
What is the risk to security of access from extraction?		X		dams, limited surface waters, Some future options from reticulated supply		
What is the risk to ongoing groundwater usage?			X	limited use of fractured rock licences in comparison to total entitlement	Ensure metering installed and monitored	
What is the risk to dependence on Town Water Supply?		X		No Local Water Utility access licences sourced from fractured rock area. However large number of community bores supporting rural residential developments requiring protection	Allow for population growth during term of plan. Identify planning needs in Strategy document, inclusion of appropriate management guidelines where reliance on groundwater required in LEP	
What is the risk to dependence on groundwater related activities? (irrigation, industry)			X	Small volume of groundwater extraction in comparison to entitlement	Define public irrigation district if growth envisaged during plan term	
What is the risk to investment in agriculture/ industry?		X		Spray based irrigation industry, drip irrigation, established industrial activities and irrigation. Risk to rural residential gardens	Define public irrigation district if growth envisaged during plan term	
Sociological Asset						
What is the risk to employment in agriculture or industry?		X		Significant employer in the valley		
Risk Valuation		X				

Risk	Moderate

Appendix 13: Guide to risk assessments for the Peel Fractured Rock water source

Guide to risk assessment for aquifer assets

Geological Province:						
Groundwater source Name:						
GWMA Number:						
	Risk			**Method and Source**	**Mitigation Action**	**Relevant WSP Rules**
	High	**Moderate**	**Low**			
Ecological Asset						
What will be the risk of a change in groundwater levels on GDE's?	Reduction in groundwater level(s) or piezometric pressure beyond established trigger levels or seasonal variation, resulting in permanent loss of defined habitat type.	Reduction in groundwater level(s) or piezometric pressure beyond established trigger levels or seasonal variation, resulting in temporary loss of defined habitat type.	No change to habitat type.	Check DIPNR GDS database. Use hydrographs if available or point source data	i.e. Hots spots modelling	
What will be the risk of a change in the timing of groundwater level fluctuations on GDE's?	Fluctuation in groundwater level(s) or piezometric pressure beyond established trigger levels or seasonal variation, resulting in permanent loss of defined habitat type.	Fluctuation in groundwater level(s) or piezometric pressure beyond established trigger levels or seasonal variation, resulting in temporary loss of defined habitat type.	No change to habitat type.	Check DIPNR GDS database. Use hydrographs if available or point source data	i.e. Hots spots modelling	
What will be the risk of changing base flow conditions on GDE's?	Permanent reversal of base flow conditions.	Temporary reversal of base flow conditions exceeding seasonal variation.	No change to habitat type.	Check DIPNR GDS database. Use hydrographs if available or point source data	i.e. Hots spots modelling	

Water Quality Asset						
What is the risk of changing the chemical conditions of the water source?	Permanent change in pH, temperature and/or turbidity	Temporary change in pH, temperature and/or turbidity	Negligible change (<5%)	Check NOW's contaminated sites and Triton databases.	i.e. local impact rules	
What is the risk on the water source by a change in the freshwater/salt water interface?	Permanent change in location or gradient of salt/freshwater interface	Temporary change in location or gradient of salt/freshwater interface	No change or not applicable	Check NOW's Triton database.	i.e. local impact rules	
What is the likelihood of a change in beneficial use of the water source?	Reduction in water quality beyond designated BU category (for identified trigger parameters)	Reduction in water quality within designated BU category (for identified trigger parameters)	Negligible change for identified triggers (<5%)	Check NOW's contaminated sites and Triton databases.	i.e. local impact rules	
Aquifer Integrity Asset						
What is the risk of substrate compaction	Permanent destruction the of aquifer matrix	Temporary adjustment to the aquifer matrix	No change	Check DMR data sources	i.e. groundwater modelling	
Risk Valuation						
Mitigation Effect on Sustainability Factor				Add reason for mitigation and other comments as required.		
Risk	High, Moderate or Low					

Guide to risk assessment for socio economic assets

Geological Province:						
Groundwater source Name:						
GWMA Number:						
	Risk			**Method and Source**	**Other Management Tools**	**Relevant WSP Rules**
	High	**Moderate**	**Low**			
Financial Asset						
What is the risk to security of access from extraction?	No Option for alternative water supply (source)	Limited options for alternative water supply (source)	Alternative water supply readily available (i.e. able to extract all entitlement at all times of the year).	Check NOW's LAS database, Council maps. Other sources include reticulated surface water.		
What is the risk to ongoing groundwater usage?	Large volume of groundwater extracted in proportion to total licensed (i.e. >70%)	Average volume of groundwater extracted in proportion to total licensed (i.e. 30 - 70%)	Small volume of groundwater extracted in proportion to total licensed (i.e. <30%)	Use NOW's metered or card entry data where available.	Ensure metering installed and monitored.	
What is the risk to dependence on Town Water Supply?	Large Volume of groundwater licensed for TWS in proportion to total licensed extraction (i.e. >70%)	Average Volume of groundwater licensed for TWS in proportion to total licensed extraction (i.e. 30 - 70%)	Small Volume of groundwater licensed for TWS in proportion to total licensed extraction (i.e. <30%)	Check NOW's LAS database, Urban Water Management and State Water data	Allow for population growth during term of plan. Identify planning needs in Strategy document.	
What is the risk to dependence on groundwater related activities? (irrigation, industry)	Large volume of groundwater extracted in proportion to total licences (i.e. >70%)	Average volume of groundwater extracted in proportion to total licences (i.e. 30 - 70%)	Small volume of groundwater extracted in proportion to total licences (i.e. <30%)	Check NOW's LAS database, DPI advice.	Define public irrigation districts if growth envisaged during plan term.	
What is the risk to investment in agriculture/ industry?	Significant investment in activities requiring groundwater (%GDP of Council area)	Moderate investment in activities requiring groundwater (%GDP of Council area)	Little investment in activities requiring groundwater (%GDP of Council area)	Bureau of Statistics Census data, DPI advice.	Define public irrigation districts if growth envisaged during plan term.	

Sociological Asset						
What is the risk to employment in agriculture or industry?	Majority of local population employed in associated activities (i.e. >70%)	Average proportion of local population employed in associated activities (i.e. 30- 70%)	Minor proportion of local population employed in associated activities (i.e. <30%)	Check DPI data sources and Bureau of Statistics Census data.		
Risk Valuation						

Risk	High, Moderate or Low

Appendix 14: Sustainability factor for the Peel Fractured Rock water source

Sustainability factor - Percentage of recharge available for extraction

High environmental risk	**5%**	**25%**	**50%**
Moderate environmental risk	**25%**	**50%** **Peel Fractured Rock water source**	**60%**
Low environmental risk	**50%**	**60%**	**70%**
	Low socio-economic risk	**Moderate socio-economic risk**	**High socio-economic risk**

The figure above shows the sustainability factor matrix that was used to determine the proportion of recharge calculated as environmental water and the percentage potentially available for extraction for the non-high conservation value areas. The planned environmental water reserved for the areas outside the high-conservation value areas has been set at a minimum of 30 per cent and a maximum of 95 per cent, reflecting the variation in risk to groundwater sources identified in the assessment process.

Appendix 15: Refined water sharing rules based on public exhibition

Water Source	Changes to water sharing rules	Justification
Peel Regulated River	LTAAEL defined to include TRC extraction from Dungowan Dam	Difficulty in accurately modelling the split between diversions from Dungowan and Chaffey Dams by TRC
	Existing tagged trading rules removed, allow permanent trades from the Peel to the Namoi with conversion factors to a maximum volume. Beyond that volume, additional water allowed to be traded under enlarged Chaffey scenario, with corresponding inter-valley trading account	Submissions received were mostly in opposition to tagged trading. Permanent trading with defined limits will maximise trading opportunities, including for inactive users, whilst minimising the impacts on currently active users in the Peel and the Namoi.
	Do not issue supplementary licences	Submissions received in opposition to granting additional entitlement in an already over allocated system. No submissions received on Minister's note suggesting that these licences be issued
	Reference point for trading within the water source re-defined as Jewry St. bridge	Submissions received from Peel Valley Water Users suggested Jewry St bridge as it is more clearly defined than the draft Plans description (downstream junction of the Peel River and Wallamore Anabranch)
	Change access threshold for users in the upper reach of the Peel River to environmental flows to above 50 ML/day at Piallamore gauge	Decision to lower threshold was based on small installed pump capacity in this reach of river. Additional amendment clause to increase threshold to 100 ML/day should pump capacity in this reach increase by 20% or more
Peel Alluvium	The growth in use trigger for the 5 year rolling-average be reduced from 20 to 15% above the LTAAEL	Review of historical usage figures, 5 year rolling average has not deviated from LTAAEL by more than 15%. Change made in conjunction with proposal to issue supplementary licences
	LTAAEL for the Peel Alluvium = 9,344 ML/yr	Submissions received that LTAAEL was too low. LTAAEL recalculated to include 'active use' from eight licences within Wallamore Anabranch now classified as groundwater and to exclude all zero usage years prior to licence activation, from the average. Use period of available data which Peel IQQM indicates is representative of long-term climatic variability. No trend was found to justify changing the LTAAEL based on the impact of pumping restrictions or the exceptional circumstances declarations.
	Supplementary water access licences may be issued to existing licensees in the Peel Alluvium with an entitlement equal to the history of use of the part 5 *Water Act 1912* licence defined as part of the calculation of the Peel Alluvium LTAAEL, prior to commencement of the plan. These supplementary licences will only be issued if a max AWD <0.8ML/unit share is required for aquifer access licences in the Peel Alluvium to respond to growth.	Submissions received from Namoi Water and some other water users suggested that supplementary licences be issued as a short-medium term adjustment mechanism for users in the Peel Alluvium. The basis for these licences is the perceived likelihood of triggering a growth in use response which would require a large reduction in the maximum AWD, to return extractions back to the LTAAEL.

Water Source	Changes to water sharing rules	Justification
Peel Alluvium – all management zones excluding Peel Regulated River Alluvium	Aquifer access licences in the unregulated alluvial management zones have 3 year accounting rules	The alluvial management zones and their corresponding surface water sources should have the same accounting rules as they are managed as connected resources
Peel Alluvium – Cockburn River, Goonoo Goonoo Creek and Dungowan Creek Alluvium management zones	Changes to the flow reference points, as per the relevant unregulated management zones (see below)	See below
Peel Alluvium – Duncans Creek, Attunga Creek and Moore Creek Alluvium management zones	These management zones are classified as 'less highly connected' with no linkage to surface water access rules	Flow duration analysis performed during PE showed impacts between surface and groundwater in these ephemeral streams are minimal, and hence these systems can be managed separately to surface water
Peel Alluvium and Peel Fractured Rock	Remove immediate surface water CtP for bores within 40 m of the high bank of an unregulated river/creek - same daily access rules apply for all groundwater extraction within the management zone or water source regardless of the distance of the works from the river/creek i.e. all bores in highly connected systems have lagged surface water CtP rules whilst all bores in less highly connected systems have no surface water CtP rules	The application of immediate surface water CtP rules to bores within 40m of the high bank of unregulated rivers/creeks would cause large S-E impacts for minimal environmental gain
	A discretionary clause be applied to all the distance criteria for granting/amending water supply works approvals where the Minister is satisfied that the location of the work at a lesser distance will not compromise the intent of the rule.	Outcomes from State Groundwater Panel meeting based on Peel submissions, a discretionary clause may allow some distance rules to be varied as appropriate where a hydro-geological study is not deemed to be warranted.
	Replacement bores be exempt from all distance criteria	Recognition that existing impacts are acceptable (same premise as LTAAEL), the need to maintain existing property rights and to recognise the difficulties associated with relocating a bore.
Upper Peel River Tributaries – Dungowan Creek management zone	An additional flow reference point be established at Thortons Road bridge to define the upper and lower reaches of this management zone	Submissions from Upper Dungowan water users suggest that defining access based on a gauge at the end of the system is not representative of flows along the entire length of the creek. Splitting the creek into two reaches allows for more equitable access to water and is consistent with the management of other water sources in the Peel Valley
	Licences upstream and downstream of Thortons Road bridge must CtP when there is no visible flow at Thortons Road bridge or at the pump site – the visible flow at the pump site rule will be amended for licences downstream of Thortons Road Bridge to, zero flow at a gauge at the end of Dungowan Creek, when installed	
Goonoo Goonoo Creek – Downstream Boiling Down Creek management zone	Change the FRP from Meadows Lane gauge to Timbumburi gauge	Meadows Lane gauge was installed as an SES flood indicator and is not appropriate for measuring low flows in Goonoo Goonoo Creek. The Office field inspection confirms Timbumburi gauge to be better suited for this purpose
	Change the CtP from the 95%ile at Meadows Lane gauge to the cease to flow height at Timbumburi	The 95%ile approximated a cease to flow for Meadows Lane gauge, so CtP based on cease to flow shall also be used at Timbumburi

Water Source	Changes to water sharing rules	Justification
	Visible flow at Upstream Calala Lane Road Bridge used as a second CtP condition, in lieu of visible flow at pump site	Various submissions have been received relating to the difficulty and inequality in implementing with the visible flow at pump site rule, particularly for highly connected groundwater systems. Ensuring flow at both upstream and downstream FRPs in this system should allow for more equitable access
Cockburn River – Cockburn River management zone	CtP based on visible flow at the pump site changed to visible flow at a second FRP – the rock bar 700m upstream of the Cockburn River confluence with the Peel River	Various submissions have been received relating to the difficulty and inequality in implementing with the visible flow at pump site rule, particularly for highly connected groundwater systems. Ensuring flow at both upstream and downstream FRPs in this system should allow for more equitable access
	Should a gauge at the new FRP be installed, amend the downstream CtP from a visible flow at the rock bar to zero flow at the new gauge	The rock bar 700m upstream of the confluence of the Peel and Cockburn Rivers was suggested by water users and supported by the collective local knowledge of the PAG as the most appropriate location for a second flow reference point
Lower Peel River Tributaries – Moore Creek management zone	Users in the upstream of Slippery Rock reach must not commence to pump in the first 24hrs of visible flow in Moore Creek at Slippery Rock and must Cease to Pump when there is no visible flow in Moore Creek at either the Scout Camp, or Slippery Rock, and are exempt from the 'visible flow at the pump site rule'	Changes to draft plan rules are a result of the Office's licensing review of flow conditions completed in 2008. The suggested 24 hour amendment allows for replenishment of pools downstream of Slippery Rock, whilst maintaining reasonable access for upstream users
	Add an amendment clause to alter the commencement to pump and CtP from visible flow at Slippery Rock to zero flow at Slippery Rock, should a gauge be installed at this location.	
	Add an amendment clause to allow the refinement of access conditions in Moore Creek Management Zone should monitoring information collected and analysed by the NSW Office of Water during the life of the plan indicate that this is required.	Amendment clause added in response to concerns raised by Moore Creek water users through PAG representatives.
Lower Peel River Tributaries – Wallamore Anabranch management zone	The eight Part 2 *Water Act 1912* licences for Wallamore Anabranch are converted to 'aquifer (general security) access licences' on commencement of the plan. There are no access rules for this management zone. Removal of the management zone from the Lower Peel Tributaries water source.	Flows in Wallamore Anabranch are supported by groundwater discharge originating from the Peel Regulated River. Affected licensees have been informed of the change to their access, which more accurately represents the source of their water. All licensees in attendance at a meeting with the Office agreed to the proposed change
Namoi Unregulated Rivers EMU – all water sources	LTAAEL for the EMU excludes 'active use' from the eight licences within Wallamore Anabranch	The unregulated LTAAEL must be decreased inline with the conversion of all Wallamore Anabranch management zone unregulated licences to aquifer access licences.