



Department of
Primary Industries
Water

Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009

Background document for amended plan 2016

Published by the NSW Department of Primary Industries, Water

Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources - Background Document for amended plan 2016

Background document first published 2009.

Updated in August 2016 to incorporate amendments to the plan following inclusion of the Wybong Creek Water Source

More information

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Introduction

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

In recent years, water sharing plans for unregulated¹ rivers and groundwater systems have been completed using a broad scale 'macro' approach based on whole river catchments or aquifer systems. Approximately 95 % of the water extracted in New South Wales is now covered by a water sharing plan and thus under the management and licensing provisions of the WMA 2000. Unregulated rivers are those which do not have their flows regulated by major state-administered dams. Most water users on unregulated rivers rely on natural flows for their water supply.

This background document to the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (the Plan) outlines:

- the purpose of the statutory Plan
- intended outcomes of the Plan
- a description of the Plan area
- the process of Plan development
- the use of adaptive management
- activities associated with implementation, monitoring and review of the Plan.

This document is part of a range of material available specifically on the Hunter Unregulated and Alluvial water sharing plan including:

- *The Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009*; the legal Plan written in its required statutory format,
- A guide to the Water Sharing Plan; a plain English version explaining the key Plan sections and rules (this document was written prior to the amendments to include Wybong Creek Water Source into the Plan in 2016),
- Report cards for each water source detailing background information on the water sources' classification and the proposed management rules (note: a report card for the Wybong Creek Water Source was not prepared as part of the water sharing plan replacement process),
- Rule summary sheets for each water source detailing the management rules.

An amended plan for the Hunter unregulated and alluvial water sharing plan

The Hunter Unregulated and Alluvial water sharing plan commenced on 1 August 2009. Until now, water sharing arrangements for the Wybong Creek Water Source have been covered under a separate water sharing plan that commenced in 2004. The *Water Sharing Plan for the Wybong Creek Water Source 2003* (Wybong WSP) plan was amongst the first in NSW and expires in 2016.

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.

In 2013 the Minister approved the replacement of the Wybong WSP based on reports from the Natural Resources Commission and the Department of Primary Industries, Water (DPI Water). As part of the replacement process, single catchment unregulated river water sources and groundwater aquifers have been merged within the larger “macro” water sharing plan for that area. The replacement water sharing plan rules for the Wybong Creek Water Source has therefore been incorporated into the Hunter Unregulated and Alluvial water sharing plan.

The merging of this Plan with the more recent Hunter Unregulated and Alluvial water sharing plan will bring it into line with the current legislative and policy framework for water sharing in NSW. All unregulated and alluvial water sources in the Hunter will now be governed by one plan. Once amended, the Plan will set the rules for water sharing arrangements until 30 June 2020 providing certainty to water dependant businesses and the environment.

Changes to the provisions of the replacement plan (Wybong WSP) has occurred for a number of reasons including: prolonged suspension of the Wybong WSP, changes to policy, updates to legislation, updated data, outcomes of audits, and stakeholder requests. Changes to the provisions in the Wybong WSP plan area has have been developed in close consultation with stakeholder groups. DPI Water has aimed to avoid unnecessary changes and focus on improving provisions based on the information mentioned above.

Purpose of the Plan

Why are water sharing plans being prepared?

To provide certainty for the environment and water users

Continued expansion of water use across NSW has placed most catchments at the limit of their available water. This has seen increasing competition between water users (towns, farmers, industries and irrigators) for access to water. In addition, this has placed pressure on the health and biological diversity of our rivers and aquifers.

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

Under the WMA 2000, water sharing plans must protect water sources and their dependent ecosystems, and must protect the basic rights of landholders to extract water. In this way, environmental water and basic landholder rights are afforded priority over licensed water extractions. Among licensed water users, priority is given to water utilities and licensed stock and domestic use, ahead of commercial purposes such as irrigation and other industries.

Water sharing plans also recognise the economic benefits that commercial users such as irrigation and industry can bring to a region. When a plan commences, access licences held under the *Water Act 1912* are converted to access licences under the WMA 2000 which separates the water licences from land tenure. This facilitates the trade of access licences and encourages more efficient use of water resources. It also allows new industries to develop as water can move to its highest value use.

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

Why a macro approach to water planning?

The macro planning process was designed to develop broader-scale water sharing plans covering water sources not included in the initial round of planning. Each macro plan covers a large river basin rather than a single sub-catchment, or in the case of groundwater systems, covers a particular type of aquifer (for example fractured rock). Macro plans generally apply to catchments or aquifers where there is less intensive water use.

Macro plans were developed through a process involving technical assessments, classification and development of water sharing rules by regional panels and a state groundwater panel.

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

- *Macro water sharing plans – the approach for unregulated rivers. A report to assist community consultation* – explains the method used to classify and set water sharing rules for unregulated streams across the state,
- *Macro water sharing plans – the approach for unregulated rivers. Access and trading rules for pools* – explains the method used to set access and trading rules for pools in unregulated water sources across the state,

- *Macro water sharing plans – the approach for groundwater. A report to assist community consultation – explains the method used to classify and set water sharing rules for groundwater across the state,*
- *Guidelines for Surface Water Sharing Plan Report Cards – explains the information presented in report cards.*

Intended outcomes of the Plan

The objectives of the Plan are to:

- protect, preserve, maintain or enhance the important river flow dependent ecosystems of these water sources,
- protect, preserve, maintain and enhance the Aboriginal, cultural and heritage values of these water sources,
- protect basic landholder rights,
- manage local water utility/major utility water supply for the benefit of the community whilst recognising the environmental needs of the water sources,
- provide opportunities for market based trading of access licences and water allocations within sustainability and system constraints,
- provide water allocation account management rules which allow sufficient flexibility in water use,
- provide sufficient flexibility in water account management to encourage responsible use of available water, and
- allow for adaptive management, that is, to allow changes to be made when more information is available.

Benefits for water users

With the introduction of the Plan, a number of benefits flow to water users:

- Greater certainty for water users – the Plan sets out the water sharing arrangements for a 10 year period.
- greater security with existing water licences converted to perpetual water access licences under the WMA 2000
- The Plan will facilitate trading of licences (and water allocations) – clear trading and access rules will help foster trading on unregulated rivers and within alluvial aquifers.

The Plan recognises the economic benefits to the region that are generated by commercial users such as irrigators and industry. Six of the water sources covered by the Plan were classified as being of high economic significance to local communities due to their dependence on commercial extraction (Table 1).

Table 1: Water sources with high level of economic dependence

Water source	Description
Black Creek	Relatively high value of irrigated agricultural production associated with vineyards. High value of tourism
Dartbrook (including Kingdon Ponds and Middle Brook)	Relatively high value associated with irrigated agricultural production (e.g. lucerne) and horse studs.
Halls Creek	Relatively high value of irrigated agricultural production.
Lower Goulburn	Relatively high value of irrigated agricultural production for vineyards and horse studs.
Lower Wollombi	Relatively high value of irrigated agricultural production for vineyards.
Pages River	Relatively high value of irrigated agricultural production for horse studs.

Note. Initial classification did not include groundwater extraction and was only based on unregulated river extraction. Groundwater extraction was recognised by the Interagency Regional Panel in the recommendation of appropriate management rules for individual water sources.

Environmental outcomes

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

Most of the demand for water from unregulated systems usually occurs at those times when stream flow is low. In order to protect a proportion of some of these very low flows for the environment, the Plan imposes restrictions on access on days when flows are low. This is achieved by establishing ‘cease to pump’ rules that describe when water must not be extracted, depending on the amount of flow in the river on any day. Extensive research undertaken in Australia on the importance of protecting very low flows indicates that they are very important for maintaining water quality, allowing passage over riffles for fish and other fauna to pools used for drought refuge, and maintaining those parts of aquatic ecosystems that are most productive. For example, the faster flowing riffle areas between pools usually contain the highest abundance and diversity of aquatic fauna. Additionally, it should be noted that although many streams naturally stopped flowing in dry times, it is the increased frequency and duration of drying, as a result of extraction, which has potential to impact on stream ecosystems.

Prior to the commencement of the Plan, at least fourteen water sources in the Plan area had no existing licence conditions requiring pumping to cease when flows are low. In others, only a small proportion of licenses were subject to flow rules. Since the commencement of the Plan, surface water irrigation licences in all water sources are now subject to cease to pump rules (excluding basic landholder rights, local water utilities and food safety and essential dairy care).

In some water sources, local Water User Associations have hourly pumping restrictions or other arrangements to conserve water during dry times. While these have often been very effective in sharing water between license holders, they are voluntary and have not been enforceable via licence conditions. DPI Water supports continued management of flows above the cease to pump levels by Water User Associations. The Plan applies cease to pump rules across all water sources where extraction is occurring.

Eleven water sources were identified as having high instream value (see Table 2). Where these values are at risk from extraction, the cease to pump rule tends to be conservative. For

these water sources, water trading will be limited so that there is no increase in water entitlement, and in some cases trading aims to decrease entitlement.

Water sources identified as having high instream value tend to be those water sources where threatened species are present. The identified threatened species are listed in Appendix 1.

Table 2: Water sources with high instream value (based on initial assessment)

Water Source	Description
Dora Creek	<ul style="list-style-type: none"> • 7 threatened frogs. • 1 threatened macroinvertebrate. • 2 threatened bird species identified. • High species diversity. • Moderate wet flora quality. • High fish community integrity. • SEPP 14 wetlands.
Glennies	<ul style="list-style-type: none"> • 7 threatened frog species. • 1 threatened bird species. • 1 endangered ecological community. • High species diversity. • High fish community integrity. • World heritage and declared wilderness areas. • Good condition riparian vegetation upstream of Glennies Creek Dam.
Upper Paterson	<ul style="list-style-type: none"> • 6 threatened frog species. • 4 threatened bird species. • 2 threatened plant species. • High species diversity. • High wet flora quality. • Moderate quality riparian vegetation. • High fish community integrity. • World heritage and declared wilderness areas.
Merriwa	<ul style="list-style-type: none"> • High species diversity. • Moderate fish community integrity, with high value habitat for catfish.
Newcastle	<ul style="list-style-type: none"> • 6 threatened frog species. • 7 threatened birds species identified. • High species diversity. • Moderate quality riparian vegetation. • High fish community integrity. • High value wet flora. • SEPP 14, Ramsar and Nationally Important Wetlands. • JAMBA and CAMBA bird species.
Paterson/Allyn	<ul style="list-style-type: none"> • 6 threatened frog species. • 4 threatened bird species. • 2 threatened flora species. • Drought refuge for water plants and animals including Platypus. • World heritage and declared wilderness areas.
Rouchel	<ul style="list-style-type: none"> • 4 threatened frog species. • High species diversity. • High fish community integrity. • Contains recognised wild and scenic river values.
Williams	<ul style="list-style-type: none"> • 8 threatened frog species. • 6 threatened bird species. • High species diversity. • High fish community integrity. • High quality wet flora. • World heritage and declared wilderness areas.

Upper Goulburn	<ul style="list-style-type: none"> • 1 threatened frog species. • High species diversity. • Good quality wet flora. • Significant proportion of the stream flows through National Park.
Upper Hunter	<ul style="list-style-type: none"> • 5 threatened frogs species. • 1 threatened bird species. • High species diversity. • High wet flora values. • Moderate fish community integrity. • Significant lengths of stream in good condition in the upper catchment.
Upper Wollombi	<ul style="list-style-type: none"> • 6 threatened frog species. • 3 threatened bird species. • 1 threatened macroinvertebrate species. • High value features such as Ellalong Lagoon and the good condition of Congewai Creek upstream of Millfield. • Drought refuge for water plants and animals such as Platypus.

Scope of the Plan

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

The Plan, as gazetted in 2009, contained four **extraction management units** (EMUs), consisting of one or several water sources, specified for the purpose of establishing a geographic area over which a long-term average annual extraction limit (LTAAEL) apply. The 2016 amendments have merged the Goulburn and the Hunter EMUs into the Greater Hunter EMU because the Goulburn River is a tributary of the Hunter River and these systems are hydrologically connected. Merging of the EMUs will not affect the LTAAELs as these are based on the sum of existing entitlement (excluding major water utility access licences held by Hunter Water Corporation) plus basic landholder rights. In the Greater Hunter EMU there is a separate LTAAEL for the major water utility access licences held by Hunter Water Corporation equal to 78,500 Megalitres per year (ML/year).

The Plan area is divided into forty **water sources**, which coincide with sub-catchment boundaries. It is at the water source level that water sharing rules are developed.

Ten of the water sources have been subdivided into **management zones** where finer resolution of rules is required.

These water management units are listed in Table 3, and a map showing the location of these units is provided in Appendix 2.

Table 3: Water management units in the amended Hunter Unregulated and Alluvial water sharing plan

New water sources are shaded in grey

Extraction management unit	Water source	Management zone
Surface Water		
Greater Hunter Extraction Management Unit	Munmurra River Water Source	
	Krui River Water Source	
	Bow River Water Source	
	Merriwa River Water Source	
	Halls Creek Water Source	Halls Creek Management Zone Giants Creek Management Zone
	Baerami Creek Water Source	
	Widden Brook Water Source	
	Bylong River Water Source	
	Wollar Creek Water Source	
	Upper Goulburn River Water Source	
	Lower Goulburn River Water Source	
	Dart Brook Water Source	Upper Dart Brook Management Zone Upper Middle Brook Management Zone Petwyn Vale Management Zone Lower Dart Brook Management Zone Lower Middle Brook and Kingdon Ponds Management Zone
	Pages River Water Source	Murrurundi Management Zone Scotts Creek Management Zone Kewell Creek Management Zone Gundy Management Zone Segenhoe Management Zone
	Isis River Water Source	
	Upper Hunter River Water Source	
	Rouchel Brook Water Source	
	Muswellbrook Water Source	
	Jerrys Water Source	Jerrys Management Zone Appletree Flat Management Zone
	Glennies Water Source	
	Glendon Brook Water Source	
	Luskintyre Water Source	
	Singleton Water Source	
	Martindale Creek Water Source	
	Doyles Creek Water Source	
	Lower Wollombi Brook Water Source	

	Black Creek Water Source	
	Newcastle Water Source	
	Paterson/Allyn River Water Source	Paterson River Tributaries Management Zone
		Allyn River Management Zone
	Williams River Water Source	Williams River Management Zone
		Seaham Weir Management Zone
	Upper Paterson Water Source	
	Upper Wollombi Brook water Source	Congewai Creek Management Zone
		Wollombi Brook Arm Management Zone
	Wallis Creek Tidal Pool Water Source	
	Paterson River Tidal Pool Water Source	
	Hunter River Tidal Pool Water Source	Upper Hunter Management Zone
		Stewarts Brook Management Zone
	Wybong Creek Water Source	Kars Springs Management Zone
		Bunnan Management Zone
		White Rock Management Zone
		Manobalai Management Zone
		Wybong Management Zone
		Cuan Management Zone
		Cuan and Reedy Creeks Management Zone
Lake Macquarie Extraction Management Unit	North Lake Macquarie Water Source	
	South Lake Macquarie Water Source	
	Dora Creek Water Source	
Hunter Regulated River Alluvium Extraction Management Unit	Hunter Regulated River Alluvial Water Source	Upstream Glennies Creek Management Zone
		Downstream Glennies Creek Management Zone
		Glennies Creek Management Zone

Description of the Plan area

The Hunter Unregulated and Alluvial water sharing plan covers an area of more than two million hectares. The catchment of the Hunter extends further inland than any other coastal catchment in New South Wales. The catchment is bordered in the north-west by the Liverpool Ranges which separate it from the Namoi catchment, and on the west by the Great Dividing Range, which separates it from the Macquarie River catchment. To the north and north east, the boundary which separates the Hunter from the Manning and Karuah catchments respectively, falls from the Barrington Tops to the sea near Raymond Terrace. On its south eastern perimeter it includes a series of smaller east flowing streams which form the Lake Macquarie Catchment. Refer to map included in Appendix 2.

Most of the water in the Hunter system comes originates from the north eastern part of the catchment. The major tributaries of the Hunter River include:

- The Goulburn River in the west, which drains almost half of the catchment, but contributes only 23 % of the river flow. The Goulburn River rises in the Great Dividing Range at an elevation of 620 metres (m) with tributaries including the Merriwa, Munmurra, Krui, Growee, Bow and Bylong Rivers, Baerami, Halls and Wybong Creeks and Widden Brook.
- The Paterson and Williams Rivers which drain the wetter area to the north east of the catchment, and rise in the Barrington Tops at elevations over 1,400 m.
- Wollombi Brook, which drains the south eastern segment of the catchment and rises in the Hunter Range at an elevation of about 440 m.
- Tributaries to the upper sections of the Hunter River including the Pages and Isis Rivers, and Middle, Dart, Stewart, Moonan and Ormadale Brooks.
- The Wybong Creek is the most eastern of the northern tributaries of the Goulburn River. The headwaters of the creek are in the Liverpool ranges to the north. A narrow strip of alluvial fill composed of sand or boulders with minor clay lenses is associated with the water source.

The lower Hunter River catchment is relatively flat and the river has a large flood plain reaching widths of up to 40 kilometres (km) in some places. In the upper part of the catchment the floodplain is about 3 km wide, expanding to almost 24 km in width by Maitland. The remainder of the catchment is comprised of undulating country and steep slopes in the Barrington Tops.

The main arm of the Hunter River starts on the western side of the Barrington Tops and Great Dividing Range, north of Muswellbrook, and flows south to where it meets the Goulburn River and then east to Newcastle, having covered a total of 467 km. Salt water influence extends to approximately Belmore Bridge at Maitland, with tidal fluctuations extending as far as the rail bridge at Oakhampton.

There are two estuarine areas in the Hunter Plan. Freshwater inflow impacts on the functioning of an estuarine ecosystem to different extents. The Hunter River estuary has medium sensitivity to reduced freshwater inflows (at low flow). Its large catchment area provides freshwater to the estuaries during floods and high flows. These large flows are important for prawn production and for triggering the migration of Bass upstream. During low flows, however salt water has the potential to move upstream at a more rapid rate if extraction of water becomes too high. In contrast Lake Macquarie has a low sensitivity to inflows as it has salinity levels similar to seawater, and is fed by relatively small streams.

Stream flows

Most of the flows in the Hunter unregulated water sources are protected from extraction. The total volume of water licensed for extraction in the Greater Hunter unregulated EMU is 73,000 megalitres (ML), compared to an estimated annual average flow to the Hunter Estuary of 2,175,000 ML. Current licensed entitlements within the tidal pool total approximately 15,000 ML.

In the Lake Macquarie EMU the total volume of surface water licensed for extraction is 2,400 ML, compared to an annual average flow from Jigadee Creek at Avondale (a tributary of the Dora Creek), of 15,000 ML/year. This subcatchment makes up only eight per cent of the total Lake Macquarie catchment area.

Aboriginal values

The Plan area is of importance for the Kamilaroi, Geawegal and Wanatuah people.

Most information about flow-related Aboriginal values resides in Indigenous communities, and is not widely available. Preliminary consultation sessions were held with the Hunter Aboriginal Community and Environment Network, Purfleet/Taree and Forster Local Aboriginal Land Councils during the development of the 2009 Plan to determine whether the proposed water sharing rules adequately protect Aboriginal cultural values.

The consultation sessions provided some insights into Aboriginal cultural values in the Hunter Valley. Aboriginal communities have indicated that water sharing rules should protect natural instream values. Whilst Aboriginal groups acknowledge the rights of commercial water users, they believe that this should not be at the expense of the environment. In their view, the priority for water sharing plans should be to provide for natural flowing rivers with healthy aquatic biodiversity.

Climate

The Hunter Valley has a varied climate, depending on elevation and proximity to the ocean. Coastal areas and the area around Barrington Tops receive the highest rainfall of over 1,600 millimetres (mm) per year at Barrington Tops and 1,140 mm/year at Newcastle on the coast. Rainfall decreases with distance inland with rainfall at Cassilis around 620 mm per year. The wettest months away from the coast tend to be December to January. The highly erratic nature of the climate in the Hunter Valley has caused both serious droughts and extensive floods.

Geology

The topography of the Hunter Valley is strongly controlled by the underlying geology.

Soil types in the Hunter Valley are dependent on the parent rock type and rainfall levels. There are four general soil classifications recognised:

- The soils of the Hunter Valley floodplain which support more intensive land use and range from alluvial to podsollic and cracking clays,
- The soils of the Merriwa and western ranges which are fertile chocolate soils and cracking clays reflecting the basalt material from which they are derived,
- The soils of the Goulburn River corridor in the south west which are mostly light sands and earth, reflecting the sandstone country from which they are derived,
- The soils of the central northern valley are variable podsollic type soils derived from carboniferous rock.

Most of the southern tributaries of the Hunter and Goulburn Rivers flow through Triassic sandstones. As a result they tend to have bed load sediments consisting largely of sand. Such streams are also highly sensitive to land use change, and most have undergone significant

modification since European settlement, including channel incision and widening. As a result of these changes many of the streams have wide sandy beds and very unreliable flows. This unreliable flow has led to irrigation development in the southern tributaries which is largely based upon groundwater extraction. These streams are classified as having highly-connected surface and groundwater systems. In effect, extracting from groundwater can significantly affect surface water levels and vice-versa. The northern tributaries mainly flow through Tertiary basalt rocks in the west and Carboniferous rocks in the north. These streams have cobble-beds. The central part of the Hunter catchment consists of Permian rocks which were laid down in a marine environment. As a result many of the streams in this part of the catchment have relatively higher salinity levels.

Land use history

Since European settlement there have been major changes to the Hunter River catchment. These include clearing of native vegetation for agricultural and mining activities, and larger more destructive flood events due to loss of vegetation, and overstocking in the early stages of settlement. In some cases this has resulted in erosion of stream beds and banks, and wider and shallower streams in some areas.

Streams which have undergone major changes in the Hunter Valley include the Goulburn and Bylong Rivers, Widden, Wollombi and Dart Brooks (including Kingdon Ponds), Baerami, Doyles, and Martindale Creeks, and the lower Pages River. These streams generally have incised, wide, sandy channels (although Dart Brook and Pages River have gravel beds) and lack flow reliability and drought refuge pools. The large scale changes to the fluvial geomorphology have reduced instream habitat variability and water quality and resulted in the poor condition of some aquatic ecosystems in these rivers. It is likely that changes to flow management will only provide a small improvement, if any, in the health of these systems. Some of the other issues impacting on river health, other than flow extraction, are managed by the Hunter Local Land Services through their Local Strategic Plan.

Industry

The Hunter Valley is a large, fast growing coastal valley close to Sydney and other significant regional centres within the Central Coast and Manning Valley. Major population centres in the catchment include Newcastle, Lake Macquarie, Maitland, Cessnock, Denman, Aberdeen, Merriwa, Singleton, Kurri Kurri, Muswellbrook, Scone and Branxton-Greta.

The Hunter River has played an important role in the development of the region. Major industries located in the catchment include power generation, coal mining, heavy industry, agriculture and associated businesses and infrastructure. As a result a number of large water storages have been constructed. Glenbawn, Glennies Creek and Lostock Dams store water and regulate river flows for use by irrigation, town water supply, industrial use and power generation. Chichester and Grahamstown dams serve as domestic water storages for urban centres in the lower Hunter and Lake Liddell as cooling storage for the Liddell and Bayswater coal fired power stations. In addition to the dammed water up to 30 per cent of the lower Hunter's domestic water supply needs are pumped from bores and wells in the coastal sand beds between Stockton and Port Stephens.

Across the Plan area, the largest single user of water from the unregulated rivers is Hunter Water Corporation, which extracts from the Newcastle (Grahamstown Dam) and Williams River water sources (Chichester Dam and Seaham Weir). The second largest use is for irrigation and industrial purposes amounting to some 171,500 ML/year. Another 6,000 ML/year are licensed for urban supply by local councils. Basic landholder right access to water is estimated at 40 ML/year and 840 ML/year for licensed stock and domestic use (note that these figures exclude the regulated Hunter, Glennies, and Paterson Rivers which are covered by other WSPs).

Policy and planning context

A number of national, state and regional plans and policies guide the development of water sharing plans in NSW, including:

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

The rules in the Plan were also guided by the River Flow Objectives which were developed as a whole of NSW Government initiative through a public process in 1997. Appendix 3 assesses by how much the water sharing plan rules in each water source contribute towards the river flow objectives.

National Water Initiative

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

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

The role of the National Water Commission ceased in December 2014 and some of its water management functions were transferred to other agencies. Assessment of progress in the implementation of the NWI will be transferred to the Productivity Commission.

Water Management Act 2000

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

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

The most recent version of the WMA 2000 is available from the NSW Government legislation website, <http://www.legislation.nsw.gov.au/>

Access Licence Dealing Principles

The *Access Licence Dealing Principles Order 2004* (hereafter referred to as the Dealing Principles) draws on the objects and water management principles of the WMA 2000 and

provides state-wide guidance and rules for applications to undertake water dealings including trade.

The Dealing Principles specify that dealings must consider:

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

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

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

Natural Resource Commission targets

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

Appendix 4 provides information as to how the Hunter Unregulated and Alluvial water sharing plan contributes to the 13 state-wide targets.

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

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

Catchment Action Plans

Catchment action plans are statutory, non-regulatory plans that were previously prepared by the state's catchment management authorities under the *Catchment Management Authorities Act 2003* (now repealed). The Hunter Unregulated and Alluvial water sharing plan was developed to be consistent with and contribute to the Hunter-Central Rivers Catchment Action Plan (CAP) (January 2007, Catchment Action Plan, Hunter-Central Rivers CMA). The CAP had a resource condition target for aquatic health; *By 2016 improve aquatic health and condition of streams in the Hunter-Central Rivers*.

The Plan also contributed to achieving the aquatic health target of the CAP by:

- setting a defined share of water for riverine ecosystems,
- protecting of very low flows,

- implementing trading rules to maintain or reduce entitlement in high value streams,
- adaptive management, giving the ability to adjust rules once information becomes available.

In January 2014 the NSW Government established Local Land Services (LLS) and transferred the functions of catchment management authorities into this new organisation to provide agricultural support, natural resource management and emergency management to rural communities through a single organisation. The Hunter Local Land Services will be responsible for continuing the delivery of natural resource management programs in the Hunter, including catchment management plans.

One of the LLS/CMA's responsibilities, as observer on the Interagency Regional Panel, was to provide advice on the alignment of the proposed classification and extraction limits and water sharing rules with the priorities in their CAP.

Policies specific to water sharing plans

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

Protecting Aboriginal values

Aboriginal people have a spiritual, customary and economic relationship with land and water that provides an important insight into natural resource management. The NSW Government established the Aboriginal Water Initiative in 2012 to facilitate effective engagement with Aboriginal communities in the water sharing process and ensure that measurable Aboriginal water outcomes are achieved. The Initiative aims to build Aboriginal peoples' capacity to participate as water users, protect their rights to water, maintain a healthy environment, and take full advantage of economic opportunities.

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

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

The Hunter Aboriginal Community and Environment Network, Purfleet/Taree and Forster Local Aboriginal Land Councils were consulted during the public exhibition period.

Aboriginal Community Development access licences

Many of our rivers already have a high number of irrigation licences, and are generally judged to be 'stressed', particularly during dry times when, for example, river flows are low. This effectively prevents the issuing of any new water licences on these 'stressed' rivers. However in some of our coastal rivers, higher and more reliable flows are common and provide an opportunity for licences to be granted for Aboriginal Community Development activities, provided this additional extraction would not negatively impact on ecological values that are dependent on high flows. In these coastal catchments, Aboriginal Community Development

licences² may be issued which allow water to be pumped from rivers during the higher flows, and stored in farm dams or tanks, to be used as needed. It is important to note that higher flows are not just peak or flood flows but also include flows that occur for 50 per cent of the time.

Since granting these Aboriginal Community Development licences would mean less water remains in the river to meet environmental needs, it will be necessary to limit the total volume that can be extracted for Aboriginal Community Development purposes. The limit would be a proportion of the river flow, and would never exceed 500 ML/year per water source. The government does not propose to limit the volume assigned to each individual Aboriginal Community Development licence, only the total volume per water source.

High flow conversion

Many of our coastal unregulated rivers suffer severe competition for water during dry spells. These extended periods of low flow tend to be when water users compete most strongly for access to dwindling flows and pools. Instream values can also be stressed during these low flow periods as wildlife is concentrated and water quality can deteriorate. Therefore, there is merit in incentive schemes that attempt to move extraction out of the low flows and into the higher flows, as an attempt to improve environmental conditions.

By changing water use from periods of low flow to periods of relatively higher flow, over time, streams may be de-stressed and river conditions may improve. An incentive is required though, as low flow extraction is cheap and convenient – water users simply pump the water when it's available. To utilise higher flows, generally it would be necessary to construct on-farm storage. Water could then be pumped during periods of higher flow and stored and used at a later time. This is a much more expensive approach to irrigation but can provide enhanced security for water users.

The proposed incentive through the draft Plan is to allow those pumpers that convert to higher flows to be granted additional volumes of water.

Given that the purpose of the higher flow conversions is to 'de-stress' low flows in our coastal river systems, a detailed assessment was undertaken to ensure that there is an overall environmental benefit achieved.

The conversion has been recommended in specified water sources only if the following criteria are met:

- The water source is classified as having important instream values at high risk from extraction or in water sources having high hydrological stress,
- There are adequate mechanisms in place to ensure the surrendered low flow is reserved for the environment,
- There is a no highly sensitive estuary (for example Intermittently Closed and Open Lakes and Lagoons) or other identified high flow sensitive feature such as a wetland within the Extraction Management Unit,
- There is no existing high flow stress (i.e. significant extraction already in the high flows),
- The conversion would not significantly impact on tidal pool users or Town Water Supplies.

² This new category of licences is not fully commercial. While they may be temporarily traded, they cannot be subject to permanent trade and as such will remain in the Aboriginal community for the life of the licence. Aboriginal communities, enterprises and individuals are encouraged to seek financial assistance from funding bodies to purchase fully commercial licences.

Through this process, conversions are capped at the extraction management unit by either an increase of 20 per cent of the existing annual entitlement, or 10 per cent extraction of the daily 30th percentile converted to an annual limit based on a half year growing season, whichever is the lesser.

Further assessment would be required before additional conversions (up to a maximum of 30 per cent of the 30th percentile x 110) would be within a sustainable framework.

Trading of higher flow entitlements is possible, but constrained as follows:

- Within water source trades will generally be permissible,
- Cease and commence to pump levels at the new location will generally be the 50th percentile,
- As long as the proposed location meets the eligibility criteria explained above, trades between water sources would generally be permissible.

Protecting basic landholder rights

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

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

The requirements of harvestable rights have been inherently considered in the water sharing process, as access rules are based on river flows that result after harvestable rights extractions have occurred.

There are currently no extractions for native title rights in the Hunter Unregulated and Alluvial water sharing plan, however the Plan allows for these rights should they be activated during the Plan's ten year term.

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

Protecting town water supply access

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

Protecting pools, lagoons and lakes

Pools in NSW are an important source of water for licence holders, landholders and communities. Pools also have a key ecological function as a critical refuge and habitat for flora and fauna.

The policy document *Macro water sharing plans – the approach for unregulated rivers. Access and trading rules for pools* can be found on the DPI Water website www.water.nsw.gov.au. This

document provides guidance for Interagency Regional Panels in setting water access and trading rules for pools that are covered by unregulated river water sharing plans.

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

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

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

Protecting estuary health

Estuarine values can be threatened from water extraction. Some estuaries are highly sensitive to freshwater inflows, whilst others are quite resilient to changed inflows. The size and shape of estuaries vary and this, combined with the amount of freshwater inputs, determines the estuaries overall sensitivity to freshwater extraction. Where possible, extractions will be tightly capped in catchments found to be highly sensitive to freshwater inflows.

An analysis was undertaken by a group of estuary specialists to determine how sensitive each of the State's estuaries is to changes to freshwater inflows. The method was checked by staff from DPI (fisheries) and the Office of Environment and Heritage (OEH). It ranks the sensitivity of estuaries based on their physical attributes; size, shape and the ratio of catchment size to the surface area of the estuary. Small estuaries, such as coastal lagoons, tend to be highly sensitive to inflows. Barrier estuaries tend to be long and narrow and less sensitive to changes to inflows.

The Hunter estuary extends from Nobby's (the mouth of the Hunter River) inland to Oakhampton Bridge on the Hunter River, Seaham Weir on the Williams River, and near Gostwyck on the Paterson River.

The tidal pool is a part of the upper estuary that ranges from essentially fresh water to brackish, despite being affected by daily tidal movements. In the Hunter Valley, the Hunter River, Paterson River and Wallis Creek have fairly significant tidal pools that sustain some commercial extraction. Extraction from the tidal pool has the potential to impact on estuary values so further investigations will be undertaken during the life of the water sharing plan to determine adequate protection measures.

The Williams River's tidal pool only forms during wet periods. During dry periods the saltwater extends to Seaham Weir.

Extraction from the tidal pool has the potential to impact on estuary values so further investigations will be undertaken during the life of the Plan to determine adequate protection measures. Water sharing rules in the Hunter Regulated River Water Sharing Plan ensure that 50 per cent of high flow events are allowed to reach the estuary.

During periods of low flow the tidal pool is supported by inflows from the adjacent alluvial deposits giving it a medium sensitivity to groundwater extraction.

Table 4 summarises the inflow sensitivities for the Hunter estuaries.

The document *Macro water sharing plans – the approach for unregulated rivers. A report to assist community consultation* provides further information about the principles used to determine estuary sensitivity to freshwater inflows.

Table 4: Inflow sensitivities for Hunter estuaries

Name	Groundwater sensitivity	Low flow inflow sensitivity	High flow inflow sensitivity
Hunter River, Estuary	Medium	Medium	Medium
Hunter River, Tidal Pool	Medium	Medium	Medium
Hunter River, Paterson	Medium	Medium	Medium
Lake Macquarie, North	Low	Low	Low
Lake Macquarie, South	Low	Low	Low

Water interception activities

Changed land-use activities can intercept significant quantities of water. Examples of this are an increased farm dam capacity in a catchment or significant areas of new forestry plantations. Under the National Water Initiative, significant interception activities will require a water access licence.

The Hunter is considered an area in which there is no significant water interception activities anticipated within the life of the Plan. Large areas of the catchment are covered by National Parks and State Forests. State Forests are managed with selective logging technique, resulting in minimal change to catchment hydrology. Some plantation forests are anticipated but are not considered to have a significant impact on river flow at the water source or catchment level. Plantation developments are controlled in NSW under *the Plantations Afforestation Act 1999* and will be monitored in the Hunter catchments, and assessed to determine if water access licences are required for new plantations.

Instream dams

Farm dams currently require an access licence when:

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

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

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

Managing surface water and groundwater connectivity

Groundwater and surface waters are inextricably linked, and indeed, a key objective of the National Water Initiative is 'recognition of the connectivity between surface and groundwater

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

resources and connected systems managed as a single resource'. The actual connections between surface and groundwater systems vary significantly between systems. For example, surface waters recharging alluvial aquifers may emerge again at a discharge point in the river within hours. In contrast water recharging aquifers of the Great Artesian Basin may not discharge for some tens of thousands of years. The connection characteristics need to be considered in linking surface water and groundwater planning, because in some cases, the same resource is being accessed.

For the purposes of water sharing, aquifer types have been grouped into four basic categories:

- Porous rock aquifers found in rock formations such as sandstone or limestone. Groundwater occurs within the pore space in the rock matrix.
- Fractured rock aquifers found in rock formations such as granite or basalt. Groundwater in these rocks occurs mainly within the fractures and joints.
- Coastal sand aquifers, where groundwater is contained in the pore spaces in the unconsolidated sand sediments.
- Alluvial aquifers, where groundwater is contained in the pore spaces in the unconsolidated floodplain material.

The level of connectivity, the relative level of impact and the timing of connection have been considered in developing both the unregulated river and the associated groundwater sharing plans for the Hunter and North Coast areas. One of the key factors in determining the sustainable yield for various aquifers is the downstream values in associated streams.

The aquifer types and groundwater sources that occur within the Hunter and their connectivity characteristics are given in Table 5. It is based on principles and recommendations in *Towards a National Framework for Managing the Impacts of Groundwater and Surface Water Interaction in Australia* by Sinclair Knight Merz (2006).

The *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* provides management rules in relation to fractured and porous rock aquifers in the Hunter valley and the *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016* provides management rules in relation to coastal sands aquifers within the Hunter catchment.

Table 5: Connectivity between aquifer types and surface water sources

Aquifer type	Water sources	Level of connection between surface and groundwater	Level of impact on instream values	Estimated travel time between groundwater and unregulated river
Coastal sands	Hawkesbury to Hunter Coast Coastal Sands	Significant (tidal section only)	Low as connection with saline water	Days to months
Up-river Alluvial	All unregulated rivers and the regulated Hunter River.	Significant	High due to impact on base flows	Day to months
Coastal Floodplain Alluvial	Hunter Catchment Floodplain	Low – moderate (tidal section only)	Low as not major contributor and low level of connection	Season
Fractured rock	New England Fold Belt	Low – moderate	Low as not major contributor	Years to decades

Porous Rock	Sydney-Gunnedah Basin	Low – moderate	Low as not major contributor	Years to decades
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Alluvial aquifers

The alluvial aquifers can have a significant connection to their parent streams, depending on the type of alluvial material. For example, where alluvial aquifers are found in upriver situations and are made from coarse material such as sands and gravels, groundwater and surface waters interact significantly. However, in the lower catchment areas, where alluvial materials tend to be finer, there is generally only moderate inter-play between groundwater and the river.

The alluvial aquifers in the Hunter water sharing plan area have been grouped into two categories:

- The shallow ‘upriver’ alluvial aquifers are characterised by coarse materials and relatively short travel times between surface and ground. These aquifers are considered to be ‘highly connected’ to their parent streams. The water sharing rules for the upriver alluvial aquifers are covered in this Plan.
- The coastal floodplain alluvial aquifers tend to have relatively fine materials, often interspersed with silt and clay layers, with only a small amount of interchange between the surface and groundwater. Since the alluvial aquifers that occur on the coastal floodplains (i.e. those downstream of the tidal limit) of the Hunter are only low to moderately connected to their parent streams, it was not considered necessary to fully integrate the surface water and groundwater sharing rules for these systems. However, further consideration determined that the rules for the coastal floodplain aquifers will be incorporated into the Plan at the time of Plan review. It will be important that the Plan protects against saltwater intrusion and properly considers the impact of groundwater extraction on estuary values.

The tidal limit is a useful boundary between the coastal and upriver alluvial systems. For the purpose of water sharing, the boundary between the coastal and upriver alluvial systems is the:

- Seaham Weir on the Williams River (the current tidal limit),
- 980 m downstream of Gostwyk Bridge on the Paterson River (the current tidal limit),
- 1400 m upstream of Oakhampton rail bridge on the Hunter River (the current tidal limit).

The water sharing rules for the highly connected upriver alluvial systems are based on the following principles:

- Extend the unregulated river water sources to include the up-river shallow alluvial aquifers.
- Manage to a single long term annual extraction limit for the unregulated and up-river shallow alluvial groundwater. This is based on the sum of existing unregulated and alluvial groundwater entitlement, plus basic landholder rights, plus exemptions such as Aboriginal community development or town water purposes (where these apply),
- Extend the Extraction Management Unit to cover both the surface water and the up-river shallow alluvial groundwater.
- Manage growth in use through a linked set of available water determinations for both surface and groundwater users.
- Permit within water source licence conversion, assignment or allocation of surface to groundwater licences but not the reverse (i.e. one way only).

- Manage the trade of alluvial groundwater licences with the same trading rules as the adjoining surface water. In effect, this would prohibit trading into areas identified as having high instream values, or are characterised as high hydrological stress.
- For less connected alluvial systems manage existing bores located within 40 m of an unregulated river to surface water access rules, from year six of the Plan, except for existing access licences for stock and domestic, local water utilities, food safety or essential dairy care. This represents a significant change for water users. Accordingly, this rule will commence in year six of the Plan, in order to give water users time to adjust their operations.
- For highly connected alluvial systems from commencement of the Plan manage existing bores located to surface water access rules, except for existing access licences for stock and domestic, local water utilities, food safety or essential dairy care for highly connected systems. This may represent a significant change for water users.
- Prohibit new bores within 40 m of first and second order streams, except for bores as a result of a conversion of an unregulated river access licence, unless:
 - they are drilled into the underlying parent material, and the slotted intervals of the production bore commences deeper than 30 m,
 - the applicant can demonstrate that the bore will have minimal impact on base flows in the stream.
- Prohibit new bores within 40 m of a third order or higher stream except for bores as a result of a conversion of an unregulated river access licence.
- Allow new bores within 40 m of an unregulated river (but only as a result of the conversion of an unregulated river licence) in which case the surface water daily access rules will apply immediately.
- Apply the standard local impact rules for alluvial groundwater and the standard provisions for newly identified Groundwater Dependent Ecosystems.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and natural ecological processes determined to some extent by the availability of groundwater.

The Macro Water Sharing Plan for the Hunter includes water sharing rules for the highly connected alluvial aquifers. Water sharing rules have been designed to protect significant GDEs where they are known to occur on the alluvial aquifers. GDEs can include cave ecosystems, wetlands and endangered ecological communities.

Cave ecosystems

Caves ecosystems are below the ground surface and at groundwater discharge areas and tend to be totally dependent on groundwater. Groundwater dependent cave ecosystems are typically associated with limestone and support an abundant variety of fauna such as crustacea and macro-invertebrates. Entire families of creatures are known to exist in these systems, some of which have been extinct from the surface for millennia. These caves are rich in biodiversity and it is important to ensure that groundwater extraction doesn't impact on that biodiversity. Caves in the Hunter Unregulated and Alluvial water sharing plan area that are considered to be highly dependent on groundwater include the Bandon Grove Limestone Member (Williams River, Paterson/Allyn Rivers Water Sources), Timor Limestone Member (Isis River Water Source) and Verulam Oolite Member (Williams River Water Source). Further investigation may occur during the term of the Plan to identify any additional highly groundwater dependent cave ecosystems.

Wetlands

Groundwater dependent wetland ecosystems are typically areas where the water table is at the surface, or periodically at the surface. While the degree of groundwater dependency is variable, groundwater plays a critical role in wetlands found on alluvial floodplains. Many wetlands are species rich with a mixture of plants and animals and are often considered to have high conservation value. A number of highly dependent coastal wetlands have initially been identified in the Newcastle and Williams River Water Sources. Further investigation may occur during the term of the Plan to identify any additional highly dependent wetlands.

Endangered ecological communities

An endangered ecological community (EEC) is an assembly 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). In the case of plant communities, where these forests/woodlands occur on alluvial floodplains, it is assumed that the vegetation roots are at or below the water table and they use groundwater to sustain transpiration and growth. Groundwater extraction can effectively lower the water table, having a negative impact on the vegetation community. No highly dependent EECs have initially been identified on the alluvial floodplains however there are a number of potentially dependent EECs which may be further investigated during the term of the Plan.

Water sharing rules for GDEs

Where highly connected GDEs are known to occur these are identified within the Plan and rules included such that new or replacement bores will not be permitted within a buffer zone around the GDE. 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).

Developing the Plan

Panels

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

State Interagency Panel

The State Interagency Panel (SIP) has overall responsibility for the strategic direction of water planning in NSW, to ensure that adequate resources are available and that the varying policy and statutory requirements of the relevant NSW Government agencies are met. The SIP also has the role of making water sharing decisions in cases where interagency regional panels cannot reach agreement or where the issue has state-wide significance.

The SIP is chaired by DPI Water and comprises representatives from DPI Water, OEH and Local Land Services (formerly Catchment Management Authorities) and agriculture, fisheries and aquaculture specialists from Department of Primary Industries. DPI Water is responsible for overall project management.

State Groundwater Panel

The State Groundwater Panel was established to oversee the development of policy for the macro water sharing planning process for groundwater. The Panel has members from NSW DPI (Water, Fisheries and Agriculture) and OEH. Local Land Services are also represented by an inland and coastal representative.

The State Groundwater Panel is a subcommittee of the State Interagency Panel. The Panel provides a senior level forum for discussing and resolving a wide range of water planning and policy issues specific to groundwater. In particular, the State Groundwater Panel developed state-wide distance criteria which the regional panels used as a starting point when considering distance rules for groundwater sources.

Interagency Regional Panels

Interagency Regional Panels (IRPs) were established to develop water sharing plans. IRPs consist of representatives from DPI (representing DPI Water, Fisheries and Agriculture) and one representative from Office of Environment and Heritage (OEH). A representative from Local Land Services attends meetings as an observer to provide advice on consultation issues and other matters within their area of expertise.

Appendix 5 lists the names of the Hunter IRP, their areas of expertise and agency staff who provided specific technical and scientific information.

The key responsibilities of the IRP are to:

- ensure water sharing rules are consistent with state policy,
- review the water management units provided by DPI Water,
- review economic, social and environmental values and undertake risk and value assessments to classify each unregulated water source,
- review existing and generic water sharing rules as to their applicability,
- make recommendations on water access and dealing rules for each water source,
- assist with consultation on proposed rules,
- review submissions from targeted consultation and public exhibition, and make changes where necessary to the water sharing rules.

The IRP uses local knowledge and expertise in developing and recommending water sharing rules through consensus decision-making approach.

An Independent Facilitator was initially engaged to chair the meetings and guide the decision-making process. An Independent Facilitator was not involved in the later IRP meetings which were focused on the clarification and finalisation of draft Plan provisions.

Classification method

In developing water sharing plans for unregulated rivers, DPI Water classified each water source based on the risks and values of water extraction. Two matrices were developed – the first being the ‘value matrix’ which rated a water source’s instream value against its hydrologic stress. The second was the ‘risk matrix’ which rated the risk of extraction to instream values against community dependence on extraction.

This classification method took into account:

- the amount of water extracted,
- the impact of extraction on rivers, estuaries and their ecosystems,
- the associated uses from this extraction,
- social and economic considerations of restricting extraction.

Specifically the classification process involves assessment of factors, including:

- instream values (such as threatened fish species) and the risk to these values posed by existing or increased extraction,
- the risk to instream values posed by extractions,
- hydrologic stress, which is the amount of water extracted in the peak demand month for extraction relative to low flows (i.e. flow that is exceeded 80 per cent of the time),
- extraction value, a qualitative assessment of the economic value of the agriculture which relies on the water licensed for extraction,
- the economic dependence of the local community on activities requiring licensed water extraction,
- the sensitivity of estuaries to the removal of freshwater inflows,
- amount of water extracted as basic landholder rights and for town water supplies,
- whether the existing water sharing rules are adequate to manage the risk to instream values and basic landholder rights,
- NSW Government policy.

A large range of reference material was used in addition to the knowledge of IRP members and technical support staff. The reference material is listed in Appendix 6.

The classification assisted in determining the optimal balance between extraction and protection of water for each water source. These broad-scale relative assessments showed where water sharing rules 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 extraction. Generic, indicative rules were developed for each classification for each matrix to expedite the development of the water sharing plans by the IRP. Where necessary, the IRPs refined these indicative rules to reflect local circumstances. The ‘value’ matrix was used to develop trading rules and the ‘risk’ matrix used to develop the water access rules. The final classifications determined by the IRP for all water sources (both value and risk matrices) have been summarised in Appendix 7.

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

IRP was to use the local knowledge of IRP members to check whether the final classifications were realistic. Amendments to both the classifications and the management rules by the IRP were based on local and technical knowledge of the water sources. In addition, the approach did not include some information which was added by the IRP, such as extraction for town water supplies and the economic values of water extraction that were not considered in the classification process. Justification for changes the IRP made to the initial classification of water sources is provided in Appendix 8.

As a pilot region for the State, undertaking the classification process and in the development of macro plans, the IRP went through a number of iterations of the assessment process and classification of water sources. This was due to changes and improvements made to the guidance used to assist IRPs in the classification process.

Classifications for some water sources changed several times as a result of improvements to the classification process.

Developing water sharing rules

Water sharing rules that the classification process focused on consist of:

- access rules – which determine at what flow levels extraction is allowed
- dealing rules – which control:
 - the trade of water, both transfer of access licence and assignment of water allocation between access licences,
 - change of water sources,
 - the location for extraction.

Other management rules are considered in the development of the Plan such as:

- extraction limits – which set the total volume of water that can be extracted annually from the water source or water management zone,
- rules for granting new entitlement – what types of access licences may be granted,
- rules for granting works approvals – what types of set back conditions are required,
- system operation rules – what types of rules are required for major storages (where relevant).

The key rules in the Plan specify when licence holders can access water and how water can be traded.

For details about the water sharing rules for each water source covered by the Plan, refer to the Water Source Rules Summary Sheets, available on the DPI Water website

www.water.nsw.gov.au

Developing the access and dealings rules

The IRP used local knowledge and expertise in applying the water sharing rules. For example:

- The option to formalise existing local water sharing rules was examined to determine whether those rules achieved the same level of environmental protection as those proposed under the relevant classification and provided for basic rights. In some instances, indicative rules were further refined if site specific information was available,
- Local studies or information from regional staff in areas such as irrigation or aquatic ecology (DPI) were included.
- Extractions patterns by local water and major utilities were examined.
- Consideration was given to see if the estuary at the end of the system necessitated additional catchment-wide protection.

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

- recommended new gauges be installed for high-risk or highly stressed water sources,
- looked at alternatives such as ‘staff’ gauges (which measure river height but not flow) or visible flow references where the risk to instream values was low.

They also considered any known specific requirements of threatened species in relation to key reproductive needs, migration or other particular ecological process.

The IRP recommended a staged approach to change, so as to limit adverse social and economic impacts. In essence, this proposes that water users be given time to adapt to new rules. Where the existing rules were not consistent with the IRP’s recommended rules, the degree of immediate change (and hence the effect on extractors) was limited to the next higher level of rule in the first instance, unless a higher level of protection could be achieved with minimal socio-economic impact. The IRP then determined a timeframe and the further steps required to achieve the recommended rules during the life of the Plan.

Once the proposed water sharing rules were determined, a check was done to ensure that the rules integrate well and are practical across the catchment.

While the initial work focused on unregulated river flows, consideration of the interaction between alluvial aquifers and river flows was undertaken prior to the finalisation of the Plan in line with review of policy for dealing with connectivity between surface and groundwater.

Exceptions to the generic rule approach

In reviewing the indicative rules proposed for each water source the IRP used their local knowledge to refine access and trading rules where appropriate. Amendments made were based on factors such as:

- available infrastructure (e.g. river gauges),
- available management systems (e.g. ability to manage the rules),
- existing management rules (e.g. existing licence conditions or Water Users’ Association management rules),
- whether the highly variable nature of the water source required differing management rules,
- additional issues that we not addressed in the generic analysis.

It was recognised that local interpretation of the indicative water sharing rules was very important. For example, the rule of ‘no pumping from pools when pool drops to a specified height’ was regarded as inappropriate in coastal systems due to small pool sizes and the numerous numbers of pools, making it very difficult to implement and inconsistent with River Flow Objectives (pools need to be maintained for drought refuge). In these instances the IRP adopted a rule of ‘no pumping from pools where there is no visible inflow and outflow’.

In water sources where the existing access rule was more stringent than the indicative rule, the existing access rule was generally adopted, given that there should be no adverse social or economic impact as there would be no change to current operations. In these circumstances the IRP acknowledged that many of the rules had been negotiated by water users, had been a place for a long period of time, and seemed to be adequately protecting values while providing security for water users.

For trading rules the IRP initially did not recommend ‘no net gain’ trades at the commencement of the Plan, proposing no trading into these water sources instead, due to the difficulty in effectively administering ‘no net gain’ type of trade at the time. A ‘no net gain trade’

means that a trade cannot increase entitlement in a water source to a level above that at the start of the Plan. 'No net gain trades' are generally considered for water sources with low to medium instream values and high hydrologic stress/risk. The IRP amended the trading rules post public exhibition due to concerns from water users and introduction of management systems to administer 'No net gain trades'.

Appendix 9 outlines the changes made to the initial access and trading rules by the IRP.

Aboriginal Community Development access licences

A detailed assessment was undertaken to determine where it may be appropriate to grant Aboriginal Community Development licences. It was decided that no new licences would be granted in water sources with high instream value or in areas that could not support any high flow licences. For the Hunter Unregulated and Alluvial water sharing plan area, provision is made for the granting of Aboriginal Community Development licences in the following water sources:

- Isis River,
- Pages River,
- Lower Wollombi Brook,
- Paterson/Allyn Rivers,
- Rouchel Brook.

The restriction of Aboriginal Community Development licences to high flows has been raised as a general issue across all water sharing plans. DPI Water is currently working with the Aboriginal community through the Aboriginal Water Initiative to address these concerns and look at options for allowing limited access to lower flows.

High flow conversions

Statewide guidelines recommend that high flow conversions only be adopted in specified water sources if:

- the water source is classified as having important instream values at high risk from extraction or in water sources having high hydrological stress,
- there are adequate mechanisms in place to ensure the surrendered low flow is reserved for the environment,
- there is no highly sensitive estuary or other identified high flow sensitive feature such as a wetland within the EMU,
- there is no significant extraction already occurring in high flow periods,
- the conversion would not significantly impact on tidal pool users or town water supplies.

The IRP considered these factors and recommended that high flow conversions be made available in the following water sources:

- Isis River,
- Pages River,
- Lower Wollombi Brook,
- Paterson/Allyn Rivers,
- Rouchel Brook.

Consultation

The classifications and the IRP's recommended rules underwent targeted consultation with water users and specific interest groups⁴ before the Plan was drafted. Formal public exhibition⁵ of the draft Plan ensured wider public consultation.

While developing the macro plans, the participating agencies (DPI, OEH and the LLSs) identified areas where better data is needed for making future water planning decisions. Similarly, the community suggested areas where further analysis or data gathering was required. This local input was essential in the finalisation of the draft Plan.

The former Catchment Management Authorities assisted with the public consultation process, to ensure that all stakeholders and interested parties had an opportunity to examine and comment on the proposed water sharing rules. In particular, stakeholders were encouraged to provide:

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

Targeted consultation of the draft rules for the Hunter

Targeted consultation for the draft Hunter Unregulated and Alluvial water sharing plan occurred in late 2005 – early 2006. The objectives of this consultation were:

- to provide background for key stakeholders as to why the plans were being developed, how they were developed, what rules were proposed in the various areas and how stakeholders could provide feedback;
- to provide a 'first opportunity' to informally consult and to test the suitability of the proposed water sources and management zones, flow reference points and access and trading rules where significant changes were proposed from current management.

A total of 103 submissions were received as a result of the targeted consultation. These were reviewed by the IRP (excluding groundwater submissions relating to groundwater aquifers not addressed within this Plan).

An additional meeting was held in Merriwa and Branxton in September 2006 as part of the Groundwater Macro Water Sharing Planning, process providing an overview of the proposed management rules for aquifers. This covered the proposed alluvial aquifer management which was still under a separate water sharing plan at the time, but has since been included in this Plan.

The IRP reviewed all matters raised at the targeted consultation meetings and consequently made changes to the initial water sharing rules. Appendix 10 outlines the changes to the proposed rules as a result of the consultation.

⁴ Targeted consultation refers to informal consultation held with key stakeholders to test the suitability of the proposed water sharing rules and provide feedback on the rules potential impacts.

⁵ Public exhibition is the formal exhibition of the draft Plan where the Minister invites submissions on the draft Plans and in particular will seek comment on a range of key issues.

Table 6: Key groups consulted for Hunter Unregulated and Alluvial water sharing plan

Date	Groups	Locations
October 2005	Hunter Aboriginal Community and Environmental Network (ACEN)	Total
November – December 2005	Bylong Valley WUA Allyn River WUA Upper Pages WUA Halls Creek WUA Merriwa WUA	Bylong Gresford Murrurundi Merriwa
February – May 2006	Williams River WUA Seaham Weir Pool WUA Wollombi Creek WUA Kingdon Ponds WUA Lower Pages Rivers WUA Rouchel Brook WUA Upper Isis water users Widden Brook WUA Baerami Creek WUA	Clarence Town Broke Scone Gundy Rouchel Upper Isis Baerami Widden.
November 2005	Macquarie Generation	Newcastle
December 2005	Hunter Water Corporation	Newcastle
December 2005	General Public	Cessnock, Muswellbrook
June 2006	Hunter Aboriginal Community and Environmental Network (ACEN) * process to liaise with LALCs developed	Singleton
June 2006	Nature Conservation Council	Singleton
May 2006	Hunter tidal pool water users	Maitland, Raymond Terrace
November 2006	Hunter Regulated River Alluvial water users	Singleton

Public exhibition of draft rules for the Hunter

Public exhibition of the proposed rules was held in the Hunter WSP area in early 2008. The objectives of this consultation were:

- to provide background to stakeholders as to why the water sharing plans were being developed, how they were 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 sources rules and how they will be implemented,
- to seek feedback in writing from stakeholders and the general community about the proposed water sharing rules.

Seven public briefings were held at Scone, Sandy Hollow, Merriwa, Maitland, Singleton, Morissett and Clarencetown during the public exhibition period. A number of additional meetings were also with key stakeholder groups on request. A total of 118 submissions were received as a result of the public exhibition. These were reviewed by the IRP.

The IRP reviewed all submissions as well as the matters raised at the meetings and as a result made some changes to the rules which are outlined in Appendix 11. The IRP provided a general response to all submissions so that individuals and groups could see the outcomes of the review of submissions in relation to amendments to the Plan.

Consultation for amendment to Wybong Creek access rules

Proposed changes to the access rules to the Wybong Creek Water Source were placed on public exhibition from 16 March to 27 April 2011. Nine submissions were received and resulted in changes to the proposed water sharing rules. These were the merger of two management zones and replacement of two flow reference points that were located at river road crossing with telemetered gauging stations.

Public submissions regarding the replacement of the Wybong WSP were called for in 2012. Three submissions were received which raised the same issues as those raised in the 2011 public exhibition process. A report was submitted to the Minister recommending the Plan be replaced.

Water users affected by proposed changes to the access rules in the Wybong Creek Water Source were consulted again in December 2015 and were generally agreeable to proposed rules.

Public exhibition of the plan amendment

No public exhibition was held for the merging of the Wybong Creek Water Source into the Hunter Unregulated and Alluvial plan. This is because the existing Plan for the Hunter had been subject to public exhibition when it was first developed in 2002, and no major changes to the Plan were proposed other than the inclusion of access rules for the Wybong Creek Water Source. As discussed above, the proposed rules for the Wybong Creek Water Source were placed on public exhibition in 2011 with further consultation occurring in 2012.

Amendments to the Plan

Addition of the Wybong Creek Water Source

In 2016, the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* was amended to incorporate the water source previously regulated under the *Water Sharing Plan for the Wybong Creek Source 2003* (the Wybong water sharing plan). Wybong Creek forms part of the Hunter River catchment and is a tributary of the Goulburn River. Merging the Wybong water sharing plan into the Hunter Unregulated and Alluvial water sharing plan will bring all unregulated and alluvial water sources of the Hunter Valley into one water sharing plan.

Following commencement of the Wybong water sharing plan in 2004, it was suspended during the 2006 drought following extended dry conditions that resulted in cease to pump conditions for over 200 days. Irrigators within Wybong creek have since been self-managing and ceasing to pump when there is no visible flow at various road crossings. In the spring of 2009 to early summer 2010, DPI Water conducted field verification studies in the creek and confirmed that flow in Wybong Creek is intermittent and disappears at some locations.

Between 2011 and 2015, the Department conducted targeted stakeholder consultation and public exhibition to determine the most appropriate management zone boundaries, reference points and cease to pump levels.

The Wybong Creek water source is now divided into seven management zones with cease to pump rules when there is no visible flow at specified reference points and telemetered gauge sites. A greater number of management zones, each with their own cease to pump rule, allows greater flexibility for water users, allowing them to pump when flow is available in their zone, while the creek may have ceased to flow in other zones.

Access to water is permitted below these cease-to-pump thresholds for basic landholder rights and activities that are considered critical to human needs or animal health requirements.

The seven management zones and the location of the flow reference points specified in the access rules are listed in Table 7 (access rules) and Table 8 (flow reference points).

Table 7: Access rules for Wybong Creek Water Source

Management Zone	Access Rule
Kars Springs Management Zone	Pumping is permitted when there is visible flow at both Wybong Creek at Kars Springs AND at Wybong Creek 1.
Bunnan Management Zone	Pumping is permitted when there is visible flow at Wybong Creek 1 AND at Wybong Creek 2
White Rock Management Zone	Pumping is permitted when there is visible flow at Wybong Creek 2 AND at Wybong Creek 3
Manobalai Management Zone	Pumping is permitted when there is visible flow at Wybong Creek 3 AND at Manobalai Gauge (210147)
Wybong Management Zone	Pumping is permitted when there is visible flow at Manobalai Gauge (210147) AND at Wybong Creek at Wybong Creek Gauge (210040).
Cuan Management Zone	Pumping is permitted when there is visible flow at Cuan Creek 1 AND at Cuan Creek 2
Cuan and Reedy Creeks Management Zone	Pumping is permitted when there is visible flow at Cuan Creek 2 AND at Cuan Creek 3

Table 8: Flow reference points for Wybong Creek Water Source

Flow reference point	Approximate locations
Wybong Creek at Kars Springs	Ford across Wybong Creek on Little Creek Road at Kars Springs; 145 metres from Kars Springs Road
Wybong Creek 1	Wybong Creek, approximately 50 metres upstream from the Staunton Bridge at Bunnan
Wybong Creek 2	Wybong Creek rock bar 50 metres upstream from the Ridgeland Road Bridge
Wybong Creek 3	Ford across Wybong Creek on Ridgeland Road across Wybong Creek at 'Ridgeland'
Manobalai Gauge (210147)	Approximately 6.5 Km upstream of Dry Creek Bridge on Wybong Creek. Location and real-time flow data is available http://www.water.nsw.gov.au/realtime-data
Wybong Creek at Wybong Creek Gauge (210040)	Wybong Creek at the rock bar in at Yarranman Road. Location and real-time flow data is available http://www.water.nsw.gov.au/realtime-data
Cuan Creek 1	Cuan Creek rock bar immediately downstream of the Guan Gua Bridge 8 km east of Bunnan on the Merriwa to Scone Road
Cuan Creek 2	Cuan Creek 2 Cuan Creek rock bar adjacent to the cottage at 'The Valley'
Cuan Creek 3	Cuan Creek, approximately 1.5 km upstream from junction with Wybong Creek

Total Daily Extraction Limits

Total daily extraction limits (TDEL) set how much water can be taken from a particular flow class on a daily basis for water. This enables water to be shared fairly amongst all water users, plus a provision made for environmental needs. However, before these flow classes and daily extraction limits can be implemented, the establishment of additional gauging stations and the metering of extractions is required.

The TDELs that were established in the Wybong water sharing plan for the unregulated river access licences have not been carried forward into the Hunter Unregulated and Alluvial water sharing plan due to the current lack of infrastructure which limits the ability to effectively manage these daily limits.

The Plan includes an amendment clause enabling the establishment, amendment, removal or reinstatement of TDELs if required at a later date.

Requirements for water

The Plan provides for domestic and stock rights and native title rights, both forms of basic landholder rights (BLR) which extract water from the river and do not need to be licensed.

A new method for estimating water use for BLR has been developed since the Wybong plan commenced in 2004. The new method uses GIS layers, DPI Water land use data, population and housing census data, and reasonable take and use zones to estimate stock and domestic water use. The method reduces the possibility of double accounting and has reduced the BLR estimate in the Wybong Creek Water Source from 1.8 ML/day to 0.75 ML/day.

There are currently no known extractions for native title rights from the water source. However, both forms of basic landholder right may increase during the Plan's ten-year term.

Licence entitlement volumes for the Wybong Creek water source have also been updated to reflect any changes to licenced entitlement since the Plan was developed.

Access licence trading rules

Due to the high volume of water that is extracted relative to available water in Wybong Creek water source, trades *into* the water source are not permitted.

Trade rules *within* the water source will remain the same as in the 2004 Plan and will be allowed between management zones in a downstream direction as long as the increase in entitlement in the management zone is not greater than 10% of current entitlement. The trade limits will be provided in the Plan as figures of share components. Because there are now seven management zones in the Wybong Creek Water Source, the trade limits will apply to the group of management zones that correspond to the previous water management zones defined in the 2004 Plan.

Applications for in-river dams

The Wybong Creek water sharing plan previously did not allow applications for in-river dams. DPI Water's current policy is to allow applications for in-river dams except in those water sources which have been identified as having a high instream value. When a risk and value assessment was completed for Wybong Creek it was classified as having a low instream value. Therefore applications for new in-river dams will not be prohibited in this water source.

Other amendments to the Hunter water sharing plan

Other changes to Hunter Unregulated and Alluvial water sharing plan were limited to:

- Standardising clauses to make them consistent with the latest water sharing plans and legislative framework
- Incorporating policy developments since 2004
- Merging of the Goulburn and the Hunter Extraction Management Units (EMUs) into the Greater Hunter EMU.

The IRP agreed to the merging of the Goulburn and the Hunter EMU into one EMU because the Goulburn River is a tributary of the Hunter River and the two are therefore hydrologically connected. The new EMU will be known as the Greater Hunter EMU. Combining the two EMUs will not affect compliance of the LTAAEL as the LTAAELs for both EMUs are not fixed to a specified volume.

A paragraph to acknowledge the traditional land owners will also be included in the Plan. This is being included in all new water sharing plans in NSW.

Adaptive management

Adaptive management refers to the practice of change in response to new information such as monitoring or some other improvement in understanding obtained during the 10 year life of the Plan. In the case of water sharing plans, such information could include socio-economic studies, hydrological modelling, ecological studies and information about Aboriginal cultural values.

Adaptive management is a requirement of both the *Water Management Act 2000* and the National Water Initiative, and has been allowed for through amending provisions and establishment of 'limits of change' to the Plan. These provisions allow some aspects of the water sharing plan to be changed within defined limits. Specific amendment provisions are discussed below.

Monitoring, evaluation and reporting are key activities for the adaptive management of water sharing plans. Further information on these is provided below.

Amendment provisions

Standard amendments that apply to all water sharing plans include:

- amending water sources, management zones or EMUs,
- establishing new or additional flow classes in any water source where management zones are added or amended,
- amending requirements for metering or record keeping in relation to licensed access works,
- updating information in Schedules or deleting them if no longer required.

How the rules may change

In twenty-eight of the Hunter unregulated water sources, there was a lack of adequate information to develop the final water sharing rules which could fully manage the risk to instream values and/or protect community dependencies. In these cases, further analysis or data collection will be undertaken during the life of the Plan (see Table 9). These include additional monitoring or investigation in relation to surface water flows, water quality and estuarine water requirements.

There may be other general amendment provisions included in the Plan which are not mentioned in this document. Please refer to the Plan for a full list of amendment provisions.

Research opportunities

The planning process has identified a number of opportunities for research at a state and regional level. In order to better assess trade-offs, integrated hydrological/ecological studies and socio-economic models are required. An assessment of Aboriginal cultural values and an investigation into the Hunter/Paterson/Wallis estuaries including economic valuation and hydraulic behaviour are further research opportunities in the Hunter area.

It is intended that a statewide research prospectus be developed that reflects research needs and knowledge gaps across all macro plans once they have been drafted. Opportunities for a collaborative approach to research with organisations such as universities and co-operative research centres will be explored.

Table 9: Water sources where adaptive management applies

Water Source	Adaptive Management
Access rules	
<p>Wollar Bylong Widden Baerami Martindale Doyles Lower Wollombi Upper Goulburn Lower Goulburn Pages (Segenhoe MZ) Halls (Giants Creek MZ) Dart (Lower Dart Brook MZ, Lower Middle Brook MZ and Kingdon Ponds MZ) Jerrys (Appletree Flat MZ).</p>	<p>These are highly connected water sources. Groundwater bores are installed and monitoring will occur to assess groundwater behaviour, extraction impacts, and potential for impact on any groundwater dependent ecosystems over a number of years. A groundwater cease to pump level will be set based on the above and socio-economic assessment. Local impact and trading rules have been proposed to protect high value environmental features and existing users before the cease to pump rule is set. Groundwater dependent ecosystems may be identified/ refined during the Plan term based on further studies to locate and determine the level of water dependence of these sites.</p>
<p>Upper Wollombi (Wollombi Brook MZ and Congewai Creek MZ) Halls (Halls Creek MZ only).</p>	<p>These water sources are highly variable, and contain areas with both surface and groundwater dominated extraction. It is planned that bores be installed and monitored, and hydrological studies undertaken to determine the most appropriate access rules. A groundwater or surface water cease to pump level will be set based on the above and socio-economic assessment.</p>
<p>Pages (Gundy MZ).</p>	<p>In the Gundy Management Zone 0.6 ML/day (cease to pump) and 1.0 ML/day (commence to pump) access rules were originally proposed by the Pages River and Tributaries Water Users Association (WUA) as part of the targeted consultation. In light of concerns raised by water users about the implementation of access rules at this level for the specified five year period, the WUA is encouraged to review the frequency of these flow levels and impacts on water extraction and livelihood during the first five years of this Plan to help inform the setting of appropriate access rules at year six of this Plan.</p>
<p>Dart Brook Upper Dart Brook MZ and Upper Middle Brook MZ) Pages (Scotts Creek MZ) Isis Rouchel</p>	<p>Further assessment of surface water flows will be undertaken in these water sources over the first few years of the Plan to allow greater accuracy in flow modelling and determination of rules. A surface water cease to pump level (at a level up to 95 percentile flow) will be set based on consideration of socio economic impacts and environmental requirements. In the Isis this may result in the development of separate management zones, cease to pump rules and flow reference points for the upper and lower system.</p>
<p>Hunter Tidal Pool Paterson Tidal Pool Wallis Tidal Pool</p>	<p>It is recognised that tidal pool water sources are different systems from those upstream. Tidal influences and salinity may impact on the ability of users to extract water more than instantaneous flow levels. Further studies are required in these water sources to determine the appropriate location for the installation of salinity probes, or other relevant infrastructure, and assessment of the users and extraction within the water source. Access rules will be determined, and transfer rules reviewed based on the outcomes of these studies.</p>
<p>Paterson/Allyn (Allyn River MZ) Merriwa Pages (Kewell Creek MZ) Upper Hunter Upper Paterson</p>	<p>In some water sources the introduction (Allyn/Upper Paterson) or reinstatement (Merriwa) of gauging infrastructure may result in amendment or introduction of access rules. Additionally, in some water sources gauging stations have only been installed recently and further time is required for data collection and assessment prior to the determination of access rules.</p>

Water Source	Adaptive Management
Williams	<p>The Williams River water source is currently a trial area for the pilot Williams River Flow Accreditation Scheme. The proposed access rules within the Plan are based on access rules developed under the Scheme. This pilot scheme is due to end within the Plan term and as a result of the pilot it may be necessary to amend the specified access rules.</p> <p>Hunter Water Corporation, as a major extractor from this water source, is undertaking a number of studies as part of their licence conditions. Access rules for B class flows may be developed and included within the Plan based on the outcomes of the study to determine appropriate entitlement and access rules to manage extraction from Seaham Weir Pool by Hunter Water Corporation.</p> <p>Access rules for the Very Low Flow Class in the Seaham Weir Management Zone may also be amended following any studies to determine the appropriateness of the 0.38 m flow level cease to pump in protecting environmental values.</p>
Pages Paterson/Allyn Rivers Dart Brook Lower Goulburn Hunter Regulated River Alluvial	<p>Access rules may be amended in these water sources during the term of this Plan based on augmentation of the local water utility.</p>
Hunter Regulated River Alluvial	<p>It is recognised that there are linkages between alluvial groundwater systems and the regulated river system. Access rules may be amended during the term of the Plan based on the outcomes of further data collection and any surface/groundwater connectivity studies undertaken, to amend the available water determination and introduce water sources or management zones if required.</p>
Trading rules	
Pages	<p>Downstream transfers may be introduced within this water source based on studies to determine how transfer rules influence the spread of access licences and the ability to mitigate clustering of licensed entitlement. The intention is to prevent the occurrence of hotspots in the Segenhoe Management Zone through the spread of entitlement and adoption of appropriate transfer limits.</p>
Upper Wollombi Upper Goulburn Rouchel Brook (excluding Back Creek)	<p>Upstream transfers within these water sources may be introduced based on studies to define groundwater dependent ecosystems or aquatic environmental features and their water requirements. The intention is to allow for increased flexibility in transfer rules whereby upstream transfers may be considered where key environmental values can be identified and protected within the water source.</p>
Hunter River Tidal Pool Paterson River Tidal Pool Wallis Creek Tidal Pool	<p>Transfers rules for change of water source in the Goulburn River Extraction Management Unit may be introduced to allow downstream transfers based on studies to determine how transfer rules influence the spread of access licences and the ability to mitigate clustering of licensed entitlement. The intention is to prevent the occurrence of hotspots through the spread of entitlement and adoption of appropriate transfer.</p>

Monitoring, evaluation and reporting

DPI Water has developed a Monitoring, Evaluation and Reporting Framework in collaboration with key stakeholders. The framework conforms to NSW and Commonwealth government guidelines for monitoring, evaluation and reporting, and demonstrates an adaptive management approach to water planning required under the principles of the WMA 2000.

The evaluation framework aims to inform the community of the outcomes of water sharing plans, and to collate the results of various legislatively required evaluations and relevant knowledge to inform the review of the water sharing plans. The framework will assess the inputs, outputs and outcomes of the water sharing plans and their operations. The assessment will consider:

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

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

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

Performance indicators

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

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

Audit

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

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

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

When conducting an audit the panel will review a range of analysis and material provided by DPI Water to:

- identify patterns of implementation activities across water source types, across plans and types of water sharing plan provisions,
- identify actions required to address instances of partial and non-implementation,
- develop broad recommendations for improving the implementation of existing plans and the robustness of new plans, and
- identify opportunities for linking the audit findings with other related processes, particularly the review of catchment action plan targets.

Plan review

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

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

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

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

Glossary

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

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

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

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

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

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

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

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

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

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

Full capacity: The volume of water that is impounded in the pool, lagoon or lake when the level of water in the pool, lagoon or lake is at the highest water level where there is no visible flow out of that pool.

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

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

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

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

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

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

Management zone: An area within a water source used for defining the location of applicability of water sharing rules, but secondary to the water source. A management zone is more likely to be designated where 'cease-to-pump' rules for works approvals apply.

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

Regulated river: A river that is declared by the Minister, by order published in the Gazette, to be a regulated river. Typically rivers where state owned storages catch water during wetter periods and the river is used to supply stored water to meet downstream users' orders during dry times are regulated rivers.

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

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: 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 each year.

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Appendices

Appendix 1: Identified threatened species

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

It should also be noted that some threatened species, such as the Eastern Freshwater Cod, are highly sensitive to low flow extraction, whilst other threatened species, such as plants that occur in the riparian zone, are less sensitive. Accordingly, threatened species considered to be highly sensitive to low flows are given a highly priority for protection.

The table below shows the threatened species known or expected to occur in the Hunter Unregulated and alluvial water sources

Threatened Species	Munmurra	Krui	Bow	Merrriwa	Halls	Wybong	Baerami	Widden	Bylong	Wollar	Upper Goulburn	Lower Goulburn	Dart	Pages	Isis	Upper Hunter	Rouchel	Muswellbrook	Jerries
Booroolong Frog							✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		
Davies Tree Frog																✓	✓		
Giant Barred Frog										✓									
Giant Burrowing Frog							✓	✓											✓
Glandular Frog																✓	✓		
Green and Golden Bell Frog																			✓
Green-thighed Frog																			
Spagnum Frog																✓			
Red-crowned Toadlet							✓	✓											
Stuttering Frog																✓	✓		
Wallum Froglet																			
Australasian Bittern														✓		✓			
Black Bittern												✓							✓
Black-necked Stork																			
Comb-crested Jacana																			
Freckled Duck																		✓	✓
<i>Maundia triglochinos</i>																			

Threatened Species	Glennies	Glendon	Luskintyre	Singleton	Martindale	Doyles	Lower Wollombi	Black	Wallis	Newcastle	Paterson/Allyn	Williams	Upper Paterson	Upper Wollombi	North Lake Macquarie	Dora Creek	South Lake Macquarie
Adams Emerald Dragonfly							✓							✓	✓	✓	✓
Booroolong Frog	✓				✓						✓	✓	✓				
Davies Tree Frog	✓										✓	✓	✓			✓	✓
Giant Barred Frog	✓						✓		✓		✓	✓	✓	✓		✓	✓
Giant Burrowing Frog				✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓
Glandular Frog	✓										✓	✓	✓				
Green and Golden Bell Frog				✓			✓	✓	✓	✓		✓		✓	✓	✓	✓
Green-thighed Frog	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓		✓	✓	✓
Littlejohns Frog							✓			✓				✓	✓	✓	✓
Spagnum Frog	✓											✓					
Red-crowned Toadlet					✓	✓	✓							✓		✓	
Stuttering Frog	✓						✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Wallum Froglet										✓					✓		✓
Australasian Bittern									✓	✓	✓	✓	✓				✓
Black Bittern	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Black-necked Stork				✓					✓	✓	✓	✓	✓		✓	✓	✓
Blue-billed Duck									✓	✓							
Comb-crested Jacana							✓		✓	✓		✓		✓	✓		
Freckled Duck							✓			✓		✓		✓			
Magpie Goose										✓	✓	✓	✓				
<i>Phaius australis</i> (Southern Swamp Orchid)											✓		✓				
<i>Maundia triglochoides</i>											✓		✓				

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

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

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

Appendix 3: Contribution to the river flow objectives

Levels of assessed contribution:

FULL – contributes to objective in full. HIGH – while not fully contributing to objective is considered a good level of contribution. PARTIAL – goes some way to contributing to the objective. LOW – only small degree of contribution to the objective.

Note that for some systems while there may be no specific rule for each river flow objective the extent to which the rules, annual extraction limits and the risk to values contributed to the objectives was considered, and a specific rule developed only where necessary.

* Note that for the tidal pool water source although rules have not yet been developed the following assessment is based on the intent of the rules. Tidal pool is assessed against the RFOs based on rules intended to maintain natural variability of salinity levels, and protect from significant salt water intrusion.

	Protect pools in dry times	Protect natural low flows	Protect important rises in water levels	Maintain wetland and floodplain inundation	Mimic natural drying in temporary waterways	Maintain natural flow variability	Maintain natural rates of change in water levels	Manage ground-water for ecosystems	Minimise effects of weirs and other structures	Minimise effects of dams on water quality	Make water available for unforeseen events	Maintain or rehabilitate estuarine processes and habitats
Munmurra Krui Bow Dart (Upper Dart Brook MZ, Upper Middle Brook MZ) Muswellbrook, Jerrys Singleton Glendon Brook, Luskintyre Wallis Newcastle Paterson/Allyn (Paterson River Tributaries MZ)	FULL	LOW	PARTIAL	HIGH	N/A	HIGH	HIGH	PARTIAL	N/A	N/A	N/A	LOW
Black (*water source receives treated sewage discharge)	FULL	LOW	PARTIAL	HIGH	LOW	HIGH	HIGH	PARTIAL	N/A	N/A	N/A	LOW

	Protect pools in dry times	Protect natural low flows	Protect important rises in water levels	Maintain wetland and floodplain inundation	Mimic natural drying in temporary waterways	Maintain natural flow variability	Maintain natural rates of change in water levels	Manage ground-water for ecosystems	Minimise effects of weirs and other structures	Minimise effects of dams on water quality	Make water available for unforeseen events	Maintain or rehabilitate estuarine processes and habitats
Merriwa Rouchel Paterson/Allyn Williams Isis Upper Hunter Pages (Scotts Creek MZ, Kewell Creek MZ, Gundy MZ)	FULL	FULL	PARTIAL	HIGH	N/A	HIGH	HIGH	HIGH	N/A	N/A	N/A	HIGH
Pages (Murrundi MZ) Upper Paterson Glennies North Lake Macquarie Dora Creek	FULL	PARTIAL	HIGH	HIGH	N/A	HIGH	HIGH	PARTIAL	N/A	N/A	N/A	PARTIAL
Hunter Regulated River Alluvial	N/A	N/A	N/A	N/A	N/A	N/A	LOW	HIGH	N/A	N/A	N/A	LOW
Halls (Halls Creek MZ) Upper Wollombi	HIGH	PARTIAL	PARTIAL	HIGH	N/A	HIGH	HIGH	HIGH	N/A	N/A	N/A	LOW

	Protect pools in dry times	Protect natural low flows	Protect important rises in water levels	Maintain wetland and floodplain inundation	Mimic natural drying in temporary waterways	Maintain natural flow variability	Maintain natural rates of change in water levels	Manage ground-water for ecosystems	Minimise effects of weirs and other structures	Minimise effects of dams on water quality	Make water available for unforeseen events	Maintain or rehabilitate estuarine processes and habitats
Baerami Upper Goulburn Wollar Bylong Widden Lower Goulburn Martindale Doyles Lower Wollombi Pages (Segenhoe MZ) Halls (Giants Creek MZ) Dart (Lower Dart Brook MZ, Lower Middle Brook MZ and Kingdon Ponds MZ)	PARTIAL	LOW	PARTIAL	HIGH	N/A	HIGH	HIGH	HIGH	N/A	N/A	N/A	LOW
Hunter River Tidal Pool Wallis Creek Tidal Pool Paterson River Tidal Pool	HIGH	PARTIAL	PARTIAL	HIGH	N/A	HIGH	HIGH	HIGH	N/A	N/A	N/A	HIGH

Appendix 4: Contribution to the NRC state-wide targets (2005)

Relevant state-wide target	Contribution by Hunter Unregulated and Alluvial WSP
By 2015 there is an improvement in the condition of riverine ecosystems.	<ul style="list-style-type: none"> • Set a defined share of water for riverine ecosystems. • Protection of very low flows. • Trading rules to maintain or reduce entitlement in high value streams. • Adaptive management, giving the ability to adjust rules once information becomes available.
By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained.	<ul style="list-style-type: none"> • Local impact rules to protect high value floodplain wetlands in highly connected water sources. • Trading rules to reduce entitlement upstream of high value wetlands (e.g. Ellalong Lagoon).
By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems.	<ul style="list-style-type: none"> • Rules to be developed for tidal pool areas based on the environmental requirements of estuaries.
Natural resource decisions contribute to improving or maintaining economic sustainability and social well-being.	<ul style="list-style-type: none"> • Plans provide a defined share to water and defined security of access. • Water markets encourage movement of water licenses to high-value uses. • Rules developed which consider community dependence on water extraction.
By 2015 there is an increase in threatened species populations and ecological communities.	<ul style="list-style-type: none"> • Some access and trading rules were developed to protect water dependent threatened species where these were identified and the risk to these from extraction was high.
By 2015 there is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses.	<ul style="list-style-type: none"> • Local impact rules will be applied which protect significant riverine and non-riverine GDEs. • Common access rules for both alluvial groundwater and surface water will be implemented in recognition of their highly connected nature, and to prevent over-extraction of groundwater and resultant impacts on surface water.

Appendix 5: Interagency Regional Panel and support staff

Table 10: Hunter IRP membership and expertise for 2009 Plan development

Name	Agency	Role	Expertise
Allan Raine (formerly Brian Gardoll and Mark Mignanelli)	DPI	Agency representative	Coastal riparian vegetation ecology, rapid assessment of stream health; fluvial geomorphology.
Bruce Reddan (formerly John Wilson and Glenda Briggs)	DPI	Agency representative	DPI regional input to water reforms, agriculture, catchment management and land use/strategic planning.
Richard Bath	Former DECC	Agency representative	DECC regional input to water reforms, catchment hydrology research, remote sensing, biodiversity.
Cal Cotter (formerly Garry Hunt and Sharon Vernon)	Former HCRCMA	CMA observer	Catchment management, riparian vegetation and wetland ecology, fluvial geomorphology.
Neville Pavan	Former HNCMA	CMA observer (Hawkesbury Nepean component)	Catchment management, project management and implementation of programs in soil and land management, and riparian restoration. Former HNCMA representative for water issue coordination.

Table 11: Hunter IRP membership and expertise for 2016 Plan replacement

Name	Agency	Role	Expertise
Peter Evans	OEH	Technical support	Regional experience in NRM management, floodplain planning and interagency coordination.
Glenda Briggs	DPI (Agriculture)	Technical support	Regional experience in NRM management, coastal agricultural industries, catchment management and interagency coordination.
Scott Carter	DPI (Fisheries)	Technical support	Fisheries management and conservation issues, threatened species, biological/environmental research, local knowledge of flow behaviour of catchments, WSP development and implementation.
Eddie Harris	DPI (Water)	Technical support	Water planning/administration/policy. Geomorphology. Riparian management. Stream ecology/restoration.

Table 12: Support staff and expertise for 2009 plan development

Name	Agency	Role	Expertise
Roland Bow	Former DEC	Technical support/ alternate representative	Technical and management expertise in research, aquaculture, commercial fisheries, compliance and conservation, fisheries management and aquaculture.
Gavin Doyle	Former DEC	Technical support/ alternate representative	Fluvial geomorphology, catchment management, fluvial/estuarine sedimentology, biogeography, plant ecology.
Scott Carter	DPI	Technical support/ alternate representative	Fisheries management and conservation issues, threatened species, biological/environmental research, local knowledge of flow behaviour of catchments, WSP development and implementation.
Danny Norris	DPI	Technical support/ alternate representative	Water policy implementation including water use, enterprise management and basic structural adjustment strategies for water users, water licensing, groundwater/surface water interactions, flow data analysis, local knowledge of flow behaviour of catchments, WSP development and implementation.
Sandra Mitchell	Former DWE	Technical support	Knowledge of flow and water quality relationships, WSP development and implementation, ecological habitat in relation to flow, monitoring.
Mark Simons	DPI	Technical support	Hydrologist – flow data analysis, hydrology, local knowledge of flow behaviour of catchments, WSP development and implementation, policy driver for connected systems, major utility licensing arrangements.
Jon Sayers	DPI	Technical support	Hydrologist – flow data analysis, hydrology, local knowledge of flow behaviour of catchments, WSP development and implementation, high flow policy development, water user background knowledge, local utility licensing arrangements.
John Williams	DPI	Technical support (groundwater)	Groundwater analysis and hydrology.
Brian McDougall	DPI	Technical support (licensing)	Licensing officer, local knowledge of water users, WUAs and local access arrangements.
Lyndal Betteridge	DPI	Macro coordinator	Water policy and planning, utility planning arrangements, WSP development and implementation, project management.
Neil Dufty	Independent	Independent facilitator	Qualified educator and earth scientist, experienced facilitator in NRM planning, former chair of water management committees

Table 13: Support staff and expertise for 2016 plan development

Name	Agency	Role	Expertise
Lyndal Betteridge	DPI Water	Macro coordinator	Water policy and planning, utility planning arrangements, WSP development and implementation, project management.
Sally Hunt	DPI Water	Plan Coordinator	Water sharing plan development and stakeholder liaison.
Brendan Mee	DPI Water	Technical support.	Licensing and compliance officer, local knowledge of water users, WUAs, local access arrangements and reference points.
Mark Simmons	DPI Water	Technical support.	Hydrologist – flow data analysis, hydrology, local knowledge of flow behaviour of catchments, WSP development and implementation, policy driver for connected systems, major utility licensing arrangements.
Jon Sayers	DPI Water	Technical support	Hydrologist – flow data analysis, hydrology, local knowledge of flow behaviour of catchments, WSP development and implementation, high flow policy development, water user background knowledge, local utility licensing arrangements.
Danny Norris	DPI (Agriculture)	Technical support/alternative representative	Water policy implementation including water use, enterprise management and basic structural adjustment strategies for water users, water licensing, groundwater/surface water interactions, flow data analysis, local knowledge of flow behaviour of catchments, WSP development and implementation.

Appendix 6: Reference information used by Interagency Regional Panel

DPI Water data sets:

- Licensing Administrator System – the DPI Water statewide database holding the licence details including volume of entitlement, location details and stream orders.
- Hydsys & IQQM – Hydsys is a DWE state database that holds all flow data. Flow records are available for most water sources. IQQM is the DWE preferred model that was used to undertake all flow modelling.
- RiverStyles Mapping – Riverstyles mapping has been completed for most of the Hunter Region. It is based on the nationally-adopted method developed by Macquarie University. All Hunter mappers have completed accredited Riverstyles training. Maps are produced of Riverstyle/Geomorphic Condition/Recovery Potential. The information was used to assess issues such as drought refuge, habitat heterogeneity, etc in the analysis and to inform the development of flow rules.
- Volumetric Conversion Database – used to help determine the Peak Daily Demand for each water source.
- Regional Groundwater Monitoring Network – DPI has a regional groundwater monitoring network to be used to monitor alluvial groundwater levels and assess stream/surface water connectivity.
- Regional Geographic Information Systems – the DPI Water land use and topographic information.
- TRITON Water Quality database – DWE state wide database holding all corporate water quality data. Data was available for most basic parameters (i.e. EC, pH, temp, TP, TN) for the majority of water sources. DWE has an ongoing regional water quality monitoring network.
- AUSRIVAS – DPI has a number of regional AUSRIVAS sampling sites (macroinvertebrates). The data was used in the spreadsheet to help assess river health.
- Riparian vegetation mapping – riparian vegetation extent has been mapped across the Hunter area. This was used to help determine other (non-extractive) influences on river health.

Central data sets

- Stressed rivers reports – used as the basis for identifying where there are instream barriers.
- Threatened species (fish) – Data supplied by NSW DPI.
- Threatened species (other) – Data supplied by OEH.
- Index of Social Disadvantage – Australian Bureau of Statistics.
- Employment in Agriculture - Australian Bureau of Statistics
- Roy et al. 2001. Structure and Function of South-eastern Australian estuaries.

Other agency data

- National Parks and Wildlife (OEH) Wildlife Atlas – statewide flora and fauna database
- NSW Fisheries (NSW DPI) modelled data sets (Fish Community Index, Fish Community Vulnerability).
- NSW Fisheries (NSW DPI) freshwater and saltwater recreational fishing database.

Joint DPI/University projects

- University of New England (Prof Andrew Boulton).
- An examination of the influences of flow on hyporheic zone functioning – mainly focussed on the regulated Hunter River, but also included sites in Wollombi Brook and Goulburn River catchments.
- Impacts of flow regulation and water extraction on stream ecology (fish and macroinvertebrates). Paired catchment approach focussing on Chichester/Williams Rivers, Glennies/Goorangoola Creeks, and Allyn/ Paterson Rivers.

- State project aimed at assessing impacts of stream cease to flow on instream ecology. Sites are on NSW North Coast, with results applicable to some Hunter streams of similar geomorphology.
- (Dr Peter Hancock) assessment of Stygofauna in the Hunter alluvials. Part of a state project to collect baseline information on Stygofauna, including impacts of water table fluctuation.
- University of Newcastle (Dr Anna Redden)– an examination of links between phytoplankton growth, flow and nutrients in the regulated Hunter River.
- University of Technology – Sydney (Dr Noel Merrick) – development of a model to assess impacts of groundwater extraction on baseflow to streams of the Central Coast.
- Australian National University – (Prof Ian White) – an examination of surface/groundwater connectivity and sources of salinity in the Wybong and Wollombi catchments.
- Southern Cross University (Dr Richard Bush) – an assessment of Natural Sequence Farming in Widden Brook catchment. Among other things, this project will look at issues around stream rehabilitation to increase alluvial groundwater recharge.

Other DPI projects

- Assessing response of macroinvertebrates to changes in wetted area and loss of microhabitat. Project being undertaken in the Karuah River involving differentiation between habitat requirements of riffle biota, and relating habitat loss to flow levels.
- Internal PhD examining the distribution of freshwater mussels and the impacts of changes to their habitat on distribution and abundance.
- Williams River Estuary Environmental Flow Requirements Expert Panel – Expert Panel to examine issues relating to extraction by Hunter Water and the flow requirements of the Williams River Estuary.
- Integrated Monitoring of Environmental Flows (IMEF) – Hypothesis driven project for the regulated Hunter River examining responses of the riverine ecosystem to environmental flow rules. Note: IMEF is a statewide project with all methods subject to external peer review.

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Appendix 7: Summary of final classifications recommended by IRP

Value matrix

High instream values	A Upper Paterson	B Upper Hunter	C Paterson/Allyn, Glennies, Williams, Upper Wollombi, Merriwa, Dora Creek, Upper Goulburn, Rouchel.
Medium instream values	D	E South Lake Macquarie	F Singleton, Baerami, Martindale, Widden, North Lake Macquarie, Jerrys, Lower Wollombi, Dart, Pages, Krui, Glendon, Isis, Doyles, Newcastle, Wallis
Low instream values	G Munmurra	H	I Bow, Luskintyre, Halls, Muswellbrook, Bylong, Black, Wollar, Lower Goulburn
	Low hydrologic stress of hydrologic risk	Medium hydrologic stress of hydrologic risk	High hydrologic stress of hydrologic risk

Risk matrix

High risk to instream values	A	B Paterson/Allyn, Upper Wollombi, Williams, Dora Creek	C
Medium risk to instream values	D Jerrys, Glennies, North Lake Macquarie, Newcastle, Wallis	E Isis, Baerami, Widden, Rouchel, Merriwa, South Lake Macquarie, Upper Hunter	F Lower Wollombi, Dart, Pages
Low risk to instream values	G Singleton, Muswellbrook, Wollar, Bow, Upper Goulburn, Munmurra, Upper Paterson	H Krui, Bylong, Luskintyre, Doyles, Glendon, Martindale	I Halls, Lower Goulburn, Black
	Low dependence on extraction	Medium dependence on extraction	High dependence on extraction

Appendix 8: Justification of final classifications based on IRP knowledge

Water source	Change to classification	Justification
Munmurra	Value classification changed from H-G	The Panel revised the hydrological stress from medium to low due to very small level of extraction, noting flows are highly unreliable.
Krui	Value classification changed from I-F Risk classification changed from E-H	The Panel revised the instream value from low to medium in recognition of the value of the river for catfish. The Panel revised the instream risk from medium to low, as it was deemed the risk to values from extraction was low.
Merriwa	Value classification changed from I-C Risk classification changed from H-E	The Panel revised the instream value from low to high in recognition of the more reliable flows and good condition and habitat value of the river relative to other northern tributaries of the Goulburn River. The Panel revised the risk to instream values from low to medium to reflect the higher instream value compared to hydrological stress.
Bylong	Risk classification changed from G-H	The Panel revised the level of economic dependence from low to medium to reflect the relatively large amount of groundwater extraction that occurs.
Dart	Value classification changed from I-F Risk classification changed from G-F	The Panel revised the level of instream value from low to medium to reflect that high values in the upper reaches. The Panel revised the level of risk to instream value from low to medium to reflect the potential for impacts from extraction on groundwater dependent ecosystems. The Panel revised the level of economic dependence from low to high to reflect the high reliance on groundwater for commercial crops.
Pages	Value classification changed from I-F Risk classification changed from I-F	The Panel revised the level of instream value from low to medium to reflect that the Pages River flows through Cameron's Gorge Nature Reserve. The Panel revised the level of risk to instream value from low to medium to reflect higher value classification, noting that extraction upstream of the Nature Reserve may impact upon it.
Isis	Value classification changed from I-F	The Panel revised the instream value from low to medium as portions of the Isis River are in relatively good condition.
Upper Hunter	Value classification changed from F-B	The Panel revised the instream value from moderate to high, recognising the high values of the headwater portions of the catchment and that many tributary streams are in relatively good condition. The Panel revised the hydrological stress from high to medium as the stream gauge used in the assessment only accounts for about 50 per cent of the catchment. Flows at the end of the system would be expected to be higher.
Rouchel	Value classification changed from F-C	The Panel revised the instream value from moderate to high, because Rouchel Brook has the only stream (Back Creek) with recognised Wild and Scenic values in the Hunter Catchment.
Glennies	Value classification changed from F-C	The Panel revised the instream value from moderate to high, because of the high value sections of Fal and Carrow Brooks upstream of the dam.

Water source	Change to classification	Justification
Glendon	Value classification changed from I-F	The Panel revised the instream value from low to moderate, as it was regarded that this water source had the same values as the neighbouring Singleton water source.
Luskintyre	Risk classification changed from G-H	The Panel revised economic dependence from low to moderate, as it was regarded that this water source had the same level of economic dependence as the neighbouring Glendon water source.
Singleton	Risk classification changed from D-G	The Panel revised the risk to instream value from moderate to low, as it was regarded that this water source had the same level of risk to values as the Luskintyre and Glendon water sources.
Martindale	Risk classification changed from E-H	The Panel revised the risk to instream value from medium to low, as flow is unreliable and most of the streams in this water source consist of uniform sandy stream beds which frequently dry. High values are in the National Park areas and not affected by water extraction.
Doyles	Value classification changed from I-F	The Panel revised the instream value from low to medium, given the similar values this system has to Martindale Creek water source. These values include extensive areas of stream within National Park, in the upper catchment.
Newcastle	Value classification changed from C-F Risk classification changed from A-D	The Panel revised the instream values from high to medium to reflect that most of the major values are related to tidal wading bird habitat which is not related to fresh water aquatic values. The Panel revised the risk to instream values from high to moderate, in recognition that most of the values identified in this water source relate to estuarine wetlands, with little reliance on low flows.
Upper Wollombi	Value classification changed from F-C	The Panel revised the instream value from medium to high in recognition of high value features such as Ellalong Lagoon and the good condition of Congewai Creek upstream of Millfield.
Dora Creek	Value classification changed from F-C Risk classification changed from E-B	The Panel revised the instream value from medium to high in recognition of high value features of Dora Creek and tributaries, particularly in the Watagans area. The Panel revised the risk to instream value from medium to high in recognition of higher instream value.

Note: Classifications did not include groundwater extraction. Groundwater extraction however was considered in the development of appropriate management rules for individual water sources.

Appendix 9: Water sharing rules based on IRP knowledge

Water source	Change to water sharing rules	Justification
Munmurra	<p>Trading rules identified through the classification process were not adopted by the Panel.</p> <p>Access rules identified through the classification process (were adopted by the Panel, excepting CtP at visible flow at specific site.</p>	<p>System already exceeds 50 per cent flow stress if Basic Landholder Rights also considered. Allow for amendment of rules at year five to allow downstream transfers between water sources in Goulburn EMU based on studies to identify cumulative impacts of transfers.</p> <p>CtP at visible flow at specific site not included due to low instream value and low risk.</p>
Krui	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p>	<p>Plan allows for amendment of rules to allow downstream transfers between water sources in Goulburn EMU based on studies to identify cumulative impacts of transfers.</p> <p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p>
Bow	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were adopted by the Panel, excepting CtP at visible flow at specific site.</p>	<p>Plan allows for amendment of rules to allow downstream transfers between water sources in Goulburn EMU based on studies to identify cumulative impacts of transfers.</p> <p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>CtP at visible flow at specific site not included due to low instream value and low risk.</p>
Merriwa	<p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Plan allows for amendment of rules to allow downstream transfers between water sources in Goulburn EMU based on studies to identify cumulative impacts of transfers.</p> <p>More stringent rules currently exist on most licences, and these will continue to apply to those licences.</p>
Baerami Widden Bylong Wollar Lower Goulburn	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Plan allows for amendment of rules to allow downstream transfers between water sources in Goulburn EMU based on studies to identify cumulative impacts of transfers.</p> <p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>Due to lack of surface water flows (Baerami, Widden, Bylong, Wollar, Lower Goulburn) access rules based on classification were not adopted. The Plan allows for the development of cease to pump rules based on a groundwater level trigger by year nine of the Plan.</p>
Upper Goulburn	<p>Access rules identified through the classification process were not adopted by the Panel.</p> <p>Trading rules identified through the classification process were not adopted by the Panel.</p>	<p>Plan allows for amendment of rules to allow downstream transfers between water sources in Goulburn EMU based on studies to identify cumulative impacts of transfers (e.g. transfers may be allowed into from Krui, Wollar, Bylong, Munmurra (but only to downstream of junctions) because these streams flow into the Upper Goulburn Water Source). Within transfers in downstream direction only. Amendment of the Plan may allow for upstream transfers to identified environmental values within the water source if these can be identified.</p> <p>Due to lack of surface water flows access rules based on classification were not adopted. The Plan allows for the development of cease to pump rules based on a groundwater level trigger by year nine of the Plan, with local impact rules to protect high value areas.</p>

Water source	Change to water sharing rules	Justification
Dart	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>Due to the highly variable nature of the Dart Brook Water Source access rules based on classification were not adopted. Initial rules in surface water zones provide for maintaining a visible flow at the end of the management unit and pool protection, allowing an increase in protection by year five, if warranted. These are more stringent than the rules identified through the classification process and recognise that surface water flows in upper catchment areas need to be protected. In the groundwater zones, the Plan allows for the development of cease to pump rules based on a groundwater level trigger by year nine of the Plan with local impact rules to protect high value areas or protect existing users in areas of high competition for water. These rules are consistent with the rules identified through the classification process.</p>
Pages	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Trades are allowed between and out of the Murrurundi and Scott's Creek management zones into all zones downstream of Cameron's Gorge (excluding the Segenhoe management zone), to protect this area.</p> <p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term, excluding zones upstream of Cameron's Gorge.</p> <p>Downstream trades into the Segenhoe management zone may be allowed at year five based on further studies to determine the impacts on groundwater systems.</p> <p>Due to the highly variable nature of the Pages River Water Source access rules based on classification were not adopted. Initial rules in surface water zones provide for maintaining a visible flow at the end of the management unit and pool protection, allowing an increase in protection by year five, if warranted, as per the classification process. In the Segenhoe Zone, the draft Plan allows for the development of cease to pump rules based on a groundwater level trigger by year nine of the Plan with local impact rules to protect high value areas or protect existing users in areas of high competition for water.</p>
Isis	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p>
Muswellbrook	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel, except in some sections of streams where such a condition already exists (e.g. Sandy Creek).</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>For others a visible inflow/outflow rules apply from year five, due to the large number of small streams and lack of flow gauging stations.</p>

Water source	Change to water sharing rules	Justification
Jerrys	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>Due to lack of flow gauging station and noting that the water source is comprised of numerous small streams access rules based on classification were not adopted. A visible Inflow/outflow rule applies from year five.</p>
Glennies	<p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Due to lack of flow gauging station and small number of licences involved access rules based on classification were not adopted. A visible flow applies.</p>
Glendon	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p>
Luskintyre	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p>
Singleton	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>Due to impracticalities of introducing specific site cease to pump on multiple small streams access rules based on classification were not adopted. A visible inflow/outflow to pumping pool adopted to commence by year five of the Plan.</p>
Martindale, Doyles	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel, though very similar rules were.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>The Plan allows for the development of cease to pump rules based on a groundwater level trigger by year nine of the Plan. Most values occur upstream of irrigation, and the Plan allows for implementation of local impact rules to protect environmental values.</p>
Lower Wollombi	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p> <p>Access rules identified through the classification process were not adopted by the Panel, though very similar rules were.</p>	<p>Trades are allowed into the water source from the Upper Wollombi Water Source to reduce impact on values in this area.</p> <p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p> <p>The Plan allows for the development of cease to pump rules based on a groundwater level trigger by year nine of the Plan.</p>
Black	<p>Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available.</p>	<p>Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term.</p>

Water source	Change to water sharing rules	Justification
Wallis	Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available. Access rules identified through the classification process were not adopted by the Panel.	Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term. Due to difficulty in establishing representative end-of system flow site access rules based on the classification were not adopted. A visible inflow/outflow to pumping pool adopted to commence by year five of the Plan.
Newcastle	Access rules identified through the classification process were not adopted by the Panel.	Due to difficulty in establishing representative end-of system for multiple small streams access rules based on the classification were not adopted. A visible inflow/outflow to pumping pool adopted to commence by year five of the Plan.
Williams	Access rules identified through the classification process were not adopted by the Panel.	Access rules recommended by the Healthy Rivers Commission, including the Williams River Pilot Low Flow Accreditation Scheme were adopted.
Upper Paterson	Access rules identified through the classification process were not adopted by the Panel.	Due to lack of a flow gauging station access rules based on classification were not adopted. A rule to maintain a visible flow at the end of the water source will be implemented at Plan commencement. The Plan will allow for introduction of a cease to pump at the 95th percentile by year five if gauging infrastructure is installed.
Halls, Upper Wollombi	Access rules identified through the classification process were not adopted by the Panel.	Due to the variable nature of Wollombi Brook and Congewai Creek, and Halls Creek and the limited information available access rules based on classification were not adopted. The draft Plan allows for the development of cease to pump rules based on a groundwater level trigger and/or visible flow to be based on further studies.
North Lake Macquarie	Trading rules identified through classification process were adopted but introduction tied to appropriate management systems being available. Access rules identified through the classification process were not adopted by the Panel.	Plan allows for amendment of rules to allow no net trades into the water source based on available management systems during Plan term. Due to the lack of flow gauges, the small number of users, and the number of small streams involved access rules based on classification were not adopted. A visible inflow/outflow rule was adopted for all streams with the addition of a visible flow at a specified point for Cockle Creek. The same rule applies to tidal pool irrigators (i.e. no pumping when no visible inflow).
Dora Creek	Access rules identified through the classification process were not adopted by the Panel.	Due to the lack of flow gauges, the small number of users, and the number of small streams involved access rules based on classification were not adopted. A visible flow at a specified point on Dora Creek was adopted along with a visible inflow/outflow rule. The same rule applies to tidal pool irrigators (i.e. no pumping when no visible inflow).
South Lake Macquarie	Trading rules identified through the classification process were not adopted by the Panel. Access rules identified through the classification process were not adopted by the Panel.	The proportion of time flow is available will be limited so no into transfers are provided for. Due to the lack of flow gauges, the small number of users, and the number of small streams involved access rules based on classification were not adopted. A visible flow at a specified point was adopted along with a visible inflow/outflow rule. The same rule applies to tidal pool irrigators (i.e. no pumping when no visible inflow).

Note: Information on trading and access rules associated with a water source's classification can be found in Community Guide etc.

Appendix 10: Refined water sharing rules based on targeted consultation

Water source	Change to water sharing rules	Justification
Halls Baerami Widden Bylong Wollar Upper Goulburn Lower Goulburn Dart Pages Martindale Doyles Lower Wollombi Upper Wollombi Hunter regulated River Alluvial	Based on submissions received from water users the IRP proposed a number of amendments to the local impact management rules within the draft Plan. These relate to: 1. application of the local impact rules to all new and replacement bores 2. restriction on new or replacement works in or near rivers/creeks 3. application of the buffer distances to spearpoints – to include a provision that the buffer distances do not apply to works held by the same individual.	1. Amended to indicate that if the extraction from the replacement work does not increase the rules will not apply if the work is located within a specified distance from the previous work. 2. Amended to indicate that if it can be demonstrated that the placement of the work will not have an impact on the river environment or river stability than the buffer distances do not apply. 3. This means that the individual works within the spearpoint do not incur the buffer distances.
Dart	The Upper Kingdon Ponds management zone has been renamed the Petwyn Vale management zone and has been amended to exclude any of the Kingdon Ponds aquifer. The Kingdon Ponds aquifer is now covered entirely by the Lower Middle Brook and Kingdon Ponds management zone. The access rules were amended based on the change to the management zone boundary with the Petwyn Valley management zone being managed through a proposed pool rule.	The basis for the amended naming and boundaries of the management zones was to reflect that the upper reaches of Kingdon Ponds have unreliable surface water flow and most extraction is from groundwater. In contrast Petwyn Vale Creek has more reliable surface water flows.
Pages	The lower boundary of the Blandford management zone was amended to be in line with Camerons Gorge and an additional management zone was introduced (Kewell Creek) which extends from Camerons Gorge to the confluence of the Pages River with the Isis River. The upper limit of the Gundy zone is now this confluence point. Based on further field work from the targeted submission comments it is also proposed to now split the Blandford management zone into the Murrurundi Management Zone (extending upstream of the confluence of Warlands Creek and the Pages River), and the Scotts Creek Management Zone (extending from the confluence of Warlands Creek and the Pages River to Camerons Gorge). Access rules in the: <ul style="list-style-type: none"> Murrurundi Management Zone access rules have been proposed as visible flow at Benhams Bridge. Scotts Creek Management Zone the former proposed Blandford access rules of no visible flow at the Pages River at Blandford gauge remain. Kewell Creek Management Zone the proposed access rule is visible flow at Pages River upstream of Kewell Creek gauge with a move to the 95th percentile flow level at year six, with studies to identify appropriateness of gauge due to concerns raised by water users. 	The basis for splitting the Murrurundi and Scotts Creek management zones is that Blandford gauge is located downstream of the confluence with Scotts and Warlands Creeks (now the Scotts Creek Zone). As a result it has more reliable flows than the upstream reaches, which are now included as part of the Murrurundi Zone. The basis for the separation of the Gundy and Kewells Creek management zones is that there are a number of tributaries which flow into the Pages River downstream of Benhams Bridge which may influence the gauge reading at Blandford. In the Gundy and Segenhoe management zone amendment of the access rules recognised the existing rules managed by the WUA. The proposal for high flow conversion was removed from the Segenhoe management zone given that it is identified as a high extraction groundwater area where the flow reference point is upstream. Further amendment of the Gundy access rules recognised concerns raised by water users over the term of the proposed rules e.g. five years and concerns that this may have a significant impact on users, rather than the ability to monitor on e.g. an annual basis. Further amendment of the Segenhoe access rules recognised that current WUA arrangement only activated on weekends and in moving to these rules on a daily basis may have been overly restrictive to water users. It was determined to revert to the original rules

- In the Gundy Management Zone the proposed access rules based on local Water User Association management arrangements were initially adopted, by the Panel including a cease to pump level of 0.6 ML/day and a commence to pump level of 1 ML/day as measured at the Pages River at Gundy gauge, however due to concerns raised by water users these were further amended to revert to a visible flow level for the first five years of the Plan with a move to a flow level at year six up to the cease to pump level originally nominated by the WUA. This gives water users further time to assess the impacts on an increased flow level and the long-term adoption of their rules.
- In the Segenhoe Management Zone proposed access rules based on local Water User Association management arrangements were initially adopted by the Panel for the first nine years of the Plan, prior to review of appropriate groundwater cease to pump levels by year ten of the Plan. However due to further investigation it was determined that the current application of these rules was significantly less than anticipated and consequently the Panel reverted to no access rules at Plan commencement with adoption of an appropriate groundwater cease to pump levels by year 10 of the Plan.

Provision for high flow conversion was also removed.

Trading rules were amended to include the Kewell Creek, Scotts Creek and Murrurundi management zones.

proposed which was based on collection of groundwater data for a number of years to inform aquifer behaviour and determination of access rules.

Isis

Based on submissions received from water users, the IRP initially proposed amendment of the proposed access rules within the draft Plan. These include the inclusion of a commence to pump flow level, and amendment of the proposed cease to pump level from visible flow to 1.5 ML/day. However due to concerns raised by water users these were further amended to revert to a visible flow level for the first five years of the Plan with a move to a 95th percentile flow level at year ten with consideration of the cease to pump levels originally nominated by the WUA. This gives water users further time to assess the impacts on an increased flow level and the long-term adoption of their rules.

Amendment of the access rules recognises the existing rules managed by the WUA Further amendment recognised concerns raised by water users over the term of the proposed rules e.g. five years and concerns that this may have a significant impact on users, rather than the ability to monitor e.g. on an annual basis.

Rouchel Brook

Based on submissions received from water users in the Hunter the Panel has proposed a number of amendments to the local impact management rules within the draft Plan. These relate to:

- no transfer allowed in an upstream direction in the Rouchel Brook water source. This rule previously only applied to Back Creek
- access rules have been amended to include a commence to pump figure of 10 ML/day, and a differential cease to pump figure based on seasons as recommended by water users
- B class access is now proposed for the Rouchel Brook water source.

Amendment of the transfer rules to limit transfers in a downstream direction is based on recommendations by the WUA, and also provides a greater level of environmental protection.

Amendment of the Rouchel Brook access rules is based on the recognition of the existing rules managed by the WUA.

The introduction of B class access was based on demand from water users and assessment of adequate high flows to provide for such access.

Muswellbrook	Based on submissions received from water users the Panel has proposed amendment to the proposed access rules for the Muswellbrook water source. These have included the removal of the application of the Rouchel Lane access conditions to all access licences on Sandy Creek. These conditions will remain for those licences which already have them but all other access licences will be governed through a pumping rule relating to pool levels from year five of the Plan.	This recognises that the Rouchel Lane access conditions were for a specific area/purpose and should not be applied across the whole water source.
Lower Wollombi	It is proposed to allow transfers from the Upper Wollombi to the Lower Wollombi.	Allowance of transfers recognises the requests of water users and the increased values of the Upper Wollombi water source (e.g. Ellalong Lagoon) and benefits of allowing transfers to the Lower Wollombi water source and reducing pressure on extraction in Upper Wollombi by doing so.
Paterson/Allyn	Based on submissions received from water users the Panel has proposed a number of amendments to the proposed access and trading rules within the draft Plan. These relate to: <ul style="list-style-type: none"> • separation of the water source into two management zones – the Allyn River and Paterson River Tributaries • given the small streams in the Paterson River Tributaries management zone it is proposed that all access licences will be governed through a pumping rule relating to pool levels from year five of the Plan. • amendment of the proposed access rules for the Allyn River to reflect the flow levels recommended by the Water Users Association. 	Separation of the Allyn and Paterson River tributaries recognises the differences between the two areas. Amendment of the Allyn River access rules is based on the recognition of the existing rules managed by the WUA. The Panel accepted that the proposed rules will provide more water on average over the life of the Plan than those originally proposed by the Panel.
Williams	Based on submissions received from water users the Panel has proposed a number of amendments to the proposed access and trading rules within the draft Plan. These relate to: <ul style="list-style-type: none"> • separation of the water source into two management zones – the Williams River and Seaham Weir • inclusion of amendment provisions for the possible amendment of the cease to pump flow level for Seaham Weir management zone by year five of the Plan based on further studies. 	Separation of the River and Tidal Pool recognises the different access rules between these two water sources. Potential amendment of the CtP level within the Seaham Weir management zone recognises the value of assessing any new information in reviewing access rules developed based on recommendations of the Healthy Rivers Commission.
Upper Wollombi	It is proposed to allow transfers in an upstream direction in the Upper Wollombi Water Source.	An amendment clause is proposed to allow for possible upstream transfers within the Upper Wollombi water source based on studies to define high value ecosystems and their water requirements. Transfers would not be allowed upstream of these areas
North Lake Macquarie	No changes were proposed by water users or interest groups to the proposed rules during the targeted consultation period. Further field work relating to the identification of flow reference points, however, did result in a change to the proposed access rules. It is proposed that from the start of the Plan, extraction of water will only be permitted in the Cockle Creek tributary when	This amendment was due to a lack of suitable gauge site, with a specific site only available in Cockle Creek.

there is a:

1. visible inflow and outflow from the pumping pool
2. visible flow⁶ at the pump site
3. visible flow at a specific point (the causeway on The Weir Road, Barnsley).

For all other tributaries in the North Lake Macquarie water source, extraction of water will only be permitted where there is:

1. visible inflow and outflow from the pumping pool
2. a visible flow at the pump site.

Dora Creek

No changes were proposed by water users or interest groups to the proposed rules during the targeted consultation period. Further field work relating to the identification of flow reference points, however, did result in a change to the proposed access rules. It is proposed that from the start of the Plan, extraction of water will only be permitted in the Dora Creek tributary when there is a:

1. visible inflow and outflow from the pumping pool
2. visible flow at the pump site
3. visible flow at a specific point (the weir downstream of the roadbridge on Freemans Drive at Corranbong).

For all other tributaries in the Dora Creek water source, extraction of water will only be permitted where there is a:

1. visible inflow and outflow from the pumping pool
2. visible flow at the pump site.

This amendment was due to a lack of suitable gauge site with a specific site only available in Dora Creek.

South Lake Macquarie

No changes were proposed by water users or interest groups to the proposed rules during the targeted consultation period. Further field work relating to the identification of flow reference points, however, did result in a change to the proposed access rules. It is proposed that from the start of the Plan, extraction of water will only be permitted when there is a:

1. a visible inflow and outflow from the pumping pool
2. when there is a visible flow⁶ at the pump site.

This amendment was due to a lack of suitable gauge sites.

Hunter River Alluvial

The Hunter River Alluvial 3 water source was removed.

Allow for formation of new water source or management zones based on outcomes of further studies.

Allow for amendment of the proposed available water determination rules based on further studies/data collection to assess connectivity and to include a phase in period for water users if required.

In recognition of the potential for impacts on water users of the proposed rules it was acknowledged that further studies and data collection over the next five years can help inform access rule amendment. It was recommended that the draft rules be amended to:

1. retain the proposed Water Source 1 (within 40 m of the high bank of the river) with an available water determination (AWD) equal

⁶ Visible flow is the continuous downstream movement of water that is perceptible to the eye.

⁷ Visible flow is the continuous downstream movement of water that is perceptible to the eye.

- to regulated river (general security) access licences in the Hunter Regulated River in recognition of existing state policy regarding surface and groundwater connectivity, and the provisions of the Hunter River Water Sharing Plan (regulated)
2. remove Water Source 3 and extend Water Source 2 (greater than 40 m of the high bank of the river) with an AWD equivalent to regulated river (high security) access licences in the Hunter Regulated River in recognition that further studies and data collection are likely to help further define the level of connectivity of surface water to groundwater as you move away from the river
 3. allow for formation of new management zones or water sources where appropriate based on further studies and data collection
 4. allow for the available water determination (AWD) for Water Source 2 to be amended from year five of the Plan to an AWD equivalent to:
 - AWD equal to regulated river (general security) access licences in the Hunter Regulated River
 - AWD equal to alluvial access licences
 - AWD equal to a proportion of (general security) access licences under the Water Sharing Plan for the Hunter Regulated River Water Source 2003 and aquifer access licences. For example the AWD may be the sum of 50 per cent of the AWD for general security and 50 per cent of the AWD for aquifer access licences or some other variation of percentage equal to 100 per cent. It may also be appropriate to have a sliding scale of AWD application based on distance from the river if justified.
 5. Provide for an adjustment period for amendment of the available water determination, if necessary, to allow for a phasing in period in order to achieve requirements of clause above in recognition that there may be an impact on water users.
 6. Provide for sharing of the outcomes of data collection and further studies, and consult with relevant agencies and stakeholders (including water users) where amendment of the rules is proposed to ensure discussion of information outcomes and consideration of impacts of proposed uses on water users.
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Appendix 11: Refined water sharing rules based on public exhibition

Water source	Change to water sharing rules	Justification
All	<p>Rules for granting water supply works (bore) approvals:</p> <ul style="list-style-type: none"> Distance criteria for replacement bores amended from 10 to 20 m. Definition of acceptable impact included for works within the streambed. <p>Maps/Area to which Plan applies:</p> <ul style="list-style-type: none"> Ensure maps show all existing WSP areas excluded from this Plan. Ensure clarity between alluvial area covered by Hunter Regulated River WSP and the Hunter Unregulated and Alluvial WSP. 	<p>These amendments recognised:</p> <ol style="list-style-type: none"> A number of submission indicated that: <ul style="list-style-type: none"> the distance criteria proposed for replacement works was not realistic and should be increased the draft Plan used the words ‘no impact’ when referring to works within the streambed and further clarification was required on the level of impact that would be acceptable. Maps contained within the Plan and the area defined by the Plan needs to ensure no areas addressed by other WSPs are identified.
Baerami Widden Bylong Wollar Upper Goulburn, Lower Goulburn Martindale Doyles Lower Wollombi Pages (Segenhoe MZ) Jerrys (Appletree Flat MZ) Halls Dart (Lower Middlebrook and Kingdon Ponds MZ)	<p>No carryover or rolling average for aquifer access licences in highly connected water sources for the first five years of the Plan. Amendment from year five possible.</p>	<p>These amendments recognised that the impact on groundwater resources of increased extraction in any one year should not be permitted until further information is available on the groundwater systems and their recovery rates etc. While carryover and rolling averages in proposed for surface water systems these are much more reactive than groundwater systems. Information from monitoring bores used to inform groundwater cease to pump triggers will also be used to inform accounting rules for highly connected groundwater.</p>
Upper Hunter	<p>Water source split into two management zones:</p> <ol style="list-style-type: none"> Upper Hunter and Stewarts Brook CtP from year five of the Plan for Upper Hunter Management Zone amended from 19 ML/day to: <ol style="list-style-type: none"> 7 ML/day at Moonan Damsite gauge and visible flow at Belltrees gauge for years six to nine 12 ML/day at Moonan Damsite gauge and visible flow at Belltrees gauge from year ten. <p>Amendment provision allows for movement to Belltrees gauge for flow levels by year ten if agreed with water users, otherwise option to include new management zone with flow classes at Belltrees equivalent to Moonan Damsite flow classes.</p> <p>CtP for Stewarts Brook Management Zone set at visible flow at both Garlands Bridge and Belltrees gauge.</p> <p>Amendment provision allows for visible flow at Belltrees gauge to be increased to the 95th percentile flow by year ten of the Plan.</p>	<p>These amendments recognised:</p> <ul style="list-style-type: none"> Stewarts Brook behaves independent of the rest of the water source and should have separate management rules and flow reference points. Measurement at the Belltrees gauge ensures a flow through the entire system. Existing management rules used by the WUA. Time for adjustment to higher flow levels. Options for managing the system.

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Jerrys	<p>Water source split into two management zones:</p> <ol style="list-style-type: none"> 1. Jerrys and Appletree Flat. 2. CtP for Appletree Flat to be determined over term of the Plan based on groundwater trigger. 	<p>These amendments recognised:</p> <ol style="list-style-type: none"> 1. Appletree Flat behaves independent of the rest of the water source and extraction is groundwater dominated.
Isis	<p>Amendment provisions extended to allow for development of management zones, cease to pump rules and flow reference points.</p> <p>Amendment provisions extended to allow B class flows to be measured at Stick Me Up Bridge gauge.</p>	<p>These amendments recognised:</p> <ol style="list-style-type: none"> 1. a number of submissions sought to have separate management zones for the Upper and Lower Isis in recognition of the different flow characteristics throughout the system. Further information is needed to determine the appropriateness of such rules. 2. B class flows are currently proposed to be measure at Gunday Recorder gauge due the limited period of operation of the Stick Me Up Bridge gauge. Once further information is collected it is appropriate that the flow reference point is amended to within the water source.
Hunter Regulated River Alluvial	<p>Water Source 2 amalgamated with Water Source 1.</p> <p>Option for new water sources or management zones to be established.</p> <p>AWD for Water Source to be equivalent to high security (Hunter Reg River access licence) for first five years of Plan.</p> <p>Option to retain high security AWD after year five.</p> <p>No trading into 200 m of the river.</p> <p>Existing users within 200 m of the river cannot transfer if it results in the transfer being to a work that is closer to the river than the existing work.</p> <p>No new works within 200 m of the river.</p>	<p>These amendments recognised:</p> <ol style="list-style-type: none"> 1. The difficulty in defining the boundary of Water Source 1 (40 m from high bank) and continued concerns from water users about the degree of connectivity. 2. Further information will be collected to inform decision making on surface/groundwater connectivity. 3. Setting the AWD at equivalent to high security Hunter Regulated River access licences provides for equity between water users. 4. Amending trading limitations from within 40m to within 200 m and prohibiting new bores within 200 m is consistent with existing government policy in the water source.
<p>Krui Bow Halls Baerami Widden Bylong Wollar Dart Pages Isis Muswellbrook Jerrys Glendon Luskintyre Singleton Martindale Doyles Lower Wollombi Black Wallis North Lake Macquarie</p>	<p>Provision for no net gain transfers from Plan commencement.</p>	<p>These amendments recognised that licence holders sought freeing up of trading opportunities where possible. No net gain transfers were previously limited to when management systems were available. These issues are now being resolved.</p>

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Upper Goulburn	Provision for amendment to no net gain transfers based on further studies (already identified for review of 'within' water source transfer rules).	This amendment recognised that limitations on trading both into and within the water source were based on environmental values within the system. Further studies are provided for determine the water requirements of these values and whether amendment of transfer rules is appropriate.
Lower Goulburn	Amendment from no net gain transfers to trades allowed in to the water source.	This amendment recognised the need to provide some flexibility to encourage a trading market in the EMU which was primarily water sources where there is 'no net gain transfer' or 'no transfer permitted' into water sources recommended.
