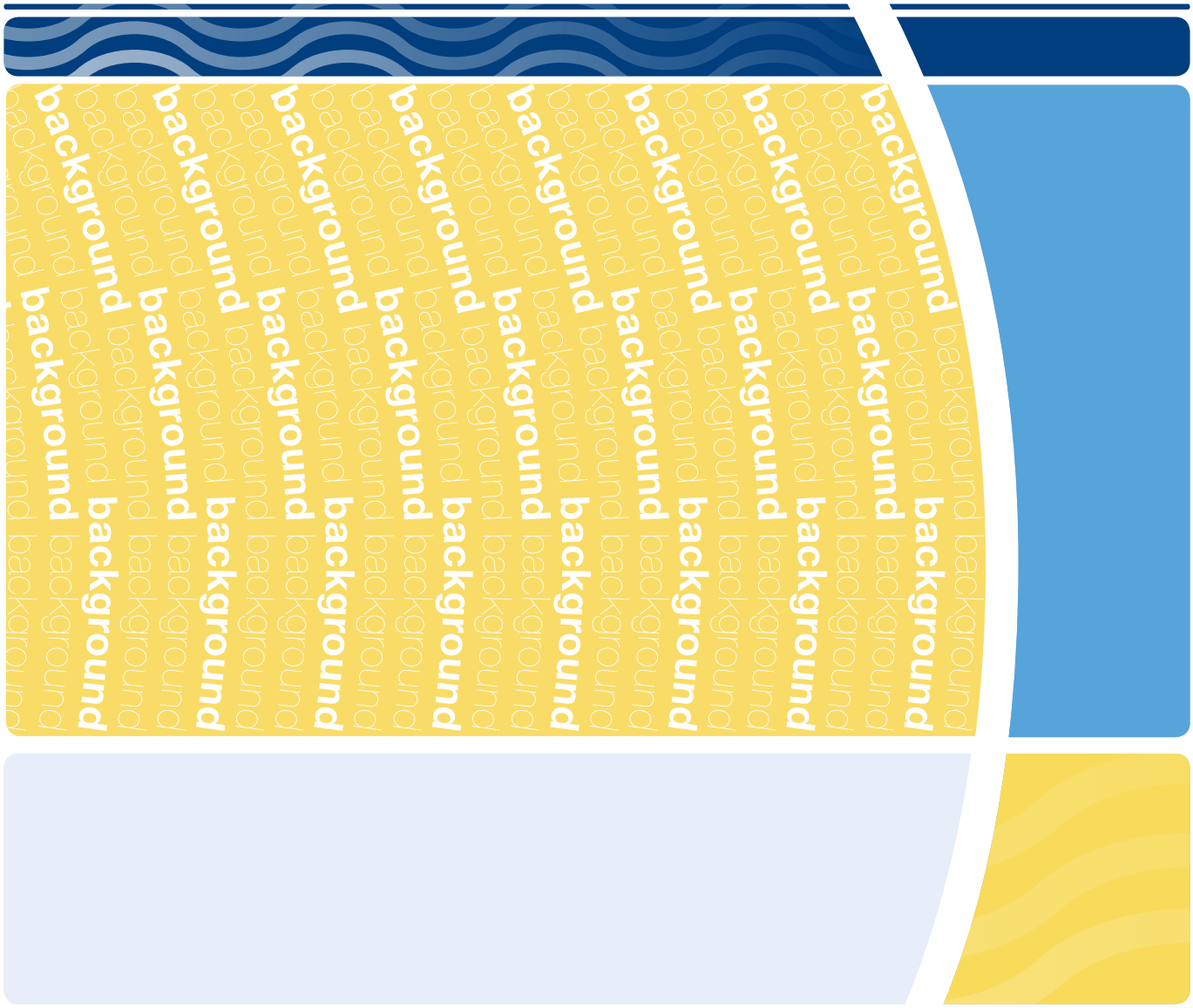
Department of Primary Industries
Office of Water

Water Sharing Plan
Murray Unregulated and Alluvial Water Sources
Background document



Leading policy and reform in sustainable water management

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The NSW Office of Water manages the policy and regulatory frameworks for the state's surface water and groundwater resources, to provide a secure and sustainable water supply for all users. It also supports water utilities in the provision of water and sewerage services throughout New South Wales.
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Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources – Background document

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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*. These plans protect the health of our rivers and groundwater while also providing water users with perpetual access licences, equitable conditions, and increased opportunities to trade water through separation of land and water. In July 2004, 31 water sharing plans commenced in NSW, bringing these water sources and about 80 per cent of water extracted in NSW under the management and licensing provisions of the *Water Management Act 2000*.

In recent years, water sharing plans for the unregulated rivers and groundwater systems have been completed using a 'macro' or broader-scale river catchment or aquifer system approach[1]. More than 95 per cent of the water extracted in NSW is now covered by the *Water Management Act 2000.* The macro planning process is designed to develop water sharing plans covering most of the remaining water sources across NSW. Each macro plan covers a large river basin rather than a single subcatchment, or in the case of groundwater systems, cover a particular type of aquifer, such as fractured rock.

The *Water Sharing Plan for the Murray Unregulated and Alluvial Water Sources* covers 15 unregulated water sources that are grouped into two extraction management units, together with one alluvial groundwater source (refer Appendix 1). Water sharing rules that the plan focuses on are:

- environmental water rules – the share of the water reserved for the environment
- access rules – which determine when extraction is allowed (for example, above a set river flow rate or set volume at a gauge)
- dealing rules – which control the trade of water, both the transfer of share components of an access licence and assignment of water allocation between access licences, as well as changing the location for water extraction.

The following additional water sharing rules have been prepared:

- long-term average annual extraction limits – a growth-in-use assessment and management tool
- rules for granting access licences – what types of licences may be granted
- rules for granting works approvals – what types of set back conditions are required
- system operation rules.

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

- the purpose of the plan
- a physical description of the Murray catchment including land and water use
- the process of plan development including scope, history and basis for decisions
- the relationship between the plan and the Basin Plan
- the use of adaptive management
- the activities associated with implementation, monitoring and review of the plan.

The objectives of the plan are to:

- protect the important water dependent environmental, Aboriginal cultural and heritage values
- protect basic landholder rights

[1] Unlike regulated rivers, the supply of water in unregulated rivers is typically not regulated by controlled releases of water from dams but rather is dependent solely on rainfall and natural river flows.

- manage water extraction from the rivers and the closely linked aquifers to ensure equitable sharing between users
- provide opportunities for market based trading of licences and water allocations
- provide flexibility for licensed water users in how they can use their water
- allow for adaptive management, that is, to allow changes to the plan to be made as a result of more information that may become available during the life of the plan.

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

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

In addition, general information on the macro planning process is available in the Water sharing plans section of the NSW Office of Water website www.water.nsw.gov.au, and 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* – supplementary to the approach for unregulated rivers this policy is designed to inform and guide the method used for setting rules for pools within macro planning areas
- *Macro water sharing plans – the approach for groundwater. A report to assist community consultation* – explains the work begun in 2004 to develop macro water sharing plans to cover all remaining groundwater sources in NSW.

Purpose of the plan

Why are water sharing plans being prepared?

Expansion of water extraction across NSW in the 20th century has placed most valleys at or close to the limit of sustainable water extraction. This has seen increasing competition between water users (towns, farmers, industries and irrigators) for access to water. This has also placed pressure on the health and biological diversity of our rivers and aquifers.

Water sharing plans provide a legislative basis for sharing water between the environment and consumptive purposes. Under the *Water Management Act 2000* a plan for sharing water must protect the water source and its dependent ecosystems and must protect basic landholder rights. Sharing or extraction of water under any other right must not prejudice these rights. Therefore, sharing out water to licensed water users is effectively the next priority for water sharing. Among licensed water users, priority is given to water utilities and licensed stock and domestic use, ahead of commercial purposes such as irrigation and other industries.

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

In conjunction with other provisions of the *Water Management Act 2000*, water sharing plans also set rules so that commercial users can also continue to operate productively. In general, commercial licences under the *Water Management Act 2000* are granted in perpetuity, providing greater commercial security of water access entitlements. Plans also define the access rules for commercial users for 10 years providing all users with greater certainty regarding sharing arrangements.[2]

Benefits for water users

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

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

The plan recognises the economic benefits to the region that are generated by commercial users such as irrigators and industry. It sets rules so that commercial users can continue to operate productively. Two of the water sources covered by the plan are considered to have a high economic dependence on commercial extraction (Table 1).

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

Table 1: Water sources with a high level of economic dependence

Water source	Description
Mannus	High dependence on extraction for irrigation (mainly pasture, cereals, berries, nuts and vineyards)
Upper Murray River	High dependence on extraction for irrigation (mainly pasture, lucerne, cereals, olives, and vineyards)

Environmental considerations

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

Unregulated water sources

Most of the demand for water from unregulated systems usually occurs at those times when stream flow is low. While there is only limited research on the importance of protecting very low flows, a body of evidence suggests that low flows are essential for maintaining water quality, allowing passage over riffles for fish and other fauna to pools for drought refuge, 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. Although many streams will naturally stop flowing in dry times, it is the increased frequency and duration of drying as a result of extraction that has the potential to impact on stream ecosystems.

Accordingly, in order to protect a proportion of these very low flows for the benefit of the environment, the plan imposes new access restrictions on days when flows are low. This is achieved by establishing 'cease-to-pump' (CtP) rules that describe when water must not be extracted, depending on the amount of flow in the river on any given day.

When a CtP event has been activated for a period of time, eventually flows will increase again above the CtP level. After a CtP has occurred, a 'commence to pump' will then be activated to let users know that they are able to extract water again. The commence-to-pump level can vary between water sources and management zones and may be immediately activated once the river levels have exceeded the CtP or some higher level specified by the commence to pump, or it may be delayed for 24 hours after river levels have exceeded the CtP level.

Nine unregulated water sources were identified as having high instream values (Table 2). For these areas, trading into the water sources is limited to prevent increases in water entitlement. In some zones the trading rules aim to decrease water entitlements. Where instream values are at high risk from extraction, the CtP tends to be conservative. Appendix 2 details the threatened species considered when assessing the management zone values (note this only includes species that are likely to be sensitive to extraction).

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

Water source	Description of instream value
Albury	8 threatened species, high rarity
Dora Dora	6 threatened species, high naturalness, high diversity
Hume	7 threatened species, high rarity
Jingellic	8 threatened species, high diversity
Murray below Mulwala	9 threatened species, high naturalness, high diversity, high rarity
Ournie Welaregang	6 threatened species, high diversity
Swampy Plain	9 threatened species, high naturalness, high diversity
Tooma	8 threatened species, high naturalness and diversity
Upper Murray River	6 threatened species, high naturalness

Pre-existing rules

A number of licences within the plan area previously had a cease-to-pump condition under the *Water Act 1912*. These ranged from a specific flow rate or height at a gauge to 'no visible flow at the pump site'. In the past, these conditions have been applied only to specific licences and not as a water source or management zone as a whole. In some water sources there has been no previous history of a cease-to-pump condition imposed during low flow periods. These are mainly in water sources with few or no users. Several water sources have also been subject to statutory restrictions and suspensions in the past. These have occurred mainly during summer months and have ranged from sharing a total extraction limit averaged over a 10 day period to a total suspension on irrigation pumping when flows are less than a specified level at the gauge.

Proposed rules

On commencement of the plan, surface water licences in all unregulated water sources became subject to CtP rules (excluding licences listed in Schedule 2 of the plan). Rules vary depending on where a licence is located within the plan area. This information can be found on individual rule summary sheets available on the Office of Water's website www.water.nsw.gov.au.

In instances where the existing cease-to-pump rule under the *Water Act 1912* was based on a higher flow rate or height at a gauge than the CtP proposed by the plan, the existing CtP took precedence, but the CtP exemptions will be applied.

Alluvial water sources

An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay) from which groundwater can be usefully extracted. Aquifers can store large volumes of water, often accumulated over thousands, or even tens of thousands of years; this is referred to as 'storage'.

The volume of water in storage is recharged in a number of ways depending on the type of the groundwater system. Recharge usually comes from rainfall, surface water bodies such as rivers, or via flow from adjacent aquifers.

Pre-existing rules

Access licences for groundwater extraction have not been subject to annual limits or individual bore extraction limits.

Proposed rules

Commencing in the second water year of the plan, access licences for groundwater extraction may be subject to an annual limit, but this limit will vary annually following an assessment of average volume of groundwater extracted over the preceding five years relative to the long-term average annual extraction limit as set out in the plan.

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

Description of the plan area

The Murray unregulated and alluvial water sources are located in the south-western region of NSW, covering an area of approximately 20,500 square kilometres, from the Murray River in the south, Billabong Creek catchment divide to the north, the Australian Alps to the east, and the confluence of the Murrumbidgee and Murray rivers to the west.

The **Albury** water source has a medium rainfall of about 700 millimetres per year. Most of the streams in the water source are ephemeral (i.e. they flow only after rain). The water source is a narrow valley drained by a series of very small intermittent creek systems, all of which directly enter the Murray River downstream of Hume Dam. These creek systems include Eight Mile Creek (which drains through the Thurgoona Golf Club), Bungambrawtha Creek (which drains through central Albury), Splitters Creek and Deadmans Creek. The Albury water source is densely settled around Albury and it is highly likely that small-scale developments will occur in the future.

The **Dora Dora** water source has a relatively high rainfall of about 900 millimetres per year. The streams in the water source are permanent (spring fed). The water source is a very narrow and steep water catchment with several creek systems including Swamp Creek; Seven Mile Creek and its tributary Cockatoo Creek; and Basin Creek and its tributary Stony Creek; which drain directly to the Murray at three different locations between Jingellic and Talmalmo. The water source is not densely settled (no localities within water source). It is unlikely that development for irrigation would occur in the future.

The **Hume** water source has a medium rainfall of about 700 millimetres per year. Some of the streams in the subcatchment are permanent (spring fed) while others are ephemeral (i.e. flow only after rain). The Hume water source drains directly into Lake Hume through several creek systems. It has significant rural residential development. In the south-eastern portion of the water source, small systems such as Home Flat, Wagra and Fowlers Swamp Creeks drain relatively steep valley areas directly to Lake Hume in the uppermost storage areas of the Murray Arm. The north-eastern portions of the water source are drained by the Sweetwater, Waterfields and Daly Creeks, which converge to form the Mullengandra Creek, near the locality of Mullengandra before entering Lake Hume in the middle of the Bowna Arm. The western portion of the water source is drained by the Table Top and Bowna Creeks and their tributaries directly into the northern extremity of the Bowna Arm. The Hume water source is relatively densely settled around the localities of Mullengandra, Bowna and Table Top. It is a likely area for small-scale irrigation developments in the future.

The **Indi** River is the local name for the Murray River above the Swampy Plain River junction and forms the border between NSW and Victoria. The NSW portion of the water source encompasses an area of 411 square kilometres and is bounded by the Great Dividing, Youngal and Indi Ranges to the west and the Indi (Murray) River to the east. The Indi water source is in a relatively high rainfall area (approximately 900 millimetres per year). Streams in the water source are permanent (spring fed). The Indi River originates from an elevation of over 1800 metres and flows in a northerly direction through a relatively steep and narrow valley to join the Swampy Plain River near Bringenbrong, at an elevation of 300 metres. In the uppermost reaches of the river below Mount Pilot the surface water network comprises a series of first and second order streams that drain directly to the Indi River. At an elevation of 800 metres, the valley widens slightly and larger tributaries such as Cascade, Dead Horse, Leather Barrel and Snowy Creeks develop. Further downstream, around Tom Groggin, the Indi River emerges temporarily into an open area of low-relief country before again passing back through rugged country until it spills out onto the broad river flats at Biggara before joining the Swampy Plain River at Bringenbrong. The subcatchment is not densely settled with the majority being national park.

The **Jingellic** water source is in a relatively high rainfall of about 900 millimetres per year. The streams in the water source are permanent (spring fed). The northern parts of the Jingellic water source are

drained by the Vyners, Yarrara, Two mile and Coppabella creeks which originate in the Carabost State Forest at elevations of about 700 metres and progressively merge to form the Coppabella Creek proper. The eastern part of the Jingellic subcatchment is drained by the Lankeys Creek system, which meets the Coppabella Creek two thirds of the way down the water source. Towards Jingellic Township, Coppabella Creek is joined by the small Jingellic Creek system. Below here the creek system is known as Jingellic Creek and drains into the Murray at Jingellic Township. The water source is relatively densely settled around the localities of Jingellic and Lankeys Creek. It is a likely area for small scale irrigation developments in the future.

The **Lower Wangamong** water source has a low rainfall of about 490 millimetres per year. The Billabong Creek catchment to the north and the Murray River catchment to the south enclose the subcatchment and a lot of drainage is retained in swamps and depressions. There are no streams of note. The subcatchment is relatively densely settled around the localities of Brockelsby, Lowesdale, Savernake and Berrigan. Small-scale development is unlikely in the future.

The **Majors** water source has a medium rainfall of about 700 millimetres per year. Most of the streams in the water source are ephemeral (i.e. flow only after rain). It is drained by the intermittent Majors Creek, which, after rain, enters the Murray River upstream of Howlong. The water source is relatively densely settled around the localities of Howlong and Balldale. Future small-scale development is unlikely.

The surface water network of the **Mannus** water source comprises a tight network of small streams stemming from the elevated margins of the catchment which combine into larger watercourses before flowing into one of the water source's main creek systems: Mannus, Boggy and Munderoo Creek. Mannus Creek flows in a southerly direction through the length of the catchment, running adjacent to the steep valley walls on the catchments western margin. The elevated plateau areas in the north-east of the catchment are drained by Boggy Creek while in the south-east, the elevated plateau areas are drained by Munderoo Creek and its tributaries, Crawleys, Sandy and Back Creeks. Boggy Creek joins the Mannus near Glenroy. Downstream of the Boggy Creek junction is Mannus Dam. Downstream of the dam, Munderoo Creek flows into Mannus Creek near Mannus. From here the Mannus Creek continues to flow through a rough narrow valley before spilling onto a lowland area at Tooma before joining the Tumbarumba Creek.

The water source is reasonable densely settled and includes the localities of Mannus, Rosewood and Glenroy. Agriculture includes areas with wine grapes, fruit, seed production and grazing. It is a likely area for irrigation expansion in the future.

The surface water network of the **Maragle** water source is less complex but similar to that of the Tumbarumba water source with a network of small streams which combine into larger watercourses before draining into one of the water source's two main creek systems: Maragle and Maragle Back Creeks. Maragle Creek, which drains the northern parts of the water source, flows in a southerly direction through the length of the catchment running adjacent to the valley's western margin. Two thirds of the way down, Maragle Creek is joined by Maragle Back Creek which, with its tributary Reedy Creek, drains the water source's southern areas. Maragle Creek then continues its southerly path until it meets Tumbarumba Creek just downstream of Tooma.

The water source is not densely settled but includes the localities of Maragle and Back Maragle Creek. It is a likely area for small scale developments in the future, especially vineyards.

The **Murray below Mulwala** water source has a low rainfall of about 300-500 millimetres per year. The surface water network of the subcatchment comprises numerous streams and includes many lagoons and lakes. Almost all streams in the water source are ephemeral (i.e. flow only after rain and then usually only during minor to significant flood events, when the regulated rivers overflow or when flows in irrigation corporation channels are released or escape).

There is one exception to the general character of streams in this water source. This is with respect to Eagle, Bindera, and Bungaree creeks which receive no natural flow or only very limited local area run-off. The only water that is or can be taken from these unregulated creeks is water pumped into the creeks from the regulated river water source.

The water source is generally settled around the localities of Finley, Deniliquin, Mathoura, Wakool and Tooleybuc. Small-scale development is not likely in this area in the future.

The **Ournie Welaregang** water source is in a relatively high rainfall area with about 900 millimetres per year. The streams in the water source are permanent (spring fed). The western part of the water source is drained by Ournie Creek, which originates from the eastern face of Black Ridge at an elevation of 800 metres before traversing the short length of the water source to meet the River Murray approximately 25 kilometres downstream of the township of Tintaldra.

The middle part of the water source is drained by East Ournie Creek, which originates from the Ournie State Forest at elevations of 800 metres. It joins Ournie Creek in the middle of the water source. The eastern part of the water source includes the upland catchment of Spring and Big Hill Flat creeks, located west of Welaregang. The water source is not densely settled. It is unlikely development for irrigation will occur in the future.

The **Swampy Plain** water source encompasses an area of 784 square kilometres of which 713 square kilometres falls within the boundaries of the Kosciusko National Park. Most natural flows enter the system from the Geehi River which is approximately 50 kilometres long, stretching from the water source's headwaters on the southern face of Mount Jagungal to the junction with Geehi Creek at the foot of Mount Kosciusko. From this point downstream the river is called the Swampy Plain. Numerous tributaries such as the Valentine, Kosciusko, Bogong, Khancoban and Khancoban Back Creeks drain into the Swampy Plain system downstream of the Geehi River.

The Swampy Plain River below the full supply limit of Khancoban Pondage downstream to the Indi River at Bringenbrong, though part of the Swampy Plain subcatchment, is included in Upper Murray water source. It has similar characteristics which warrant similar management.

As part of the Snowy-Murray development of the Snowy Mountains Hydroelectric Scheme, significant inter-valley diversions are made from the Snowy River Valley to the Swampy Plain water source and by intra-valley diversions from the Geehi and upper reaches of the Swampy Plain River to the lower reaches of the Swampy Plain River. This complex series of diversions have been achieved through the construction of Island Bend Dam and associated aqueducts in the Snowy River Valley, the construction of Geehi Dam and associated aqueducts in the Murray River Valley and the construction of the Snowy-Geehi and Murray 1 and Murray 2 Pressure Tunnels.

Island Bend Dam impounds the headwaters of the Snowy River as well as receiving diversions from other impoundments in the Snowy River Valley such as Eucumbene and Jindabyne Dams. The Snowy-Geehi Tunnel, a 14.4 kilometres long tunnel excavated through the Snowy-Murray catchment divide, diverts flows that are captured and stored in Island Bend Dam to Geehi Dam. In an average year, 875 gigalitres of water is diverted from the Snowy River Valley to Geehi Dam (SMEC 1998a).

Geehi Dam also captures all upstream inflows of the Geehi River as well as its left and right bank tributaries directly downstream of the Dam via the Geehi River and Middle Creek aqueducts. Water from Geehi Dam is transferred via the Pressure Tunnels to the Murray 1 and Murray 2 Power Stations. Flows are discharged from Murray 2 Power Station to Khancoban Pondage to be stored for later release to the lower reaches of the Swampy Plain River and in turn the Upper Murray subcatchment.

A total of 47per cent of the Geehi River catchment flows and those from the upper reaches of the Swampy Plain River is diverted through Geehi Dam to the lower reaches of the Swampy Plain River (Speirs 1998). In an average year, this equates to a diversion of 380 gigalitres (SMEC 1998a).

A program of montane releases as specified in the Snowy Water Inquiry Outcomes Implementation Deed (Annexure 3), and Snowy Hydro's water licence (Schedule 3, Part 5, Table1) requires Snowy Hydro to provide montane releases through five points, one of which is to the Geehi River at Geehi Dam. The volume to be released is 20 gigalitres per year. This volume would not then be available for electricity generation (20 GL/year is what would normally be diverted from the dam into Murray 1 and Murray 2). Note that works will be required to enable this montane release to occur and these works have not yet commenced.

The Swampy Plain water source is not densely settled, with the majority being in national park, but includes township of Khancoban.

The **Tooma** River is approximately 80 kilometres long, stretching from the river's headwaters on the western face of Mount Jagungal to the River Murray. The river has numerous significant tributaries. In its upper reaches, fast flowing high order streams such as Toolong, Out Station, Ogilvies and Deep Creeks drain the water source's steep mountain terrain. In its lower reaches, flows from the Maragle, Mannus and Tumbarumba water sources, which collectively drain an area of 1,277 square kilometres, enter the river system via Tumbarumba Creek 12 kilometres upstream of the Murray-Tooma junction.

As part of the Snowy-Tumut Development of the Snowy Mountains Hydroelectric Scheme, significant inter-valley diversions are made from the Tooma River system to the Tumut River system in the Upper Murrumbidgee Valley. This has been achieved through the construction of Tooma Dam and Aqueduct as well as the construction of the Tooma-Tumut Tunnel and intermediate intake structures. Tooma Dam captures all upstream inflows of the Tooma River as well as its left bank tributaries directly downstream of the dam wall via the 6.3 kilometres long Tooma aqueduct. The Tooma-Tumut Tunnel, a 14.3 kilometres long tunnel excavated through the Murray-Murrumbidgee catchment divide, diverts all flows captured by the Tooma Dam to Tumut Pond Reservoir. Flows from other Tooma River tributaries located further downstream of the Dam, namely Out Station, Ogilvies and Deep Creeks, are also diverted to the Tumut Pond Reservoir through intermediate intake structures, which drop water from these tributaries directly into the Tooma-Tumut Tunnel. From the Tumut Pond Reservoir, the flows diverted from the Tooma subcatchment augment the flows of the Tumut River and are passed through Tumut 1, Tumut 2, Tumut 3 and Blowering power stations before being released into the Murrumbidgee River to be used for irrigation. A total of 33 per cent of the Tooma River catchment area is diverted to the Murrumbidgee Valley. In an average year, this equates to a diversion of 295 gigalitres. The subcatchment is not densely settled but includes the localities of Greg Greg and Possum Point. It is a likely area for possible small scale irrigation developments in the future due to water availability and low level of present irrigation development.

The **Upper Murray River** water source extends from Khancoban Pondage to the Hume Dam. It includes Khancoban Pondage and Swampy Plain River down to its confluence with the Indi. Below the Indi-Swampy Plain River junction, it includes the Murray River which flows first in a northerly direction for approximately 15 kilometres before being met by the Tooma River. Downstream of the Murray-Tooma junction, the river turns in a westerly direction and progresses to Hume Dam through a constricted valley, receiving only a small volume of tributary inflows from a number of low order streams such as the Coppabella, Bowna and Mullengandra Creeks, which drain the gentle sloping western areas of the Upper Murray River's subcatchment.

The significant inter-valley diversions of both the Snowy-Tumut and Snowy-Murray Developments of the Snowy Mountains Hydroelectric Scheme impact on the Upper Murray River Water Source. This is a direct result of the operation of Murray 1 and Murray 2 Power Stations and their final storage dam, Khancoban Pondage. Khancoban Pondage releases water diverted from both the Upper Snowy River Valley and the Swampy Plain water source directly into the lower reaches of the Swampy Plain River which augments the flow in the Upper Murray River which is eventually captured in Hume Dam to be used as irrigation supply for the Mid-Murray and Lower-Murray Valleys.

According to figures supplied by the SMEC (1998a), approximately 1,260 gigalitres is diverted through Murray 1 and Murray 2 Power Stations and discharged from Khancoban Pondage in an average year. Of that amount, 875 gigalitres is sourced from inter-valley diversions from the Upper Snowy River Valley. Considering this, net flows in the lower reaches of the Swampy Plain River have been increased on average by 875 gigalitres each year. Taking into account that 295 gigalitres of water is diverted from Upper Murray River via Tooma Dam, net flows in the Upper Murray River have increased by an average of 580 gigalitres. The subcatchment is not densely settled, with the majority being national park, but includes Murray River townships.

The surface water network of the **Tumbarumba** water source comprises small streams stemming from the elevated margins of the catchment which combine into larger watercourses before flowing into one of the water source's five main creek systems: Tumbarumba, Pound, Burra, Boggy and Stoney creeks.

Tumbarumba Creek flows in a southerly direction through the length of the catchment, running adjacent to the valley wall on the catchments western margin. The central part of the water source is drained by the Pound, Burra and Boggy creek systems, all of which enter the Tumbarumba Creek in its middle reaches. The eastern areas of the water source are drained by Stoney Creek and its tributaries, Paddys River and Ruby Creek. Stoney Creek flows into Tumbarumba Creek towards the lower end of the system's middle reach. Further downstream in its lower reaches, Tumbarumba Creek is joined by Mannus Creek and then Maragle Creek before draining into the Tooma River near Island Crossing.

The water source is reasonable densely settled and includes the township of Tumbarumba and the settlements of Tooma and Laurel Hill. Agriculture includes wine grapes, fruit, seed production and grazing. It is a likely area for irrigation expansion in the future.

The information below summarises that provided in a status report published by the former Department of Natural Resources in 2008. The **Upper Murray groundwate**r source (currently known as the Upper Murray Alluvium: Groundwater Management Area 015, Albury to Corowa) is located on the NSW side of the Murray River between Hume Dam and Corowa. There are about 3-4 productive zones (aquifers) where groundwater occurs to a depth of 100 metres mainly in formations known as Lachlan and Shepparton formations. The majority of the irrigation bores tap the deeper Lachlan aquifers while most of the stock and domestic bores extract groundwater from shallow Shepparton aquifers. The Murray River and rainfall have been identified as the major recharge sources for the aquifers while irrigation leakage was also identified as a minor recharge source. A groundwater flow model was developed in 2003/04. Annual groundwater recharge as determined by this model is 15,300 megalitres per year.

Land use history

Indigenous people settled in the Murray catchment over 40,000 years ago. Before European settlement, the region included 10 indigenous nations. According to Tindale (1974) the Djilamatang people were traditionally associated with the Upper Murray region west of Mount Kosciusko down to the upper headwaters of the Murray River. The Wiradijuri people were traditionally associated with lands north of the Murray River from Tumbarumba in the east down to Howlong in the west. The Jeithi people were traditionally associated with lands north of the Murray River from Howlong to west of Tocumwal. The Jotijota, Baraparapa, Wembarwemba, Narimara, Wati Wati, Muthi Muthi and Tati Tati peoples were traditionally associated with lands west of Tocumwal to the junction of the Murray and Murrumbidgee rivers.

Aboriginal peoples prior to European settlement were custodians of rivers, lakes and other water sources and today continue a spiritual and cultural relation to water. Rivers of the region were a source of sustenance for Aboriginal peoples, often serving as clan boundaries, and had an important place in the Dreaming. This relationship is articulated in the United Nations Declaration of the Rights of Indigenous Peoples (the Declaration), especially articles 3, 25, 28 and 29. Australia is a signatory to the Declaration. Article 3 states that Indigenous peoples have a right to determine their political status,

and their economic, social and cultural future. Article 25 states that indigenous peoples have a right to maintain and strengthen their distinctive spiritual relationship with their lands, territories, and resources confiscated, taken, occupied, used or damaged, while Article 28 states the right to redress for lands, territories, and resources confiscated, taken, occupied, used or damaged. Article 29 states the right to the conservation and protection of the environment, and the productive capacity of lands, territories and resources.

Aboriginal peoples, traditional owners and clans are represented across the region by 11 statutory Local Aboriginal Land Councils. The councils are constituted under the *Aboriginal Land Rights Act 1983* and have a range of functions relating to land acquisition, land use and management, Aboriginal culture and heritage, and financial stewardship. The 12 councils are Eden, Bega, Merrimans, Wagonga, Brungle/Tumut, Albury and District, Cummerangunja, Deniliquin, Moama, Wamba Wamba, and Balranald.

The first Europeans to arrive in the Murray catchment were the explorers Hume and Hovell, who travelled through the Upper Murray in 1824 and crossed the Murray River at Albury. European settlement occurred across the entire Murray catchment as a result of overland trips by Hume and Hovell, and Sir Thomas Mitchell. Both parties made mention of the suitability of the country for livestock. Mitchell and Captain Charles Sturt renamed the newly named Hume River to the name Murray, in recognition of Sir George Murray, Secretary of State for the colonies.

Agriculture, including pastoralism, irrigation and horticulture now dominate the landscape. Today over three-quarters of the Murray catchment is managed by private land owners for primary production. In contrast, almost three-quarters of the population live in the major towns of Albury, Corowa and Deniliquin.

Climate

The climate of the Murray catchment is described as cool temperate, controlled by eastward moving low pressure cells and associated frontal systems along the southern margins of Australia (Doughty 2003). The highest rainfall occurs on the slopes of the Snowy Mountains, and upwards of 800 millimetres elevation snow commonly falls, in winter. Rainfall in the catchment is winter/spring dominant and decreases from east to west (Murray Catchment Action Plan 2006).

Streamflows

Streamflow is currently measured at numerous gauges across the region. The plan's water sharing rules are based on flows recorded at gauging stations within the Murray unregulated water sources as listed in Appendix 3. Other records are kept, such as dam water levels and release volumes from dams. Records from both the current and discontinued gauging stations provide a history of streamflows throughout the region and have been used in the plan's development.

Climate change and variability

The NSW Office of Water has forecast rainfall and runoff across NSW using 15 global climate models from the Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios A1B climate scenario.[3] The A1B climate scenario indicates a global temperature in 2030 that is 0.9^0C higher than the global temperature in 1990.

Modelling conducted under the CSIRO Murray-Darling Basin Sustainable Yields Project indicates that future runoff in the Murray region is likely to decrease rather than increase with climate change projections (CSIRO, 2008). Under the best estimate 2030 climate average annual runoff within the Murray region would be reduced by 10 per cent and surface water availability would decrease by

[3]Vaze J., Teng J., Post D, Chiew F., Peraud J-M., Kirono D, (2009), *Future climate and runoff projections (~2030) for New South Wales and Australian Capital Territory,* NSW Department of Water and Energy, Sydney

12 per cent (CSIRO, 2008). Under the wet extreme 2030 model the average surface water availability would increase by seven per cent for the Murray region with a possible 41 per cent decrease in availability under a dry 2030 extreme model (CSIRO, 2008).

Entitlement and use

There are approximately 413 water licences in the area covered by the plan, totalling 84,705 megalitres of entitlement (Table 3). The majority of these licences are for irrigation purposes.

Table 3: Total entitlement and number of licences for each water source

Water source	Entitlement (ML/year)	Number of licences
Albury	459	22
Dora Dora	0	0
Hume	240	16
Indi	2, 366 (plus 1, 144 ML in Victoria	13 (plus 7 irrigation licences in Victoria)
Jingellic	233	7
Lower Wangamong	23	2
Majors	81	1
Mannus	1, 413	25
Maragle	417	11
Murray below Mulwala	28, 230	76
Ournie Welaregang	60	2
Swampy Plain	335	8
Tooma	1, 387	14 (plus 62 licences upstream)
Tumbarumba	1, 561	26
Upper Murray River	5, 631	28
Upper Murray Groundwater	41, 125	93
Total	**84, 705**	**413**

Water is also extracted from watercourses within the Murray unregulated catchment through basic landholder rights (not requiring a licence).

Water extraction

The majority of the unregulated surface water licences are located in Murray below Mulwala water source.

Two of the water sources covered by the plan were classified as being of high economic dependence on commercial water extraction. These were the Upper Murray River and Mannus water sources.

Detailed long-term water use is not available in the unregulated rivers since there is not yet broad scale metering in these water sources. Some metering has been rolled out over the last few years for bigger users, through the Water Use Monitoring Program. In addition, through the Commonwealth Government's Water for the Future plan and the NSW Government's Metering Scheme, the Murray Pilot Project is being conducted in the Upper Murray River to upgrade or replace 1,200 water meters which will save 10.2 gigalitres of water annually in the region. The project commenced mid-2010 and aims to be completed by late 2012.

Local water utility requirements

A number of town water supplies which range between large storages to small direct river extractions, are located within the Murray unregulated catchment. These supplies are administered through various local councils

Local water utilities are managed by local councils. Tumbarumba Shire Council supplies the largest amount of water to households. The council extracts water from Burra Creek (preferred water supply) and from Tumbarumba Creek (less preferred water supply accessed during dry conditions) to supply the township of Tumbarumba. The council also extracts water from Khancoban Creek to supply water for Khancoban. Corowa Shire Council extracts water from Upper Murray Groundwater Source to supply Balldale. Table 4 lists the local councils licensed to extract water from the Murray unregulated and alluvial water sources.

Table 4: Town water supplies, location and entitlement volume in the plan area

Water supply	Operator	Water source	Entitlement (ML/year)
Khancoban	Tumbarumba Shire Council	Swampy Plain	140
Tumbarumba	Tumbarumba Shire Council	Tumbarumba	499
Balldale	Corowa Shire Council	Upper Murray Groundwater	59
Total			**698**

Developing the plan

Scope of the plan

The plan covers the hydrological catchments of the Murray unregulated surface water sources and one alluvial groundwater source. The water sources (within the Murray-Darling Basin) include:

- Albury
- Dora Dora
- Hume
- Indi
- Jingellic
- Lower Wangamong
- Majors
- Mannu s
- Mara gle
- Murray below Mulwala
- Ournie Welaregang
- Swampy Plain
- Tooma
- Tumba rumba
- Upper Murray River
- Upper Murray Groundwater.

The plan does not cover the following:

- water contained in any fractured rock or porous rock
- water contained in the New South Wales Murray Regulated River Water Source as defined in the Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources
- water contained in the Lower Murray Groundwater source as defined in the *Water Sharing Plan for the Lower Murray Groundwater Source*
- water taken under a floodplain harvesting access licence with a share component that does not specify one of the water sources within this plan.

While there is some miscellaneous unmapped alluvial water located below the surface of the Murray unregulated surface water sources these miscellaneous alluviums are included in the *Water Sharing Plan for the NSW Murray-Darling Basin Porous Rock Water Sources*.

Water management units

Water sharing plans have a hierarchy of water planning units.

The **extraction management unit** (EMU) is the highest level in the hierarchy of planning units and may comprise one or several water sources. An EMU is specified for the purpose of establishing a geographic area over which the long-term average annual extraction limit (LTAAEL) applies. An available water determination (AWD) is made for each licence category within the EMU and any growth in extraction above the LTAAEL is managed across the EMU, not at an individual water source level.

The daily access rules apply at the **water source** and **management zone** level, which are the next level down in the hierarchy of planning units.

The plan contains 16 water sources which are displayed in Table 5. The spatial extent of the water sources in the plan area is shown in Appendix 1.

A **management zone** is the next level down in the planning unit hierarchy. It represents a portion of a water source and is the level at which more refined implementation of access or trading rules are applied. In the plan all water sources have been split into management zones which specific daily access rules and trading rules are established.

Table 5 provides a summary of the hierarchy of water management units used in the plan.

Table 5: Water management units for the plan

Extraction management unit	Water source	Management zone
Unregulated Upper Murray	Dora Dora	
	Hume	
	Indi	
	Jingellic	
	Mannus	Mannus Upstream
		Mannus Downstream
	Maragle	
	Ournie Welaregang	
	Swampy Plain	
	Tooma	Tooma River
		Tooma Tributaries
	Tumbarumba	Tumbarumba Upstream
		Tumbarumba Downstream
	Upper Murray River	
Unregulated Middle Murray	Albury	
	Lower Wangamong	
	Majors	
	Murray below Mulwala	
	Upper Murray Groundwater	

Project groups

State Interagency Panel

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

The State Interagency Panel is chaired by the NSW Office of Water. The group has representatives from the Office of Water, the NSW Office of Environment and Heritage (OEH) and agriculture, fisheries and aquaculture specialists from the NSW Department of Primary Industries (NSW DPI). There are also three catchment management authority (CMA) representatives. The Office of Water is responsible for the overall project management.

Interagency regional panel

The plan rules were developed by the Murray Interagency Regional Panel (IRP), which comprises representatives from the Office of Water, OEH and NSW DPI with the participation of the Murray CMA (as an observer). The IRP was responsible for the resolution of a number of policy matters associated with water management in the metropolitan area. Appendix 4 lists the names of the IRP representatives and their areas of expertise. The IRP had access to staff from the agencies to provide technical and scientific information. The key roles of the IRP were to:

- establish and review the hydrological units or water sources
- assign economic, social and environmental values and undertake risk and value assessments to classify each water source
- review the existing licence conditions as to their applicability
- make recommendations on the water access and trading rules for each water source
- assist the Office of Water with the public consultation on the proposed rules
- review submissions received during targeted consultation and public exhibition and recommend changes where necessary to the water sharing rules.

The IRP used a consensus decision-making approach and where agencies had particular issues those issues were highlighted during the public consultation period for specific attention.

The IRP used local knowledge and expertise in recommending 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 (NSW DPI) or aquatic ecology (NSW Office of Water).
- Extraction patterns by local water utilities.

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, and either:

- recommended new gauges be installed for high-risk or highly stressed water sources, or
- 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.

The IRP also considered known specific requirements of threatened species in relation to key reproductive needs, migration or other particular ecological activities.

Also recommended was a staged approach to change, to limit adverse social and economic impacts by giving water users 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 in the short term, 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, the rules were reviewed to ensure that they integrate well and are readily implemented across the plan area.

State Groundwater Panel

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

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

Policy context

There are a number of national and state policies that impact on and direct the development of water sharing plans.

Murray-Darling Basin Ministerial Cap

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

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

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

Schedule F (now Schedule E) of the Agreement was then introduced in 1996 and set the operating framework for the Cap. In NSW, the Cap is defined as the long-term average yearly volume of water that would have been diverted under 1993/94 levels of development and management rules. There is no MDBMC Cap Agreement on groundwater diversions.

In the basin, water sharing plans are required to be developed to ensure consistency with the Cap. This means that the long-term average annual extraction limit (LTAAEL) for regulated and unregulated water sources must be equal to or less than the Cap. NSW also committed to ensuring that the LTAAEL be not less than 90 per cent of the Cap. NSW has chosen to divide the surface water Cap into unregulated and regulated components.

In regulated water sources licences were volume based and diversions were metered with good records of past use for establishing the Cap. In unregulated water sources, licences were area based and not metered so the assessment of Cap is more difficult. As part of a volumetric conversion process, irrigation licence holders were surveyed as to the area and types of crops that they had irrigated over the six year period (1993-1999) and conversion rates were developed to establish licensed entitlements and derive average levels of water use based on crop water requirements. There was no discernable growth pattern in irrigated areas over the survey period in any of the river systems, so the Cap is based on the information calculated as an average of the yearly assessments over the survey period.

The Cap for unregulated surface water in the Murray is assessed and reported on at the NSW Murray Valley scale and any growth management actions required will also be applied at this scale.

National Water Initiative

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

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

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

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

Natural Resources Commission

The macro water sharing plans must also comply with the NSW Natural Resources Commission (NRC) state-wide standards and contribute to the relevant state-wide targets such as Targets 5 and 6 (for details see www.nrc.nsw.gov.au) which is a requirement of the NSW State Plan (see www.nsw.gov.au/stateplan). The NRC was established in 2003 to provide the NSW Government with independent advice on natural resource management issues. To achieve this, the NRC has developed and recommended a Standard for Quality Natural Resource Management and 13 state-wide targets for natural resource management in NSW, which have been embedded in the NSW State Plan. Table 6 lists the state targets and how these are met within the plan. As with the National Water Initiative, the components of the State Standard focus on the use of the best available knowledge, use of appropriate information management systems, delivery of integrated outcomes, engagement of the community and regular monitoring, measuring, evaluation and reporting to specify how delivery of the targets is progressing. The NRC reviews water sharing plans against this standard and its associated targets.

Table 6: Contribution of the plan to the relevant NRC state-wide targets

Relevant state-wide target	Contribution by the plan
By 2015 there is an increase in the recovery of threatened species populations and ecological communities (Target 3)	– some access and trading rules developed to help protect water dependent threatened species where these were identified and the risk to these from extraction is high.
By 2015 there is an improvement in the condition of riverine ecosystems (Target 5)	– sets a defined share of water for riverine ecosystems – protection of very low flows and a proportion of medium and high flows – trading rules to maintain or reduce entitlement in high value streams – adaptive management, giving the ability to adjust rules once information becomes available or at the end of plan period.
By 2015 there is an improvement in the ability of groundwater systems to support their groundwater dependent ecosystems and designated beneficial uses (Target 6)	– rules will be applied which protect significant GDEs.
By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained (Target 8)	– rules will be applied which protect sensitive environmental areas – protection of a proportion of wetland storage volume – trading rules to maintain or reduce entitlement in high value wetlands – protection of very low flows.
Natural resource decisions contribute to improving or maintaining economic sustainability and social well-being (Target 12)	– plans provide a defined share to water and defined certainty of access – separation of land and water enhances trading and value of licences – establishment of perpetual and compensable water access licences provides security for business investment – water markets encourage movement of water licences to high value uses – rules developed which consider community dependence on water extraction.

Catchment action plans

The plan is consistent with and contributes to the following catchment action plan:

- Murray Catchment Management Authority Catchment Action Plan (MCMACAP). The MCMACAP is located on the Murray Catchment Management Authority (MCMA) website www.murray.cma.nsw.gov.au in the Corporate Documents section.

One of the catchment management authority's responsibilities as an observer on the Interagency Regional Panel is to provide the IRP with advice on the alignment of the proposed classification and extraction limits and rules with the priorities of the catchment action plan.

Basin Plan

The Commonwealth *Water Act 2007* requires the Murray-Darling Basin Authority (MDBA) to prepare and oversee a Basin Plan. The Basin Plan is a legally enforceable document that provides for the integrated management of all the basin's water resources.

Some of the main functions of the Basin Plan will be to:

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

The Basin Plan will provide the new foundation for managing the basin's water resources in accordance with any rules and plan accreditation criteria established by the MDBA. At the heart of the Basin Plan will be limits on the quantities of surface water and groundwater that can be taken from basin water resources. These are known as 'sustainable diversion limits'. As these limits come into effect, they will replace the current MDBMC Cap on diversions in the basin. They will set limits on the taking of both groundwater and surface water from the basin.

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

Other considerations

There are a number of policies and water related issues that required consideration during the development of the plan.

Managing surface water and groundwater connectivity

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

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

Using the above definitions of connectivity, the Upper Murray Groundwater Source is predominately 'not highly connected'.

Granting new access licences

Water sharing plans provide for the limited application for new access licences, in addition to those that may be applied for under the Water Management (General) Regulation 2004. Under the plan, applications for specific purpose access licences may be made in accordance with Clause 19 of the Water Management (General) Regulation 2004, and an access licence may be granted in accordance with a dealing. If additional licences are granted in a water source and usage is assessed to have exceeded the LTAAEL, then the plan's growth management provisions are implemented.

Mandatory conditions

The plan sets out provisions that will be applied as mandatory conditions to water access licences and water supply work approvals. These mandatory conditions are designed to protect the rights of all users in the water source and the plan's environmental water rules. They cannot be removed or altered unless the plan is amended.

Protecting Aboriginal values

Aboriginal cultural values may be affected by water extraction from aquifers and surface waters. Most of the information about flow-related Aboriginal values resides with indigenous communities.

Initial consultation sessions provided some insights into Aboriginal cultural values associated with unregulated rivers. Aboriginal communities have indicated that water sharing rules should protect natural instream values. While Aboriginal groups acknowledge the rights of commercial water users, they believe this entitlement should not be at the expense of the environment or cultural values. In their view, the priority for water sharing plans should be to provide for natural flowing rivers with healthy aquatic biodiversity. This is consistent with the plan's proposed provisions.

Furthermore, opportunities for granting licences for Aboriginal cultural purposes throughout the Murray catchment are included in the plan. These can be used for purposes such as manufacturing traditional artefacts, hunting, fishing, gathering, recreation and ceremonial purposes. The plan also allows for the identification of water for significant Aboriginal cultural sites. The Office of Water is currently developing a process of identifying these sites and their water requirements as part of an extensive consultation program being rolled out across NSW in 2011 and 2012, using funding from the National Water Commission.

For more information on macro water sharing plans and Aboriginal water users, visit the Office of Water website at www.water.nsw.gov.au.

Protecting environmental values

The Murray unregulated and alluvial water sources contain a significant number of threatened flora and fauna species, some of which are sensitive to extraction (Appendix 2). All of these species were considered when assessing the instream values of water sources.

Species that are known to be present in specific locations and are highly sensitive to extraction include the Murray hardyhead, trout cod, southern pygmy perch, silver perch, flathead galaxid, alpine tree frog, Booroolong frog, southern bell frog and spotted tree frog.

Several additional water sources are known to host an endangered ecological community (EEC). The Lower Wangamong, Albury and Majors water sources were identified as having the Lower Murray River aquatic ecological community, which is listed as an EEC. The Lower Murray River EEC includes all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, including all their tributaries and branches. The EEC includes 23 native fish species and more than 400 native invertebrate species. Modifications to natural river flows as a result of river regulation, spawning failures and habitat loss due to cold water releases from dams, competition with introduced fish species, the degradation of riparian vegetation, removal of instream debris, agricultural practices and over-fishing have all contributed to threaten the existence of the Lower Murray River EEC (NSW NSW DPI, 2007). With this in mind the interagency regional panel developed the water sharing rules to preserve these communities.

Maintaining ecosystem functions

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

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

Protecting pools, lagoons or lakes

Pools in NSW can provide an important source of water for access licence holders, basic landholder rights holders and communities. Pools also have a key ecological function as a critical refuge and habitat for flora and fauna. Pools include lentic water bodies (standing water) in or associated with unregulated rivers across NSW, including anything falling within the definition of a 'lake' found in the Dictionary of the *Water Management Act 2000*, except for tidal pools and estuaries.

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

The approach uses an assessment of the environmental values of the pools to select rules that adequately protect these values while not having a disproportionate effect on water availability for extraction. Because it is not practical to identify and create site-specific rules for every natural pool in a water sharing plan area, the focus of the approach adopted is to establish a default access rule of no drawdown below full pool capacity for the majority of pools. The default rule may then be modified by interagency regional panels in specific circumstances, if it is justifiable and feasible to do so, to allow limited access to pools based on local hydrological, environmental and socio-economic considerations.

Different default rules apply depending on the pool type. The default rules are for:

- artificial pools created by structures covered by a water supply work approval
  - existing licence conditions to continue
  - exempt from the drawdown rule constraints that apply to natural pools
  - for in-river dams, consider a dead storage cease-to-pump rule if there are outlet works lower than the top of the crest of the weir
- natural pools
  - users must cease to pump when the pool is less than its full capacity.

'Full capacity' can be approximated by the greatest pool volume where there is no visible flow out of that pool.

The approach further differentiates between two categories of natural pools. Category 1 pools are natural pools that are any of the following:

- not a stream (regardless of size)
- on a flood-runner or floodplain
- on an effluent that commences to flow only during high flows.

Category 2 pools are all natural pools that are not in category 1 and can be found within the channels of perennial or intermittent rivers. As flows subside in the channels of intermittent rivers, pools remain and may be permanent or temporary in nature.

Under the plan, water must not be taken from a natural pool that is not within a river when the water level in the pool is less than 80 per cent of its full capacity. For natural pools that are within river the access rule varies depending on whether a flow class has been established for the associated water source or management zone. Where a flow class has been established the general cease-to-pump rule applies. Where a flow class has not been established water must not be taken from the pool when the water level in the pool is less than 100 per cent of its full capacity.

Water sharing plans contain amendment provisions to allow for changes to be made to access and trade rules for a particular pool or category of pool should new information be gained through environmental and/or socio-economic studies relating to pools in a plan area.

Groundwater dependent ecosystems

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

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

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

This desktop assessment allowed the plan to protect GDEs of known high conservation value from year one of the plan. GDEs, identified as having important conservation significance, are listed in a schedule to the plan and there are rules developed to protect them. Examples of the types of high priority GDEs identified through a desktop analysis such as this include: GDEs listed under the Directory of Important Wetlands, RAMSAR listed wetlands, communities listed under the *Threatened Species Act 1995* and Karst Conservation Reserves listed under the *National Parks and Wildlife Act 1974* by the Karst Conservation Unit of OEH.

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

First flush rules

First flush rules protect a portion of first river flows associated with a rainfall event for estuarine and immediate downstream purposes. The rules usually involve either a 24 hour delay when pumping may recommence or a commence-to-pump flow volume higher than the cease-to-pump flow volume. No water sources, management zones or pools within the plan area were identified as requiring first flush rules.

Protecting basic landholder rights

Under the *Water Management Act 2000*, extraction of water for **basic landholder rights** does not require a licence, although in the case of accessing groundwater under basic landholder rights, the bore must still be approved by the Office of Water. Basic landholder rights includes water for domestic and stock purposes extracted from a water source fronting a landholder's property or from any aquifer underlying the land, harvestable rights and for native title rights.

The principles of the *Water Management Act 2000* also require that water sharing must protect basic landholder rights. The plan does this by including an estimate of the water requirements for basic landholder rights at the start of the plan. There are currently no extractions for native title rights. However, these rights may be activated during the plan's 10 year term.

Furthermore, the access rules apply to licensed water users but not to extractions for basic landholder rights. This in effect, affords those exercising their basic landholder rights, some additional protection.

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

Water interception activities

Changed land use activities can potentially intercept significant quantities of water. Examples of this include 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.

Farm dams require an access licence only when:

- they are located on a third order (or greater) river, irrespective of the dam capacity or purpose
- they exceed the maximum harvestable right dam capacity for the property, which is a capacity that enables the landholder the ability to capture 10 per cent of the mean annual runoff from their property
- they are on a permanent (spring fed) first and second order stream.

The volume of existing licensed farm dams was considered in determining the hydrologic stress rating and resultant access rules.

Unlicensed extraction from farm dams that match none of the above criteria is permitted as a harvestable right. The full activation of harvestable rights within the area of the plan is considered highly unlikely. The plan therefore allows for an estimate of the current activation of basic landholder rights within the long-term average annual extraction limit. The current activation of harvestable rights is therefore implicitly, rather than explicitly, included within this estimate. The provisions relating to harvestable rights are unaffected by any of the rules established in the plan. However, the uptake of harvestable rights will be monitored to determine if at any stage total unlicensed dam capacity has increased to a level considered significant in terms of interception and to inform the implementation of the National Water Initiative.

Acknowledgement of floodplain harvesting activities

Floodplain harvesting is the collection, extraction or impoundment of water flowing across floodplains. Floodplain flows can originate from local runoff that has not yet entered the main channel of a river, or from water that has overflowed from the main channel of a stream during a flood.

Floodplain harvesting can generally be characterised as follows:

- diversion or capture of floodplain flows using purpose built structures or extraction works to divert water into storages, supply channels or fields or to retain flows
- capture of floodplain flows originating from outside of irrigated areas using works built for purposes other than floodplain harvesting
- opportunistic diversions from floodplains, depressions or wetlands using temporary pumps or other means.
- In unregulated river water sources, floodplain harvesting has generally already been recognised and licensed as part of the process that converted area based water licences to volume based licences.

However, further volumetric entitlements, measurement and long-term limits for floodplain harvesting may be established through the development of a NSW Floodplain Harvesting Policy. As a result, the plan may be amended at a later date in order to deal with the management of floodplain harvesting.

Risk of interception through forestry expansion

The projected growth in commercial forestry plantations in the Murray is considered negligible (CSIRO, 2008).

Protecting town water supply access

Towns have a higher priority of access to water than commercial licences. Water sharing plans recognise this priority by ensuring that a full share of water is allocated for annual town water supplies except where exceptional drought conditions prevent this. The annual share for every town water supply will be specified on the operator's licence. Towns may be able to sell part of their annual account water to other towns but, unlike commercial users, will not be able to sell the licence outright.

In unregulated surface water and groundwater sources, towns will not need to change their existing water access arrangements unless their current infrastructure is unable to meet their water needs and requires upgrading. In this case, when a major augmentation of the works occurs, town water utilities will need to meet conditions specified in the plan to ensure that there is enough water flowing to protect the environment and consider any potential impacts on other consumptive users.

Development of future water supplies

Any development of new water storages in the Murray unregulated and alluvial water sources must be undertaken within the bounds of the plan and the *Water Management Act 2000*. The plan is not prescriptive in endorsing any particular option since economic considerations vary over time. Instead, the plan sets a framework within which development of future water supplies can occur.

Rules for unregulated water sources

Classification method

The classification of water sources was the first step in developing water sharing rules. The interagency regional panel classified each unregulated water source as being of high, medium or low risk and value. Two matrices were developed – a 'value matrix,' which rated a water source's instream value against its hydrologic stress, and a 'risk matrix' which rated the risk to instream values against its community dependence. The matrices for the Murray unregulated catchment are included in Appendix 5. A full discussion of the method is provided in *Macro water sharing plans – the approach for unregulated rivers. A report to assist community consultation,* and is available on the Office of Water website at www.water.nsw.gov.au.

This classification method took into account:

- the amount of water licensed for extraction
- the potential impact of extraction on rivers
- the associated uses from this extraction
- the social and economic impacts of restricting extraction.

Specifically the classification process involved assessment of factors, including:

- instream values, for example, threatened fish that are likely to be affected by extraction
- risk to these instream values posed by the existing or increased extraction
- hydrologic stress, which is determined based on a comparison of the demands associated with the amount of water licensed for extraction relative to river flows
- extraction value, which is a qualitative assessment of the economic value of the agriculture which relies on the water licensed for extraction
- economic dependence of the local community on activities dependent on licensed water extraction
- current best estimate of the amount of water extracted under basic landholder rights and for town water supplies
- whether the existing water sharing rules are adequate to manage the risk of extraction to instream values and basic landholder rights
- NSW Government policy.

A large range of reference material was considered along with the general knowledge of the members of the Interagency Regional Panel and technical support staff of agencies. The reference material is listed in Appendix 6.

The classification assisted in determining the optimal balance between extraction and protection of water instream 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 both matrix classifications for each water source to expedite the development of the water sharing plans by the interagency regional panel. The 'value' matrix was used to develop trading rules and the 'risk' matrix was used to develop the water access rules. Where necessary, the IRP refined these indicative rules to reflect local circumstances.

Water sharing rules

Water sharing rules that the classification process focused on comprise:

- access rules – which determine at what flow rates, or height at a gauge, or proportion of full containment level of a pool, and what times extraction is allowed to commence/cease, and whether these should change in certain climatic circumstances;
- dealing rules – which control the trade of water (both permanent transfer of access licence entitlements and temporary assignment of water allocation between access licences), the change of water sources and the location for extraction.

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

- extraction limits – which set the total volume of water that can be extracted on a long-term average annual basis from the water source or water management zone
- release rules from major storages
- 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
- rules for the protection of a specific environmental asset, e.g. a threatened species that is known or expected to occur within a water source.

Developing the access and dealings rules

The interagency regional panel used local knowledge and expertise in developing the water sharing rules. In some instances, indicative rules were further refined if site specific information was available.

Once the proposed water sharing rules were determined, a check was undertaken to ensure that the rules are consistent in their application and practical to implement across the catchment.

Exceptions to the generic rule approach

In reviewing the indicative rules proposed for each management zone the IRP applied 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 self-imposed management rules)
- whether the highly variable nature of the water source required differing management rules
- whether new policies (e.g. for managing pools) warranted a variation from the indicative rule.

In water sources where the existing access rule on an individual's *Water Act 1912* licence was more stringent than the indicative rule, generally the existing access rule was adopted, given that there would be no adverse social or economic impact to that individual 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 in place for a long period of time and seemed to be adequately protecting environmental values while providing security for water users.

Appendix 7 outlines the changes made to the initial access and trading rules by the Interagency Regional Panel. Classifications for some water sources have changed from their initial classification as a result of availability of key data.

Upon commencement of the plan, surface water licences in all unregulated water sources became subject to CtP rules (excluding licences listed in Schedule 2 of the plan) and trade and accounting conditions. Rules vary depending on where a licence is located within the plan area. This information can be found on individual rules summary sheets available on the Office of Water website at www.water.nsw.gov.au.

Rules for alluvial groundwater sources

Background

Only one alluvial groundwater source is included in the plan area. The Upper Murray Groundwater Source was previously known as designated Groundwater Management Area 015. This groundwater source is defined as the unconsolidated alluvial deposits located on the NSW side of the Murray River between the Hume Dam and Corowa and extending to the foothills in the north. The western margin follows the Corowa-Urana Road. Howlong township and part of Albury city are located in the area.

The Upper Murray Groundwater Source comprises three to four productive zones (aquifers) where groundwater occurs to a depth of 100 metres, mainly in the geological formations known as Lachlan and Shepparton formations. The majority of the irrigation bores tap the deeper Lachlan aquifers while most of the stock and domestic bores extract groundwater from shallow Shepparton aquifers. The Coonambidigal Formation is generally clayey and silty; however, some shallow bores for stock and domestic use obtain smaller supplies where there are coarser sediments in the profile close to the present Murray River tract in the plain. The Olney Formation is mainly clayey and has a limited extension in the area. There are no productive aquifers in this formation.

The Lachlan Formation comprises clay, fine sand to cobbles and various mixtures of these. The sand and gravel are entirely made of quartz and are almost devoid of catchment rock types. The formation is up to 80 metres thick in the area and is overlain by younger alluvial deposits of finer texture.

The Shepparton Formation is up to 60 metres thick in the area and varies between clay and gravel, with the clays generally being restricted to areas away from the main Murray River tract. The lower part of the formation has thick zones of sand and gravel.

The Upper Murray Groundwater Source is recharged by Murray River losses, rainfall and to a lesser extent irrigation. Water quality is generally good, suitable for stock, domestic, irrigation and town water supply purposes. Bores are distributed throughout the water source with most high yield bores being located west of Howlong.

Hydrogeological modelling

A fully calibrated groundwater flow model (based on observed data and accurate aquifer properties) for this area was developed in 2003/04.

The model was developed using a Groundwater Vistas 4 / Modflow1996 platform and is represented by two layers representing the Shepparton and Lachlan formations and covers the entire extent of the alluvium on both sides of the Murray River. The model calibration period is from July 1980 to June 2003. The main dynamic components of the model are rainfall recharge, groundwater extraction and river leakage (Kulatunga 2008).

The modelled recharge is 15.3 GL/yr (amount of water that percolates into the aquifer) from all sources (excluding irrigation leakage). This estimate is based on an average annual pumping regime of 15.5 gigalitres.

Consistent with the state-wide approach, aquifers have been classified as either ‘highly connected’ or ‘less highly connected’ for the purposes of applying management rules. While the NSW Office of Water recognises that all aquifers are connected to surface water to some degree, connectivity is only being actively managed for those groundwater sources where 70 per cent or more of groundwater pumped within an irrigation season is derived from streamflow.

Under the model, three different pumping scenarios (15.5, 23.3, and 31 GL/yr) were completed to examine the impact of increased extraction on the aquifer and leakage from the river. The long-term

pumping scenario of 15.5 GL/yr revealed that 36 per cent of water pumped would be sourced from the Murray regulated river. As such the water source is classified as less highly connected and managed by groundwater rules only.

Water sharing rules

Upon commencement of the plan, licences in the Upper Murray Groundwater Source become subject to a number of management rules. These are described below and summarised within the individual rule summary sheet for the Upper Murray Groundwater Source which is available on the Office of Water website at www.water.nsw.gov.au.

Managing extraction

Setting the long-term average annual extraction limit

Following NSW becoming a signatory to the Murray-Darling Basin Ministerial Council Agreement, in 1995, surface water extractions within the NSW portion of the Murray-Darling Basin have been capped at those volumes that would have occurred under 1993/94 levels of development and management rules. The Murray-Darling Basin Ministerial Council Cap does not apply to groundwater. Subsequently, NSW has resolved that the long-term average annual extraction limit (LTAAEL) for highly connected and alluvial groundwater resources within the NSW portion of the Murray-Darling Basin, shall be set equal to current average usage. Any extraction beyond this level will result in additional impact on groundwater dependent ecosystems and other users of these connected water resources.

Bores in the Upper Murray Groundwater Source have been metered since 1990/91. The draft plan exhibited in December 2010 set the LTAAEL for metered entitlement at the sum of annual extractions averaged over 10 years, resulting in an LTAAEL of 11,976 megalitres. The basis for using a 10 year period was to use information over an adequate period of climatic representativeness and was consistent with agreed policy principles at the time.

Inland water sharing plans typically include rules to manage compliance with LTAAELs over five consecutive years. Following targeted consultation users suggested that adopting an LTAAEL equal to average annual extractions over a 10 year period does not reflect their current average usage.

The State Groundwater Panel agreed that adopting an LTAAEL that is equal to the average of annual extractions over a 10 year period is inconsistent with the five year compliance rule and agreed to a revised approach for calculating history of use. The new approach sums each individual's highest five year average usage since records began.

Submissions from users supported the change and requested that the new approach be applied to the Upper Murray Groundwater Source. The Murray IRP endorsed the revised approach and new LTAAEL for the Upper Murray Groundwater Source which is now 14,109 megalitres, defined by the sum of:

- highest individual five year average annual extractions since records began for those entitlements issued under Part 5 of the *Water Act 1912* in this water source that were metered, plus
- an estimate of annual extraction of water for those entitlements issued under Part 5 of the *Water Act 1912* in this water source that were *not* metered, plus
- an estimate of average annual usage by the current utilisation of basic landholder rights.

Managing extraction to the LTAAEL

The growth in use response described in the plan is one that allows for the 'peaks' and 'troughs' of usage above and below the average, over the period from which the LTAAEL has been defined, to be replicated. In the Upper Murray Groundwater Source, the response is triggered if the average annual usage over a period of five years exceeds the LTAAEL by more than 10 per cent.

Managing connectivity

Consistent with state-wide policy, highly connected aquifer access licences that relate more closely to Murray unregulated water sources would be managed daily, i.e. linked to unregulated river daily access rules (see below 'access rules'). However, due to the Upper Murray Groundwater Source being managed as a 'less highly connected' aquifer, as it did not meet the definition for a highly connected groundwater source, access licences will not be linked to annual or daily surface water management rules.

Protecting environmental values

The plan protects environmental values in the Upper Murray Groundwater Source by reserving a proportion of recharge to the aquifer and the water within the groundwater storage of the aquifer as planned environmental water.

Hydrogeological model scenario runs reveal that increased groundwater pumping would derive most of the additional water from the Murray River (Kulatunga 2008). Setting the LTAAEL at current average usage protects and maintains environmental water in this water source. The estimated annual average recharge to the Upper Murray Groundwater Source is 15,300 megalitres (Kulatunga, 2008). With an LTAAEL of 14,109 megalitres, 8 per cent of this recharge is reserved as planned environmental water. This approach of reserving a proportion of the recharge as planned environmental water ensures that the aquifer storage cannot be drawn down over the long term.

Although no high priority groundwater dependent ecosystems have been identified within the Upper Murray Groundwater Source, there are many River Red Gum communities identified on the floodplain of the Murray River that may at times, be dependent on groundwater. Many of these plant communities occur on buried prior river channels that still have some longitudinal connectivity with the river. Many of these are also dependent on the regular availability of regulated Murray River surface flows. More research will better quantify their relative degree of dependence on the groundwater resource. The plan may be amended to add high priority groundwater dependent ecosystems in the future.

Water supply works approvals

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

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

Groundwater flow modelling with representative aquifer parameters was used to calculate water balances and also provided water table drawdowns at different distances under a 24 hour/day pumping regime for one year. The modelling was undertaken to test the distance criteria produced by the IRPs to protect regulated stream flow and base flow in the unregulated systems. The modelling indicated that the water table fluctuation due to pumping was not above natural variations if the access rules in the plan are implemented. For high priority GDEs the distances were set so that overall ecosystem

health would remain the same and resulting impacts on drawdown would be within seasonal water level movements. For other GDEs, water users and significant sites, only a minimal level of impact was permitted.

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

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

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

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

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

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

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

Carryover and water accounts

Account management rules may provide for the carryover of unused water allocations from one water year to the next where the aquifer has the capacity to absorb a higher level of annual extraction on a short-term basis. In the Upper Murray Groundwater Source the aquifer storage is significant. As such the Murray IRP agreed to permit aquifer access licences in the Upper Murray Groundwater Source to carryover, from one water year to the next, up to 0.74 ML/unit share of the share component.

Although one submitter was concerned with the potential impact of carryover on the resource, the IRP concluded that the risk of allowing carryover is low given the significant storage, annual take limit of 1.37 ML/unit share of share component and LTAAEL, which is below the estimated annual average

recharge. This was in recognition that carryover provisions provide flexibility of access for water users to better cope with climate variation and flexibility to manage the risk of a growth in use response, should one be required.

Available water determination

Available water determinations (AWDs) are primarily used to credit water into a licences water allocation account. The AWD for groundwater access licences in all of the plan's groundwater sources is 1 ML/unit share, i.e. 100 per cent of entitlement, unless a growth in use response is required.

The maximum AWD for a water source is used to manage growth in extractions above the LTAAEL, i.e. if growth is assessed to have occurred then the maximum AWD will be reduced to less than 1 ML/unit share.

Trading of access entitlement

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

The Minister's *Access Licence Dealing Principles Order 2002* currently prohibits the trade of entitlement from a groundwater source to a surface water source. Trades are only permitted between sources where there is a hydrologic connection.

Within the water source, trades are permitted subject to local assessment.

Example of aquifer access licence accounting rules

Maximum carryover 0.74 ML / unit share		Licence holder 1	Licence holder 2
(A) Aquifer access licence share component		1,000	1,000
(B) Year 1 Available water determination (AWD) (1 ML/unit share)		1,000	1,000
(C)	Year 1 opening balance	1,000	1,000
(D)	Year 1 trades IN	500	0
(E)	Year 1 trades OUT	0	50
(F)	Year 1 extractions (not including supplementary)	1,150	100
End of year 1			
(G)	Year 1 closing balance (F = C + D - E - F)	350	850
(H)	Maximum carryover (H = A x 0.74 ML/unit share)	740	740
(I)	Water forfeited (I = G – H)	0	110
(J)	Year 2 Carryover brought forward (J = G - I)	350	740
(K)	Available water determination (AWD) (1 ML/unit share)	1,000	1,000
(L)	Opening balance (M = J + K)	1,350	1,740
(M)	Year 2 trades IN	320	0
(N)	Year 2 trades OUT	0	320
(O)	The volume of water in account prior to extraction (O = L + M - N)	1,670	1,420
(P)	The maximum volume that can be used subject to water being in the account (P = A x 1.37 ML/unit share + M - N)	1,690	1,050
(Q)	Year 2 extractions (not including supplementary) (Q cannot exceed O or P)	1,670	1,050
End of year 2			
(R)	Year 2 closing balance (R = O - Q)	0	370
(S)	Maximum carryover (S = A x 0.74 ML/unit share)	740	740
(T)	Water forfeited (T = Q - R)	0	0
(U)	Amount of water that is inaccessible in year 2 but will carry over to year 3 (U = Q - S)	0	370

Licence holder 1

In year 1, licence holder 1 receives 1,000 megalitres in their account, trades in 500 megalitres and extracts 1,150 megalitres. By the end of year 1 they have 350 megalitres in their account. All this water will carry forward to the following year, as it is less than 0.74 ML/unit share of entitlement. Assuming an AWD of 1 ML/unit share, at commencement of year 2 they will have an opening balance of 1,350 megalitres.

The maximum amount of water licence holder 1 can use in any one year is 1.37 ML/unit share, plus or minus water traded in or out of their account, subject to water being in their account.

With their opening balance they could extract up to 1,350 megalitres as that is the volume of water in their account and is within their take limit of 1.37 ML/unit share, plus or minus water traded in or out. They decide to trade in another 320 megalitres. Their new account balance of 1,670 megalitres is still within their take limit so they use it all and have nothing left to carry over into year 3.

Licence holder 2

In year 1, licence holder 2 receives 1,000 megalitres in their account, trades out 50 megalitres and extracts 100 megalitres. By the end of year 1 they have a closing balance of 850 megalitres. Carryover is limited to 0.74 ML/unit share so only 740 ML of this will carry over into year 2. The remaining 110 megalitres will be forfeited.

Assuming an AWD of 1 ML/unit share at the beginning of year 2, licence holder 2 will have an opening balance of 1,740 megalitres. Their annual take limit is 1.37 ML/unit share of entitlement (being 1,370 megalitres), plus or minus any water traded in or out of the account. In year 2 they sell 320 megalitres, so can only then use up to 1,050 megalitres themselves in year 2, unless they buy water from another user.

Their actual account balance is 1,420 megalitres. Of this, 370 megalitres is inaccessible in year 2, as it is in excess of their take limit. They extract what they can, being 1,050 megalitres, i.e. their take limit in year 2. The full balance of water remaining in their account (being less than 0.74 ML/unit share of entitlement) will be carried over to year 3.

Summary

Carryover is limited to 0.74 ML/unit share of entitlement and licence holders can use up to 1.37 ML/unit share of their entitlement in a single season (plus or minus any water traded in or out of their account) subject to water being in the account.

Note:

- The example above is illustrative only.
- AWDs may vary each year affecting the volume of water available in accounts.
- Licence holders are not permitted to take more water than available in their account.
- The example above does not take into account individual licence holder circumstances. The maximum volume of water which can be used at any given point in time can be constrained by other rules such as an individual bore extraction limit or announced restriction to manage any local impacts. It is the responsibility of each licence holder to check what restrictions are in force before taking water.

Consultation

The classifications and the interagency regional panel's recommended access and trading rules underwent targeted consultation with water users and specific interest groups[4] before the plan was drafted. Formal public exhibition[5] of the plan ensured wider public consultation.

While developing the plan, the participating agencies (NSW Office of Water, Office of Environment and Heritage, NSW DPI and the Murray CMA) identified areas where better data is needed for making future water planning decisions. Similarly, the community were able to suggest areas where further analysis or data gathering were required. This local input was essential in finalising the plan.

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

- local knowledge and expertise – for example, there may be other natural or socio-economic values that were 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 understood and able to be implemented by the licence holders
- confirmation that there are no unintended perverse outcomes from the plan – it is essential that this be given due consideration before the plan was finalised
- specific comments on the Minister's notes included in the draft plan.

Targeted consultation on the draft rules

Targeted consultation on the proposed rules for the plan began in 2010 (Table 7). The objectives of this consultation were:

- to provide background 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 provide a 'first opportunity' to consult informally with key stakeholders to test the suitability of the proposed water sources and management zones, flow reference points and access and trading rules.

The Office of Water encouraged stakeholders to submit their comments in writing or over the phone. One submission was received as a result. Discussions with water users' associations also continued though to the public exhibition period.

[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 potential impacts of the rules.

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

Table 7: Key groups consulted in the plan area as part of the targeted consultation

Date	Group	Location
13 May 2010	Tumbarumba Shire Council	Tumbarumba
18 June 2010	Goulburn Murray Water	Albury
23 August 2010	Indi Water Users Association	Biggara
23 August 2010	Licensed water users	Welaregang
24 August 2010	Tumbarumba Shire Council and other licensed water users	Tumbarumba
31 August 2010	015 Groundwater Users	Howlong
21 October 2010	015 Groundwater Users	Albury
1 December 2010	015 Groundwater Users	Albury

Refining water sharing rules as a result of targeted consultation and updated data

The interagency regional panel reviewed all submissions and recommended some changes to the initial water sharing rules. During this review updated flow data and water use data was incorporated into the assessment process. Appendix 8 outlines the changes made to the proposed rules as a result of this consultative process and inclusion of new data.

Public exhibition of the draft water sharing plan

Public exhibition of the proposed plan was held throughout the plan area in late 2010. The objectives of this consultation were:

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

Table 8 shows the locations of meetings that were held across the plan area as part of the public exhibition process.

Table 8 Public exhibition meetings held throughout the plan area

Date	Plan area	Location
11 January 2011	Upper Murray Extraction Management Unit water sources	Holbrook
11 January 2011	Upper Murray Groundwater Source	Albury
12 January 2011	Middle Murray Extraction Management Unit water sources	Deniliquin

Refining water sharing rules as a result of public exhibition

The Murray IRP reviewed all submissions as well as matters raised at public meetings and updated data.

Stakeholders were encouraged to submit their comments in writing to the Office of Water. Appendix 9 lists all the changes that were made to the plan as a result of public exhibition after being reviewed by the panel.

Implementation

Implementation programs

An implementation program may be established to set out the means by which the objectives of the plan are to be achieved. The process for monitoring of the performance indicators will be outlined in the program.

An annual review of the implementation program will be conducted to determine whether the program is effective in implementing the water sharing provisions. The results of this review will be included in the NSW Office of Water's annual report.

Monitoring water extractions

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

Measurement of extractions will be via meters fitted to approved water supply works. Different types of devices will be required depending on the nature of the water supply work installation, the size of the work, and the affect that the operation of the work may have on the water source and other water users. Telemetry systems will be placed onto all meters, subject to availability.

Compliance

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

Adaptive management

Adaptive management is an important part of a water sharing plan. Adaptive management refers to the process of ongoing data collection, monitoring, evaluation and review during the term of the plan that either enables plan amendments or remaking of an improved plan after 10 years. Adaptive management is a requirement of both the *Water Management Act 2000* and the National Water Initiative, and has been allowed for during the term of the plan through amending provisions and the establishment of 'limits of change' to the plan.

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

Monitoring plan performance

The Office of Water is also developing a Monitoring, Evaluation and Reporting (MER) Framework. This framework will be developed in collaboration with key stakeholders and will be consistent with the MER needs of the Natural Resources Commission and the National Water Commission. The intention is that the framework can be applied to existing water sharing plans and macro water sharing plans to enable the development of a specific MER plan.

Performance indicators

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

It is not practicable to monitor all issues in all water sources. The performance indicators identify that monitoring will be undertaken for specific issues in key water sources. The actual procedure for monitoring each indicator may change over the period of the plan as improved methods are developed.

Plan review

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

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

- An audit of the plan, at intervals of no more than five years, for the purpose of ascertaining whether its provisions have been given effect to. This audit is to be carried out by an Audit Panel, which has been appointed by the Minister for Primary Industries, as having this role.
- An audit of the plan by the Natural Resources Commission to assess to what extent the water sharing provisions have contributed to the relevant state wide targets, and natural resource standards and targets in the relevant catchment management area. The Natural Resources Commission will call for public submissions when undertaking its review.
- An annual review of implementation programs.
- The application of information from the relevant monitoring and evaluation programs to inform progress against the relevant state-wide targets and requirements of the National Water Commission under the National Water Initiative.

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 here to assist with understanding the water sharing plan.

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

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

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

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

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

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

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

Ephemeral: Temporary or intermittent. For instance, a creek or wetland that dries up periodically.

Extraction of water: The taking of water from a water source.

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

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

Flow duration curve: A plot that shows the percentage of time that each flow rate in a stream is equalled or exceeded.

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

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

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

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

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

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

Management zone: 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 local dealing restrictions are in place or where cease-to-pump (EFPR) rules for works approvals apply.

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 declared as regulated rivers.

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

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

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

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

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.

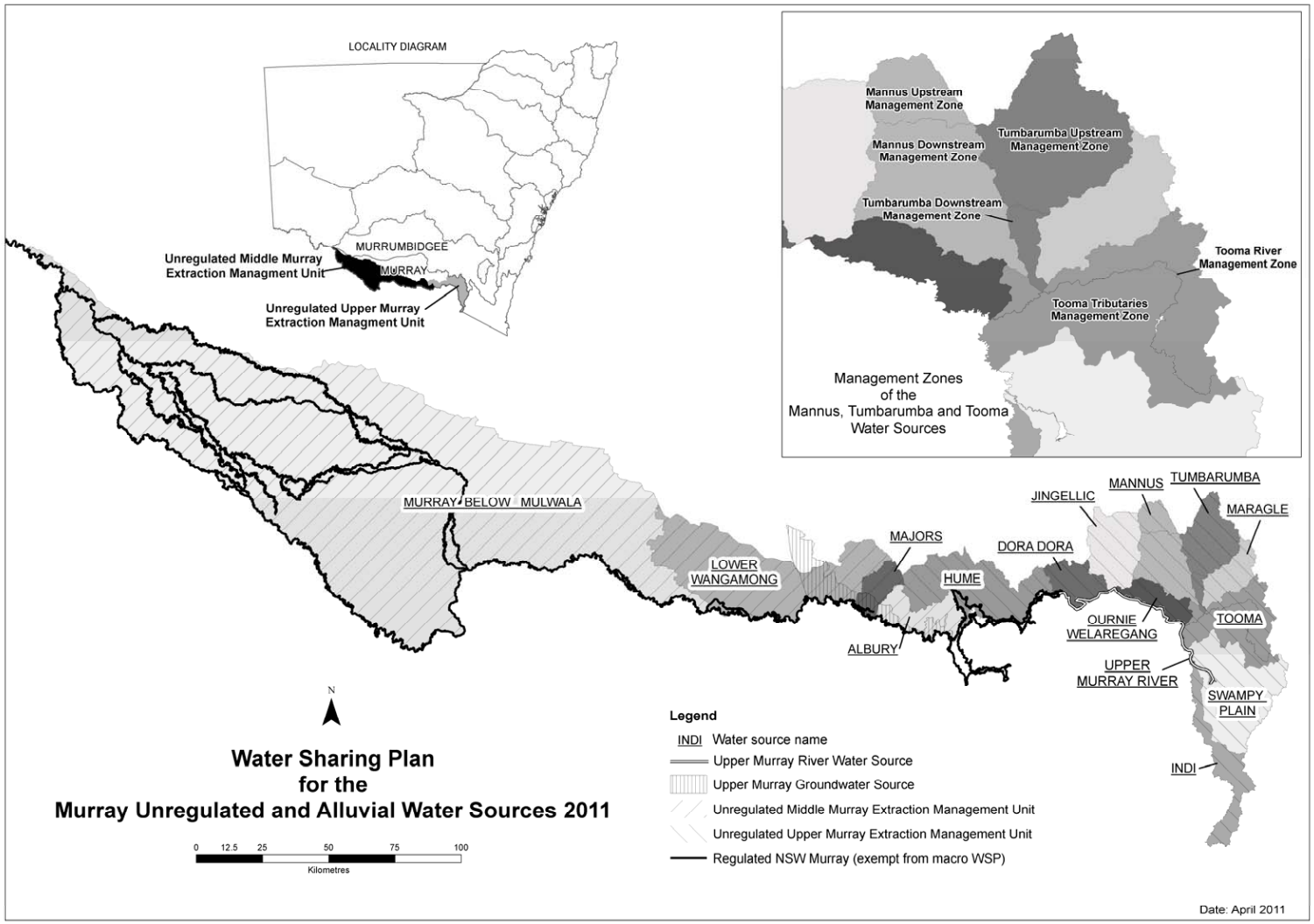
Visible flow: The continuous downstream movement of water that is perceptible to the eye.

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.

Appendix 1: Water sharing plan area

Figure 1 Map of water sharing plan area



Appendix 2: Identified threatened species

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

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

Water source	Frog species	Birds	Other fauna	Fish species	Wet flora	Endangered ecological communities	Other
Albury	2	9	1	6	1	1	High rarity
Dora Dora	2	9	1	4	1		High naturalness and diversity
Hume	2	9	1	5	1		High rarity
Indi	4	9	2	2	1		World Heritage Area, Declared Wilderness, high naturalness
Jingellic	4	9	1	4	1		
Lower Wangamong	2	9	1	6	2	1	
Majors	2	9	1	6	1	1	High naturalness
Mannus	4	9	1	2	1		
Maragle	4	9	2	3	1		
Murray below Mulwala	1	8	1	8	2	1	Ramsar listed wetland, high naturalness, rarity and diversity
Ournie Welaregang	2	9	1	4	1		High diversity
Swampy Plain	4	9	2	5	1		World Heritage Area, Declared Wilderness, high naturalness and rarity
Tooma	4	9	2	4	1		World Heritage Area, high naturalness and diversity
Tumbarumba	4	9	2	4	1		Nationally important wetlands
Upper Murray River	2	9	1	4	1		High naturalness

Disclaimer

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

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

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

Appendix 3: Stream gauging stations in the Murray unregulated water sources used as flow reference points

Station name	Station no.	Period of record		Catchment (km^2)	Water source
		Start	Finish		
Murray River at Biggara	401012	1948	2011	1165	Indi
Jingellic Creek at Jingellic	401013	1965	2011	390	Jingellic
Mannus Creek at Glenroy	40110008	2001	2011	130	Mannus
Mannus Creek at Yarramundi	401017	1983	2011	200	Mannus
Maragle Creek at Maragle	401009	1947	2011	215	Maragle
Tooma River at Pinegrove	401014	1955	2011	1845	Tooma
Tumbarumba Creek at Tumbarumba No. 2	401007	1946	2011	157	Tumbarumba
Tumbarumba Creek at Tooma (Bakers)	401024	2003	2011	1259	Tumbarumba
Murray River at Jingellic	401201A	1890	2011	6530	Upper Murray River

Appendix 4: Interagency regional panel and support staff – current membership and expertise

Name	Agency	Role	Expertise
Interagency regional panel			
Tracey Brownbill	Office of Water	Agency representative/Chair	Grad. Dip. Water Science (Monash University), Bachelor of Science (University of Melbourne). 16 years experience in natural resource management, the last 6 years in water management.
Justen Simpson	Office of Environment and Heritage	Agency representative	Bachelor of Applied Science with Honours, University of Canberra. 25 years experience in natural resource policy and management. 12 years of Water Sharing Planning experience and last 5 years as the NSW Manager for Environmental Flow Delivery.
Giles Butler	Department of Primary Industries	Agency representative	Bachelor of Rural Science (University of New England). 18 years experience in agricultural and natural resource research development, extension and management. The last 6 years as Regional Director for the South West region, having a strong focus on water policy and natural resource management.
Patricia Bowen	Murray CMA	CMA observer	15 years experience in natural resource management through management roles with catchment management authorities and NSW natural resource and environmental departments.
Support staff			
Michelle Roe	Office of Water	Plan coordinator	Bachelor of Laws and Bachelor of Science (Griffith University). Ten years experience in natural resource management, the last five years in water management.
Kathryn Pender	Office of Water	Planning support	Bachelor of Science (University of Newcastle). 5 years experience in science education. 2 years in water management.
Sally Hunt	Office of Water	Policy support	Masters of Environmental Science (Monash University), Bachelor of Science, (Humboldt State University). 17 years experience in natural resource, 10 of which in water management.
Neeraj Maini	Office of Water	Technical support (hydrology)	Master of Engineering (University of Technology, Sydney), Bachelor of Civil Engineering (India). 12 years experience in hydrology and water resource management.
Nimal Kulatunga	Office of Water	Technical support (hydrogeology)	M.Sc. Hydrogeology (University of London), B.Sc. Geology (University of Peradeniya, Sri Lanka). 30 years experience in groundwater exploration and management.
Clare Purtle	Office of Water	Technical support (licensing)	Grad. Dip. Environmental Management (La Trobe University), Bachelor of Arts (University of Sydney). 18 years experience with NSW Government in water resource planning and implementation in the NSW Murray Valley.
Lindsay Holden	Office of Water	Technical support (licensing)	Licensing officer downstream of Tocumwal, local knowledge of water users, water use agreements, local access arrangements, reference points and implementation.
Greg Delmenico	Office of Water	Technical support (compliance)	Diploma Conservation Land Management, Diploma Government Investigations. 17 years working in the water industry last 10 years working in the Water Compliance area.

Appendix 5: Final classification summary

Value matrix

High instream values	A Swampy Plain, Upper Murray River, Ournie Welaregang, Dora Dora, Murray below Mulwala	B Tooma, Jingellic	C Albury, Hume
Medium instream values	D Indi, Lower Wangamong, Majors	E	F Mannus, Tumbarumba, Maragle
Low instream values	G	H	I
	Low hydrologic stress or hydrologic risk	**Medium hydrologic stress or hydrologic risk**	**High hydrologic stress or hydrologic risk**

Risk matrix

High risk to instream values	A Hume	B Albury, Murray below Mulwala	C
Medium risk to instream values	D Jingellic, Lower Wangamong, Majors	E Tumbarumba Maragle	F Mannus
Low risk to instream values	G Ournie Welaregang Dora Dora	H Indi Swampy Plain Tooma	I Upper Murray River
	Low dependence on extraction	**Medium dependence on extraction**	**High dependence on extraction**

Appendix 6: Reference materials

Central data sets

Employment in Agriculture – Australian Bureau of Statistics.

Index of Social Disadvantage – Australian Bureau of Statistics.

Roy et al. 2001. Structure and Function of South-eastern Australian estuaries.

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.

NSW Office of Water regional data sets

AUSRIVAS – LNC area has a number of AUSRIVAS sampling sites (water quality). The data was used in the spreadsheet to help assess river health.

Hydsys – Hydsys is a NSW Office of Water statewide database that holds all flow record data. Flow records are available for most water sources in the Greater Metropolitan Region (LNC) area.

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

Riparian vegetation mapping – riparian vegetation extent has been mapped across the LNC area. This was used to help determine other (non-extractive) influences on river health.

RiverStyles Mapping – Riverstyles mapping has been completed for most of the LNC area. It is based on the nationally-adopted method developed by Macquarie University. Maps are produced of Riverstyle / Geomorphic Condition / Recovery Potential. The information was used to assess issues such as drought refuge (pools), habitat heterogeneity, etc to inform the development of flow rules.

TRITON Water Quality database – NSW Office of Water 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. NSW Office of Water has an ongoing regional water quality monitoring network.

Reference materials

Chiew F.H.S., Vaze J., Viney N.R., Jordan P.W., Perraud J-M., Zhang L., Teng J., Young W.J., Penaarancibia J., Morden R.A., Freebairn A., Austin J., Hill P.I., Wiesenfeld C.R. and Murphy R. (2008) *Rainfall-runoff modelling across the Murray-Darling Basin. A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project*. CSIRO, Australia.

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DNR. 2005. *Murray Catchment Management Authority 2005 Socio-Economic Information*. Prepared by: Economic and Social Sciences Group, Office of Knowledge, Science and Information, Department of Natural Resources.

NSW DPI. 2006. Primefact 172. *Endangered ecological communities in NSW. Lower Murray River aquatic ecological community.* NSW Department of Primary Industries. NSW.

Kulatunga N., 2008. *Groundwater Resources Status – Upper Murray Alluvium (from Albury to Corowa) GMA 015, Groundwater Status Report No.2*. NSW Department of Water and Energy. NSW.

Murray CMA. 2007. *Catchment Action Plan*. Murray Catchment Management Authority. NSW.

MDBC. 2006. *Evaluation of the connectivity between surface water and groundwater in the Murray-Darling Basin*. Murray-Darling Basin Commission. Australia.

Sinclair Knight Merz. 2006. *Towards a National Framework for Managing the Impacts of Groundwater and Surface Water Interaction in Australia*. Natural Heritage Trust, Sinclair Knight Merz.

Vaze J., Teng J., Post D, Chiew F., Peraud J-M., Kirono D, (2009), *Future climate and runoff projections (~2030) for New South Wales and Australia Capital Territory*, NSW Department of Water and Energy, Sydney.

Appendix 7: Water sharing rules based on Interagency regional panel knowledge

Water source	Change to water sharing rules	Justification
All	The indicative access rules identified through the classification process were not adopted for natural off-river pools. Instead it was recommended that water must not be taken from a natural pool that is not within a river when the water level in the pool is less than 80% of its full containment volume.	The default or recommended access rule for each water source or management zone was not suitable for off-river pools and a draft policy was being developed to refine the macro approach for defining default rules for these pools. The then indicative drawdown rule of 80% of full containment volume was accepted by the Panel.
Albury	The indicative access rule identified through the classification process (cease to pump to maintain a specified depth of flow at end of water source) was not adopted. Instead a cease to pump when there is no visible flow at the pumpsite rule was recommended.	The water source has high instream values and is the only one with no licensed extractive use.
Hume	The indicative trade rule identified through the classification process (no trading permitted into a high stress or high value water source) was not adopted. Instead the Panel agreed to permit trade into very high flows of more than 8 ML/day, limited to 653 ML/yr.	To provide flexibility for economic development the Panel recommended permitting limited trade into very high flows. An analysis was undertaken using data from the Yambla Creek at Bowna gauge (401015), in the water source. Assuming comparable rainfall and runoff across the water source area, as exists in the gauge catchment area, it was found that the estimated peak daily demand (6.6 ML/day) represents 27% of the estimated combined 30th percentile flow (25 ML/day).
Lower Wangamong	The indicative trade rule identified through the classification process for ephemeral streams (trade permitted into low to medium stress or low to medium value water source) was not adopted. Instead the Panel agreed that trade into the water source should not be permitted.	This was due to the lack of a gauge or reference point for determining the level of impact of additional trade into the water source.
Majors	The indicative trade rule identified through the classification process for ephemeral streams (trade permitted into low to medium stress or low to medium value water source) was not adopted. Instead the Panel agreed that trade into the water source should not be permitted.	This was due to the lack of a gauge or reference point for determining the level of impact of additional trade into the water source.
Mannus	The indicative trade rule of no net increase in entitlement via trading was not adopted. To provide some flexibility for economic development the Panel recommended limited trade into very high flows.	As the water source is already hydrologically stressed in the low, moderate and high flows further trade into these flow classes was not considered appropriate.
Maragle	The indicative trade rule of no net-gain with trades allowed into or upstream of water source was not adopted. To provide some flexibility for economic development the Panel recommended limited trade into moderate flows.	As the water source is already moderately stressed during low flows further trade into the low flow class was not considered appropriate.
Tooma	The indicative trade rule of not allowing trade into or upstream of the water source was not adopted.	To provide flexibility for economic development the Panel instead recommended permitting limited trade into moderate flows.
Upper Murray River	The indicative trade rule of not allowing trades into or upstream of water source was not adopted. To provide flexibility for economic development the Panel instead recommended allowing trade into high flows.	Given that the Upper Murray River behaves more like a regulated water supply (unnaturally high flows) an upper limit was not determined prior to targeted consultation.

Appendix 8: Changes to water sharing rules as a result of targeted consultation and updated data

Water source	Change to water sharing rules	Justification
Indi	Decrease the cease to pump from 133 ML/day (95th percentile flow volume during critical month of February) to 87 ML/day (being estimated 98th percentile end of system flow during critical month of February). Introduced a Total Daily Extraction Limit (TDEL) to limit extractions to 12 ML/day when flows are between 87 ML/day and 157 ML/day (the estimated 95th percentile end of system flow during critical month of February).	The previously adopted access rule of cease to pump when flows are at or below 133 ML/day (being the estimated 95th percentile of flow) was determined as likely to have a more significant impact on irrigators who have invested in spray irrigation systems as compared to irrigators who can reinstate their soil moisture profile more quickly through flood irrigation. The rule would also have meant that NSW irrigators would have been at a significant disadvantage compared to Victorian irrigators, who would continue to access water under current access arrangements.
Indi	Increase the upper limit for trade into moderate flows from 140 ML/yr to 3,238 ML/yr (equating to 10% of the estimated 70th percentile flow, assumed to be taken 120 days of the year, less the volume of entitlement already issued to existing users in the low flow class).	The revised upper limit will provide more flexibility for water to move to its highest value use, while having little risk of flows in the higher flow class becoming stressed.
Mannus	Remove the additional access rule of no pumping in February or March in both management zones.	The panel agreed with users that this additional restriction is no longer required, particularly given there can be no further entitlement granted in the low flow class.
Mannus	For the upstream management zone increase the upper limit for trade into very high flows from 22 ML/yr to 1,310 ML/year (being 30% of the very high flow index, over 120 days, less the volume of entitlement already issued in the low flow class in that management zone). For the downstream management zone increase the upper limit for trade into very high flows from 22 ML/yr to 1,668 ML/year (being 30% of the very high flow index, over 120 days, less the volume of entitlement already issued in the low flow class in that management zone).	The revised upper limits will provide more flexibility for water to move to its highest value use, while having little risk of flows in the higher flow class becoming stressed. To ensure that flows in higher flow classes do not become stressed though it was necessary to restrict trade to above the 30th percentile flow.
Maragle	Remove the additional access rule of no pumping in February or March in both management zones.	The added restriction of no pumping in February and March would have a significant impact on these summer pasture operations in wetter years, of which there are many.
Maragle	Increase the upper limit for trade into high flows from 7 ML/yr to 567 ML/yr (being 20% of the high flow index multiplied by 120 days less the volume of annual entitlement already issued).	The revised upper limit will provide more flexibility for water to move to its highest value use, while having very little risk of flows in the higher flow class becoming stressed. As the moderate flow class is also highly stressed, the Panel agreed to this proposal on the basis that access would be to high flows, above the 50th percentile, rather than into moderate flows, above the 70th.
Tooma	Increase the upper limit for trade into moderate flows from 89 ML/yr to 2,177 ML/yr (being 10% of the moderate flow index multiplied by 120 days less the volume of annual entitlement already issued).	The revised upper limit will provide more flexibility for water to move to its highest value use, while having very little risk of flows in the higher flow class becoming stressed.

Water source	Change to water sharing rules	Justification
Tumbarumba	Remove the additional access rule of no pumping in February or March in both management zones.	The added restriction of no pumping in February and March would have a significant impact on these summer pasture operations in wetter years, of which there are many.
Upper Murray River	Remove limits on trade into this water source.	The Upper Murray River receives inflow from all other sources in the Upper Murray EMU. For this reason any trade which de-stresses an upstream water source should not have a noticeable impact on this water source and no flow class or volumetric limit is required.

Appendix 9: Changes to water sharing rules as a result of public exhibition and updated data

Water source	Change to water sharing rules	Justification
Indi	Increase the TDEL for Flow Class A to 24 ML/day noting this represents a 50% improvement in the end of system flows when flows are between 87 and 157 ML/day.	Irrigators provided sufficient evidence of potential impacts. The panel recognised the disproportionate cost to irrigators in revising the Total Daily Extraction Limit. The proposed rules represent an immediate 50% improvement in the volume of water which is left in river.
Hume	Remove trade into very high flows. That is, revert to the indicative trade rule of no trade in to high stress or high value water source.	Trade could only be permitted into very high flows. This indicates that all other flow classes are highly stressed. Inconsistent to use gauge for setting trade rule, when not using to set access rule.
Tumbarumba	Include amendment provision in plan to allow for changes to be made to the town water supply exemption.	Including an amendment provision will allow the Minister to determine when augmentation is complete and the new cease to pump to apply.
Upper Murray Groundwater	Increase LTAAEL to reflect revised standard approach.	The revised LTAAEL is consistent with current policy.
Upper Murray Groundwater	Remove supplementary water access licence (SWAL) provisions.	SWAL would impact late developers who have yet to recover their investment nor have a HoE that reflects their level of infrastructure or development. Removal of SWAL allows the market to operate freely in line with the National Water Initiative principles. Carryover and extraction provisions allow licence holders flexibility in managing reduced water allocations.