15. Warrego, Paroo, Bulloo and Nebine Water Resource Plan

15.1 2007–08 highlights

Highlights in the Warrego, Paroo, Bulloo and Nebine (WPBN) Water Resource Plan (WRP) area during the reporting period included the following:

- Overland flow works in the Paroo catchment were audited.
- Annual flow past Cunnamulla was the highest recorded.
- Warrego River at Augathella experienced its first flow since 2004.
- Another year of above average streamflow enabled the Cunnamulla Water Supply Scheme to announce a 100 per cent allocation for the tenth consecutive year.
- Water diversion came in well under the modelled allowances provided for in the Murray–Darling Basin Cap process.

15.2 Overview

The WPBN WRP was approved in December, 2003. It applies to water in a watercourse, lake or spring in the Warrego, Paroo, Bulloo and Nebine catchments and includes the Warrego, Langlo, Ward, Paroo and Bulloo rivers and Angellala, Widgeegoara, Noorama, Cuttaburra, Yowah, Beechal, Quilberry, Log, Blackwater, Winbin, Goorie Goorie, Gumbo Gumbo, Nebine, Mungallala and Wallam creeks.

The WPBN WRP is implemented through the WPBN Resource Operations Plan (ROP), which was approved in January 2006.The reporting period of 2007–08 represented the first full year of operation of the ROP. The WRP, ROP and a map of the catchment can be viewed by visiting the NRW website ‹www.nrw.qld.gov.au/wrp/wpbn›.

The WRP catchments cross the Queensland–New South Wales border and, with the exception of the Bulloo catchment, are part of the Murray–Darling Basin. The WRP and ROP only deal with the Queensland components of the catchments.

The WPBN WRP catchments (again, with the exception of the Bulloo catchment) are subject to the obligations of the Murray–Darling Basin Agreement and associated Murray–Darling Basin Cap arrangements.

15.2.1 Changes to the plan

There have been no amendments to the WPBN WRP or ROP in the past reporting period.

15.2.2 Streamflow

Streamflow was markedly higher than the previous year. The Warrego and Paroo recorded major flooding events. Figures 15.1, 15.2, 15.3 and 15.4 illustrate flows between the subcatchments.

Most streams in the plan area experienced flow during 2007–08, including the upper Warrego River and tributaries, where there had been virtually no flow recorded at Augathella since a small flow in late 2004.

The Warrego, Paroo, Bulloo and Nebine streams are ephemeral in that they only flow intermittently as a direct result of rainfall within the catchment. As a result, there is no base flow component to these rivers with the recession from flow to no flow occurring in a relatively short period after a rainfall event. However, after an extended wet period, the duration of this recession will be longer, as discharge from groundwater infiltration and bank storage moves down the system.

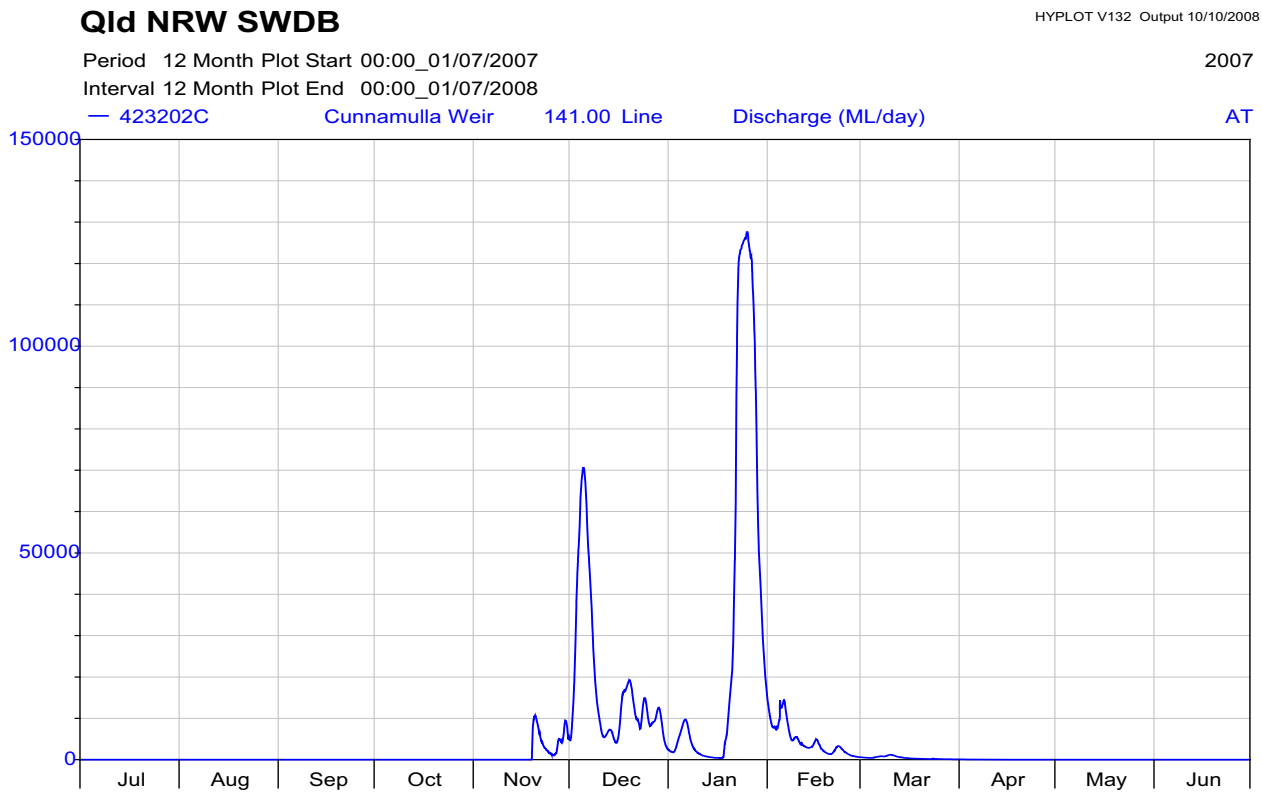
Warrego catchment

The 2007–08 year was characterised by well above average summer rainfall, which led to major flooding. Rainfall was nearly double the average at Cunnamulla and was markedly above average for the Warrego catchment as a whole. A total of 630 mm was recorded at Cunnamulla against an average of 368 mm. About 85 per cent of this total fell over the summer period (November to February).

The Warrego River is an ephemeral stream, which, when not flowing, becomes a chain of permanent waterholes. The Warrego River has a relatively reliable summer flow pattern. The summer flow this year ran from mid-November through to mid-March, with a major peak flow of over 127 000 ML/d recorded in late January. The entire catchment experienced good flows during the 2007–08 period. Flooding at Charleville in January tested the newly constructed levee protection works.

Average annual flow at Wyandra, which is a key monitoring station between Charleville and Cunnamulla, is 481 000 ML, while further downstream at Cunnamulla the annual average is 415 000 ML. Streamflow for the Warrego River at Cunnamulla for the 2007–08 water year was 1 765 000 ML. This is the highest annual volume recorded at this station since recording began in 1992.

Figure 15.1 Streamflow discharge (ML/d) for Cunnamulla in the Warrego catchment



Paroo catchment

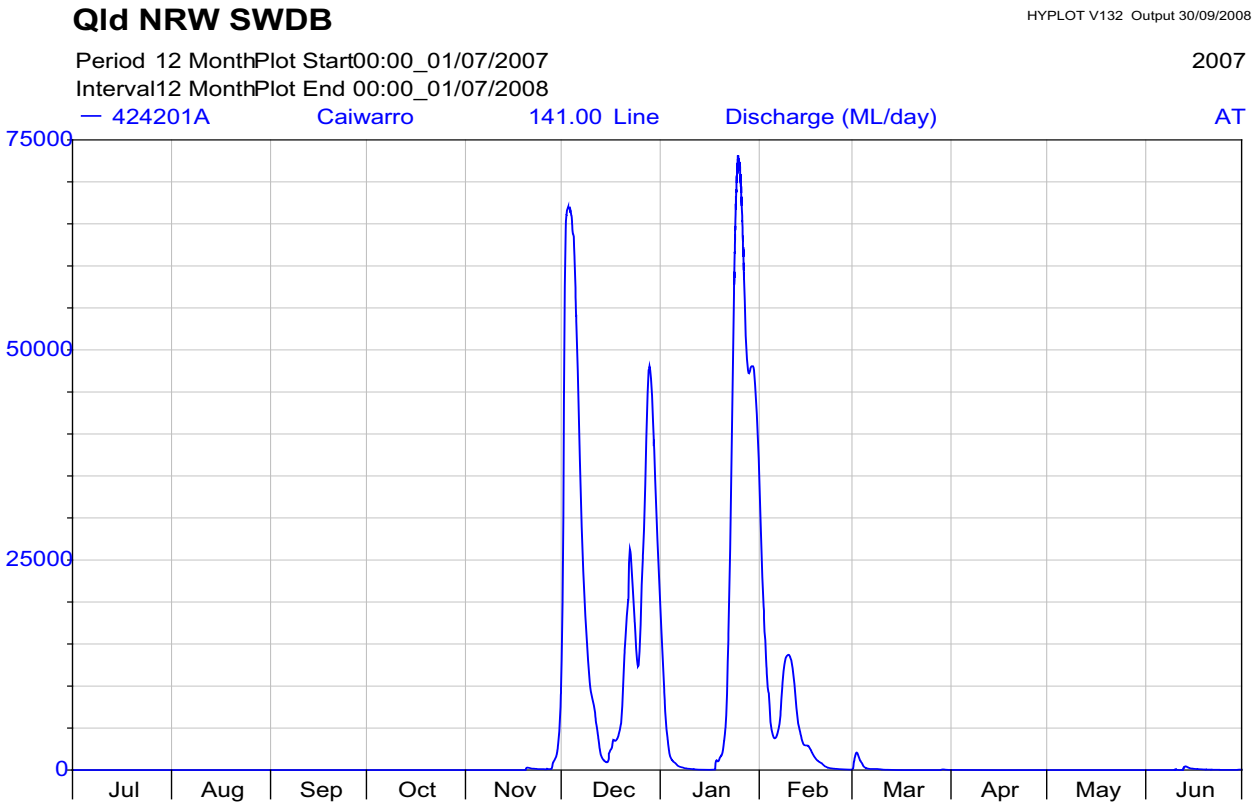
Rainfall recorded for 2007–08 at Hungerford, in the southern part of the Paroo catchment, was above the long-term average of 290 mm for the second consecutive year. The peak monthly rainfall received was in December, with 93 mm falling—against the long-term average for December of 27 mm.

There are numerous waterholes along the length of the Paroo River, many of which are permanent, but most of the surrounding shallow lakes on the floodplain are seasonal. Many of these waterholes and lakes store water that would otherwise contribute to flow in the Paroo River.

Streamflow at Caiwarro, the last gauged location on the Paroo River in Queensland, was 1 449 000 ML for 2007–08. This compares with an average annual flow at Caiwarro of 522 000 ML. This represents the fourth highest flow on record (post gauging commenced in 1968) and the highest since the record flooding of 1989–90. The excellent summer rainfall resulted in the Paroo River running from mid-November through to mid-March. The flow peaked at over 74 000 ML/d in late January 2008.

Photo by Jake Berghoffer; January floods in the Paroo River at Eulo.

Figure 15.2 Streamflow discharge (ML/d) for Caiwarro in the Paroo catchment



Bulloo catchment

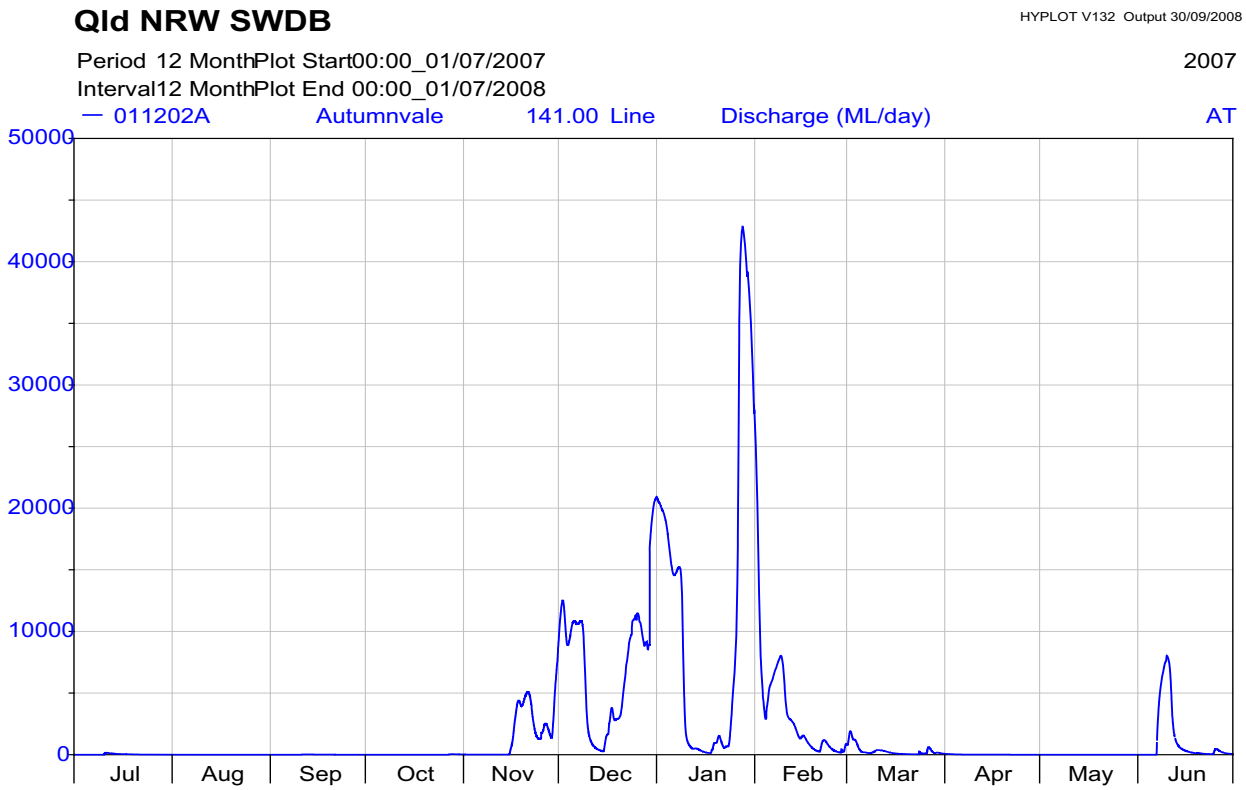
Rainfall at Thargomindah for 2007–08 was slightly below average, with 214 mm recorded. While rainfall over summer was around average levels, winter rainfall was absent—except for June 2008, which recorded the peak monthly figure of 51.3 mm.

There are numerous permanent waterholes along the Bulloo River, with flow in this system terminating in the maze of ephemeral and permanent water bodies that constitute 'the Bulloo lakes'.

The recorded average annual flow in the Bulloo River at Autumnvale, which is the last gauged point on the Bulloo River in Queensland, is 672 000 ML. This is a large average flow volume but flow is highly variable, with no flow occurring an estimated 50 per cent of the time. Total streamflow discharge volume for Autumnvale was 790 000 ML, which was above the historical average. The peak flow in this catchment passed Autumnvale (near Thargomindah) in January at 43 000 ML/d.

Photo by Andrew Radke; Autumnvale on the Bulloo River

Figure 15.3 Streamflow discharge (ML/d) for Autumnvale in the Bulloo catchment



Nebine catchment

Rainfall was significantly above average in the Nebine catchment, with 617 mm recorded at Mulga Downs for the 2007–08 water year—against an average of 260 mm. Over 70 per cent of the rain fell over the three-month period from December to February.

The mean annual flow from the Nebine catchment (including Noorama and Widgeegoara Creeks) is estimated at 33 000 megalitres per year. Flows discharge into the Culgoa River.

A small number of waterholes within the catchment are thought to be permanent; however, the shallow ephemeral lakes on the surrounding floodplains are seasonal.

The new gauging station installed at Roseleigh Crossing (on Nebine Creek) completed its first full year of recording. This gauging station is 10.5 km upstream of the Queensland – New South Wales border.

Flows in Wallam Creek at Cardiff and Nebine Creek at Roseleigh for 2007–08 were around 23 000 ML each. In both cases, flows were primarily recorded in the period from November to February. Records for the Nebine catchment are relatively recent, so recorded averages or medians are not discussed as figures and are not indicative of longer term values.

15.3 Water allocation and use

15.3.1 Overview

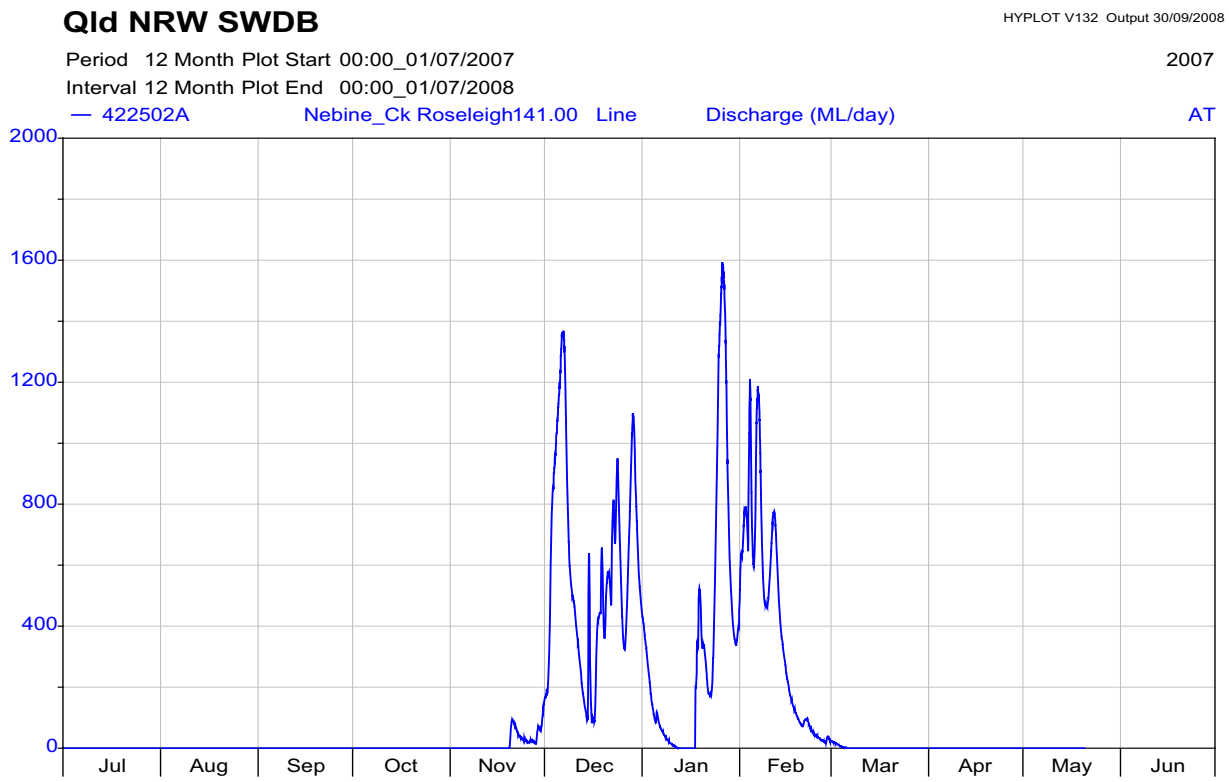
The majority of water entitlements in the WRP area were converted to water allocations on commencement of the ROP. The remaining licences have been converted into volumetric entitlements. The catchment is defined by a single water management area per catchment, with the exception of the Warrego, which is divided into two water management areas. There are four basic types of water diversions in the WPBN WRP area:

- supplemented water drawn from supplemented flows
- unsupplemented water drawn from natural flows
- take of overland flow—that is, water that runs across the land after rainfall
- groundwater (not addressed under the current WPBN WRP or ROP).

Supplemented water diversion in this valley is limited to a small water supply scheme based on a 4770 ML weir on the Warrego River at Cunnamulla. The generous flow situation for the year enabled 100 per cent allocation to be announced.

Unsupplemented diversion across all four catchments for 2007–08 was 10 656 ML. The majority of take is associated with water allocations with flow conditions (water harvesting).Take is measured by metered

Figure 15.4 Streamflow discharge (ML/d) for Roseleigh Crossing in the Nebine catchment



works; however, metering of some of the larger works has been deferred until further development of the national standards has occurred and it is clear what criteria and specifications apply to this category of diversion. Water use assessments are completed for each of these works.

15.3.2 Water use

Supplemented water

There are 27 supplemented water allocations in the plan area, all located in the Warrego catchment and supplied by the Cunnamulla Water Supply Scheme. This scheme only offers medium-priority water allocations. The announced percentage allocation available for 2007–08 was 51 per cent from 1 July 2007 and 100 per cent from 23 November 2007. A total of 1466 ML was taken by water allocation holders during the year.

Unsupplemented water

The number, nominal volume and volumetric limit of unsupplemented water allocations in the Warrego, Paroo, Bulloo and Nebine catchments are shown in Table 15.1. The majority of unsupplemented water allocations are located in the Warrego catchment, with only six allocations registered across the Bulloo, Paroo and Nebine catchments.

Table 15.1 Water entitlements in the ROP area

Water management area	Number of entitlements	Nominal volume (ML)	Volumetric limit (ML)	Volume taken (ML)
Warrego (Upper Warrego)	20	2 170	4 090	11
Warrego (Lower Warrego)	21	37 833	86 790	10 620
Warrego (Cunnamulla Water Supply Scheme)	27	2 612	N/A (2 612 @ 100%)	1 466
Paroo	2	50	70	10
Bulloo	2	20	40	0
Nebine	4	2 039	3 209	15
Total	**76**	**44 724**	**96 811**	**12 122**

Water harvesting

There were three announced water harvesting periods in the Warrego catchment for 2007–08. The first event commenced in mid-November and continued through to early January. The second event commenced six days later, in mid-January, and ran through until late February, with the last event commencing in early March and finishing three days later. The record streamflow at Cunnamulla resulted in water harvesting being announced for many water allocations for 97 days compared against an estimated average of 20 days. The total taken (10 620 ML) was limited by various operational difficulties experienced by the entitlement holders.

Movement of water across the water year

Carryover and forward draw are not currently offered for the Cunnamulla Water Supply Scheme. There are no other methods to move water take from one year into another.

Overland flow

Overland flow take is based on an estimate of overland flow infrastructure and an opportunity to take in the Warrego, Paroo, Bulloo and Nebine catchments. It is intended to further refine the overland flow take volume once sufficient data has been recorded.

As a requirement of the WRP, owners are required to notify NRW of overland flow works that take water for purposes other than for stock and domestic use. No new overland flow acknowledgements were recorded in 2007–08 for any of these catchments.

Estimates of overland flow take for 2007-08 for the Warrego, Paroo, Bulloo and Nebine catchments are shown in Table 15.2.

Table 15.2 Overland flow acknowledgements in the ROP area

Water management area	Number of overland flow acknowledgements	Volume of notified works (ML)	Volume taken (ML)
Warrego (Upper Warrego)	29	30 855	7 000
Warrego (Lower Warrego)	35	25 403	4 000
Paroo	13	10 892	4 000
Bulloo	3	50	50
Nebine	3	89	100
Total	83	67 289	15 150

Unallocated water

At 30 June 2008, the total volume of unallocated water reserved in the WPBN WRP for 'any' purpose was 9500 ML, with an additional 400 ML reserved for town water supply.

15.3.3 Water trading

There were no permanent supplemented water allocation transfers in the WPBN plan area over 2007–08. Across all four catchments, two permanent unsupplemented water allocation transfers with land occurred, with a 0.96 per cent turnover.

There were no permanent supplemented or unsupplemented water allocation transfers that occurred separate from land.

There were three seasonal water assignments of supplemented water totalling 843 ML in the Cunnamulla Water Supply Scheme (Warrego catchment).

15.3.4 Murray–Darling Basin Cap

At its June 1995 meeting, the Murray–Darling Basin Ministerial Council decided to introduce a cap on diversion of water from the Murray–Darling Basin.

In accordance with this decision, a diversion cap for the Warrego, Paroo and Nebine parts of the WPBN plan area was established in accordance with Schedule F of the Murray–Darling Basin Agreement. The Bulloo catchment was omitted, as it does not form part of the Murray–Darling Basin.

The cap for the Queensland section of the Warrego, Paroo and Nebine valleys was set as the seasonally adjusted diversion limit imposed by the rules in the Warrego, Paroo, Bulloo and Nebine ROP 2006.

That is, the limit is the extraction that could have occurred in the Warrego, Paroo and Nebine parts of the WPBN plan area under the climatic conditions for the audit year and under the rules in the resource operations plan.

This target diversion is compared with actual take to determine whether more water has been extracted than would have been permitted under the water management rules.

If the difference between measured and target diversions accumulates to a level that exceeds the trigger level, then a special audit is undertaken and this will detail the actions to be taken to bring diversions back in line with the cap.

15.4 *Water service provider operations*

SunWater operates the Cunnamulla Water Supply Scheme in the Warrego catchment. This is the only water supply scheme in the WRP area.

15.4.1 Release from storages

Under the ROP, if natural flows enter Allan Tannock Weir when it is not full, compensation releases are made downstream.

These releases are either equal to the inflow, or 300 ML/d, whichever is the lesser, subject to the pressure head resulting from the water level in the weir. The inflow is estimated from the measured river height at Wyandra Gauging Station, adjusted for travel time.

There were two compensation releases made downstream of Allan Tannock Weir, both in June 2007. A total volume of 117 ML was released.

15.4.2 Critical water supply strategy

No critical water supply arrangements are required as there is no high-priority allocation in the scheme at this point in time.

15.4.3 Environmental management

The Allan Tannock Weir has a simple outlet structure with a single-level offtake. This provides little scope for SunWater to manage downstream environmental conditions particularly, given the only releases able to be made are stock and domestic. These releases are made with due consideration of the impact on downstream aquatic ecosystems.

15.4.4 Non-compliance with the resource operations plan

The Cunnamulla Water Supply Scheme was operated in accordance with the requirements of the WPBN ROP. It was also operated in accordance with the Water Monitoring Data Collection Standards, the approved Statement of Current Programs, and the Cunnamulla Water Supply Scheme Implementation Program.

15.5 *Ecological monitoring and assessment*

15.5.1 Ecological assets identified for further monitoring

Ecological assets with critical links to flow were identified in the Warrego, Paroo, Bulloo and Nebine respectively in 2005, and were considered in a qualitative risk assessment process. Many of the assets were identical across WRP areas and only a few were restricted to one WRP area. According to the qualitative risk assessment, 15 out of the 40 assets within the Warrego WRP were considered to be at moderate potential risk and have been selected for further assessment. The remaining assets were considered to be at low potential risk from water management under the WPBN WRP in any zone, and thus will not be assessed any further. In the Paroo, Bulloo and Nebine catchments, all critically linked assets are considered to be at low or no risk under the WPBN WRP, and thus will not be assessed any further. Assets that are under some risk (moderate in Warrego only), were put through a ranking process that prioritised these assets for further study and a more detailed risk assessment.

15.5.2 Stage of monitoring and research activities

The department has not undertaken any monitoring or research activities in the WPBN catchments for WRP assessment during the reporting period.

15.5.3 Sustainable Rivers Audit program monitoring

The Sustainable Rivers Audit (SRA) program is an initiative of the Murray–Darling Basin Commission, which the Department is a partner in. The audit is designed to assess, using indicators, condition and trend of river health at valley scale across the Murray–Darling Basin. The initial SRA program from 2004 to 2010 is focusing on assessing indicators of river health related to fish communities, macro-invertebrates and hydrology. Phase 2 indicators (physical form and vegetation) are currently being developed and piloted with the aim of implementation in 2009.

The Warrego and Paroo catchments are evaluated in the first SRA report. The Bulloo River is a terminal system that does not contribute flows to the Murray–Darling Basin, and is not sampled under the SRA program. Nebine Creek is regarded as part of Condamine–Culgoa catchment and is incorporated into the evaluation for this catchment.

Sampling for macro-invertebrates in the Warrego and Paroo catchments was undertaken in the autumn of 2006 and 2008, while fish were sampled in the two catchments in 2006.

SRA Report 1, which summarises the results over the first three years (2004–07) of the program, was released in June 2008. The report states that the fish and macro-invertebrate communities of the Paroo River catchment are in moderate condition and the hydrology is in good condition. This gives the Paroo

river system an overall assessment of good health.

The fish and macro-invertebrate communities of the Warrego River catchment were evaluated as being in poor condition, and the hydrology as in good condition. This gives the Warrego River system an overall assessment of poor health.

Of the 23 valleys assessed, only the Paroo was found to be in 'good' ecosystem health. Two valleys, the Border Rivers and Moonie, and Condamine Balonne were found to be in moderate health. Seven other valleys, including the Warrego, were rated in poor health, while 13 others were found to be in very poor health. No valleys were rated in extremely poor health. For more information, refer to the SRA audit report ‹http://www.mdbc.gov.au/SRA›.

15.6 *Five year report for the Water Resource (Warrego Paroo Bulloo Nebine) Plan 2003*

Section 48(2) of the *Water Resource (Warrego, Paroo, Bulloo and Nebine) Plan 2003* states that the Minister must prepare a report five years after the commencement of the plan, including information on:

- the accuracy of flow gauging in the plan area
- community views on implementation of this plan
- the appropriateness of the performance indicators for achieving this plan's outcomes.

15.6.1 The accuracy of flow gauging in the plan area

Prior to the development of this WRP, flow gauging across this stream system consisted of a network of eight gauges, made up of:

- four in the Warrego catchment
- one on the Paroo
- one in the Nebine catchment
- two on the Bulloo.

The map in Attachment B (Map 2) illustrates where gauging stations are in the catchment.

Warrego flow gauging

In 2005, a new gauging station was established on the Warrego River at Wallen, which is about 65 kilometres upstream of Cunnamulla at Wallen. This brought the total number of stations in the Warrego catchment to five.

The medium to high stage rating for gauging stations in the Warrego catchment is considered to be of a high standard, with three of the five gauging stations (Cunnamulla, Wallen and Binowee) being measured to better than 90 per cent of highest recorded flow.

The other two gauging stations, at Wyandra and Augathella, are measured to about 60 per cent, which covers all but the few extreme events that have occurred since the stations were installed in the 1960s.

There was improvement in the maximum measured flow range at three of the five gauging stations in this catchment.

Paroo flow gauging

The Paroo River has been well measured in the higher range at the gauging station at Caiwarro, with medium flow measurements taken in recent years to confirm the rating.

Bulloo flow gauging

The Bulloo River is well rated to medium stage at Autumnvale and into the higher stages at Quilpie because of the better access to the Quilpie site when flooding occurs. There have been medium flow gaugings in recent years to confirm the rating curve accuracy; however, there has been no opportunity to increase the maximum measured flow range at these sites in the last five years.

Nebine flow gauging

A new station was established on Nebine Creek in 2007 and there has been limited flow measuring opportunity since then. This new site will provide valuable future flow information for the previously ungauged Nebine Creek.

There was no improvement in the measured flow range in Wallum Creek, the other gauging station in the Nebine subcatchment.

15.6.2 Community views on implementation of this plan

Community views on the implementation of the plan have been canvassed through consultative meetings with water users and other stakeholder interests. Meetings were held in Charleville, Cunnamulla, Hungerford and Brisbane. Written submissions were also received. Interests included water users, their regional water user associations, local governments, other government agencies and peak bodies.

Key issues raised through this consultative process are summarised below.

General

Queensland interests expressed concern about how well managed and protected the water was that flowed cross the border into New South Wales. This comment applied to both the Warrego and Paroo catchments.

The water recovery programs developed by the Commonwealth Government for the Murray–Darling Basin impacts on the WRP and the ecological outcomes it aims to achieve. Therefore coordination is critical.

Allocation security

The WRP has provided secure water entitlements, which have generally been recognised as positive outcomes.

Trading

There was concern that water tradability did not extend to overland flow entitlements.

Some water users expressed the view that that the onerous requirements for reconfiguration of overland flow works did not encourage water users who wished to improve their water use efficiency.

It was suggested that NRW should provide the hydrologic modelling and assessment required under section 130 of the *Water Act 2000*. This was considered to be a timelier and more efficient way of meeting the requirements for trading water. It was also considered to be time-consuming and inefficient for consultants to build the capability of using the department's model. Trading between catchments should be allowed.

Complexity of the land and water management planning process

The land and water management plan requirements associated with water trading were perceived to be cumbersome and of little value to the landholder.

Inadequate monitoring networks

It was suggested that more gauging stations were required, to better assess streamflow across the catchments.

Metering is essential to provide real figures on water use and determine the water available for use.

Deficiencies with the current suite of performance indicators

It was suggested that the focus for improvement should be on updating the identified ecological assets (species, ecosystems, wetlands or habitats) within the catchment, and then implementing ongoing monitoring through the ROP to determine whether the WRP is achieving the desired ecological outcomes.

It was suggested that the following assessments be added to the five-year reporting requirements:

- how well the WRP is addressing water quality issues
- breaches of compliance and breaches of compliance prosecutions
- effectiveness of the evaluation and monitoring provisions
- effectiveness of the WRP in meeting the sustainable management objectives of the *Water Act 2000*
- whether obstruction by man-made banks and the take of overland flows waters are adversely affecting the environmental values of the Paroo and the Bulloo catchments.

Where the WRP is not adequately meeting its stated environmental objectives, the Council of Australian Governments water reform framework provisions should be established.

End-of-system flows

Environmental advocacy and downstream grazing interests indicated that the end-of-system flows should be increased.

Paroo

Paroo River landholders in Queensland requested a review of the 99 per cent end-of-system flow, suggesting that scope existed for some relaxation to provide for some increased access to water for productive purposes without materially impacting on non-consumptive values.

New South Wales landholder interests were keen to see a strengthening of the provisions protecting the Paroo River system from further development, and suggested that it should be nominated as a wild river because part of it is the last free-flowing river in the Murray–Darling Basin.

These same interests raised concerns that irrigation had been allowed under the overland flow provisions in the plan, and requested that there be a ban on all extensive irrigation in the Paroo catchment, including the decommissioning of all development works undertaken since 2001. They see this irrigation as potentially destroying livelihoods of floodplain graziers and threatening environmentally sensitive wetlands and floodplains. They also requested that authorisation of all existing works be deleted from the ROP and a full independent enquiry be held into the workings of NRW.

They suggested that the irrigation development that has been allowed in the Paroo catchment goes against the objectives of the Paroo River Agreement.

It was suggested that the Paroo River should be covered by a separate WRP in recognition of the special characteristics of this catchment.

Concerns were raised about there being no sunset clause (no planned repeal or termination of the rule)

for the notification of existing works that take overland flow. Because notification only requires an estimate of storage capacities there is no accountability on how much water is harvested off the floodplain.

Warrego

Concerns were raised about the rules in the ROP relating to throughflow requirements for stock and domestic water for the Allan Tannock Weir at Cunnamulla. Community representatives suggested that the rigid rules did not take account of whether any release was needed for downstream stock and domestic requirements. Greater flexibility in the storage and release of stock and domestic flows was needed.

There were also concerns about the remote operation of the outlet valve at Allan Tannock Weir and the risk of losing valuable water from the weir if the valve failed to close properly, leaving the weir to drain and resulting in loss of valuable stored water for all downstream users and the town. Syphoning over the top of the weir was considered a safer management option for the small amounts of water required immediately downstream.

There were concerns over the recent gifting of the 8000 megalitres of unallocated water to the Commonwealth. Community representatives were concerned that they were not consulted and that the gifting would not be taken into account when determining possible further reductions in water use across the basin.

15.6.3 The appropriateness of the performance indicators for achieving this plan's outcomes

Environmental flow objectives

Section 10 of the *Water Resource (Warrego, Paroo, Bulloo and Nebine) Plan 2003* defines the performance indicators for the environmental flow objectives as follows:

(a) end-of-system flow

(b) low flow

(c) summer flow

(d) beneficial flooding flow

(e) one in two year flood.

Section 11 of the WRP provides for an end-of -system flow objective of at least 89 per cent, for the Warrego, 99 per cent for the Paroo and 87 per cent for the Nebine catchment. The plan provides for the end-of-system flow objective (of at least 99 per cent) for the Bulloo catchment at the inflow into Lake Bulloo. Section 12 of the plan states that the impacts of decisions on the above performance indicators (b) to (e) be minimised at a number of nodes throughout the plan area.

The WPBN ROP has been in effect for two and a half years, and reporting indicates that there are insufficient results on which to evaluate the appropriateness of the WRP environmental performance indicators.

The Murray–Darling Basin Sustainable Yields Project, carried out by CSIRO, has provided governments with a review of previous hydrological assessments and estimates of the impact of climate change and other risks on an individual catchment basis. The project confirms that the end-of-system flows for the Warrego and the Paroo meet the respective 87 per cent and 99 per cent flow objectives for those rivers.

The CSIRO assessment for the Warrego (2007) predicts a best-estimate for the 2030 climate scenario of a reduction of 7 per cent in total end-of-system flows for the catchment.

For the Paroo and Nebine, CSIRO have indicated no change and a 12 per cent reduction respectively. The Bulloo catchment is not reported, as it is a terminal system and does not contribute flows to the Murray–Darling Basin.

The Murray–Darling Basin Strategic Plan, proposed to be developed by the Murray–Darling Basin Authority by 2011, will consider the impact of climate change and other risks and may lead to a review of environmental objectives, including end-of-system flow objectives.

A full review of the *Water Resource (Warrego, Paroo, Bulloo and Nebine) Plan 2003* is scheduled for 2013. The full review will be required to take account of the outcomes of the Murray–Darling Basin Strategic Plan.

Water allocation security objectives

Section 14 of the *Water Resource (Warrego, Paroo, Bulloo and Nebine) Plan 2003* sets out the performance indicators for the water allocation security objectives as the annual volume probability and the 45 per cent annual volume probability. These are defined in the plan, and decisions made must not decrease these performance indicators.

The main purpose of the water allocation security objectives is to ensure that water trading can occur without affecting the security of other entitlements.

Only one long-form trade has occurred in the Warrego WRP area, in the Warrego near Cunnamulla. There has been little experience so far to measure the effectiveness of the objectives. However, there are indications that the definitions for the performance indicators may need to be reviewed to simplify the assessment process while still retaining the original intent of the water allocation security objectives.

16. Conclusion: effectiveness of the plans in achieving WRP outcomes

Overview

The preparation of the WRP Annual Report not only presents information about the WRPs and their implementation, but defines, where possible, whether current WRPs are addressing their outcomes, through the implementation of ROP management strategies.

Operational management strategies to meet water allocation security objectives and environmental flow objectives were generally met among the reporting catchments, subject to available information.

In the Barron catchment, supplemented water use in the catchment was found to be meeting environmental flows to the Barron River below Tinaroo Falls Dam.

For the Burnett Basin, water allocation, water use and water trading data collated during the reporting period indicated that water resources are being allocated and managed in accordance with the WRP.

In the Boyne River, the trigger flow release found that there were operational limitations to the trigger flow release discharge rate, which is going to be dealt with in the 10-year review.

For the Georgina–Diamantina and Cooper Creek catchments, low levels of extraction continue to maintain natural flows consistent with the outcomes of both WRPs.

There is not enough information about the Border Rivers, Calliope River, Moonie River, Pioneer Valley and WPBN WRPs to effectively determine whether the WRPs are meeting their outcomes, due to the short length of time they have been implemented by a ROP. This time has been very short for the Border Rivers and Calliope River WRPs, with their consecutive ROPs being implemented for only the last few months of the reporting period.

Amendments to water resource plans

Amendments to WRPs across the state continue to occur to improve management of water resources in the respective catchments.

The amendment to the Burnett Basin WRP to include subartesian water of the Coastal Burnett groundwater management area will further address issues of groundwater quality and availability across the Burnett Basin WRP area and enhance the sustainable management of this resource.

The Barron WRP was amended in June 2008 after extensive consultation with water users in the investigated area through the Upper Barron Water Advisory Group. The amendment process was established to review provisions of the *Water Resource (Barron) Plan 2002* for streams and subartesian resources in the area above Lake Tinaroo and in Rocky, Spring and Cherry creek catchments. In addition to the revision of the unsupplemented surface and subartesian water resources of the Upper Barron, the draft amendment also proposes minor changes for the wider plan area, which are detailed in Chapter 5 of this report.

Metering

Continued water meter installations occurred across the reporting catchments over the reporting period. This will further enhance the level of detail of water use information in the WRPs, which will benefit assessments of the plans.

In the Barron WRP, completion of the metering program for unsupplemented water allocations and licences in the upper Barron River catchment area occurred, allowing water usage data to be measured more effectively in this area.

Water meter installation for unsupplemented water entitlements in the Burnett Basin was carried out in the Boyne and Stuart rivers. This is in line with the implementation schedule of the Burnett Basin WRP by metering the volume of water taken under authorisations for this part of the ROP.

Meters for non-stock and domestic take of GAB water have been installed in management areas to ensure that compliance with water licences is achieved, and records of GAB water taken are maintained.

In the Border Rivers, meter installation in the Granite Belt area commenced, which highlighted the need for metering to be urgently extended to area-based licences. This is so that water use information can be collected to provide a basis for future conversion of these licences to tradable water allocations.

Ecological assessment

The selection and prioritisation of ecological assets across many reporting catchments are paving the way to adequately assessing the delivery of water for ecological outcomes.

Ecological assets selected for quantitative assessment have been identified in the Barron, Boyne River Basin and Calliope WRPs. Further research on already selected assets occurred in the Border Rivers, Boyne, Burnett, Fitzroy and Pioneer WRPs. No further monitoring occurred in the Moonie or WPBN WRPs over the reporting period on selected assets.

Information from the monitoring of ecological assets

will further enhance the water resource planning process by identifying whether ecological outcomes are being met.

Five-year reviews

A five-year review was due for the Border Rivers, Moonie River and WPBN WRPs and has been included in this year's edition of the WRP Annual Report. A full summary of the review is included in the relevant chapter of the WRP.

Conclusion

The assessment of WRPs is evolving due to changes to the nature and quality of information gathered from the monitoring programs that contribute to these assessments. The current review and replacement of the Fitzroy WRP is identifying issues that can be mitigated for new plans and plans already in place.

By implementing continuous improvement to understanding whether plans are meeting their own outcomes, NRW can ensure that sustainable management of Queensland's water resources is achievable.

17. Feedback form—WRP annual report

The Department of Natural Resources and Water is keen to gather and evaluate any comments or suggestions from readers of this document. This is to ensure that this document can be improved to make it more effective as a tool for information, and that the needs of readers and users of this report are met.

If you have any comments or suggestions regarding the Minister's WRP Annual Report, please complete this form and mail to the Department of Natural Resources and Water, GPO Box 2454, Brisbane Qld 4001.

Are you happy for a departmental representative to contact you for more clarification of your feedback?

☐ Yes ☐ No

Surname (Mr/Mrs/Ms/Dr/Other)	
First name	
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Signature 2	Date

Interest group (if more than one, number relevant boxes in ascending order of where your primary interest lies)

Irrigator
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Grazier
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Community group
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Horticultural interests
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State government
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Environmental interest
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Tourism
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Question 1

Is this publication user-friendly? Please state why, or why not.

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Question 2

Is the information in this report relevant to you or your group?

☐ Yes ☐ No

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Question 3

Do you like the format of the report—that is, the way the information is presented?

☐ Yes ☐ No

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Do you have any other comments or suggestions?

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Thank you for taking the time to fill out this form and send it to NRW. Your participation is greatly appreciated.

18. Attachments

Attachment A—Ecological asset prioritisation tables

Attachment B—Maps

Map 1—Moonie and Border Rivers stream gauging stations

Map 2—WPBN stream gauging stations

Attachment A—Ecological asset prioritisation tables

Barron Water Resource Plan

Table 1—Barron River assets identified as having a critical link to flow

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Processes					
In-stream carbon cycling	N/A	Occurs throughout Barron WRP river system	Stable base flow required for development and growth of periphyton, benthic algae, plankton, macrophyte and macroinvertebrate communities during dry season	Good	Yes
Amphibians					
Litoria genimaculata	New Guinea tree frog	Occurs in the mid Barron and low altitude tributaries	Requires periods of steady baseflow for spawning, larval recruitment and metamorphosis	Moderate, some gaps in life history information	No
Litoria nannotis .	Waterfall frog	Occurs in the mid Barron and low altitude tributaries	Requires rapid perennial flow over rocky substrate for obligate dwelling habitat, spawning, larval recruitment and metamorphosis	Good but some gaps in life history information	Yes
Litoria rheocola	Common mistfrog	Occurs in the mid Barron and low altitude tributaries	Requires rapid flow through riffle habitats during breeding season	Good but some gaps in life history info	Yes
Litoria jungguy	Stony creek frog	Occurs in the mid Barron and low altitude tributaries	Requires periods of steady baseflow for spawning, larval recruitment and metamorphosis	Moderate, gaps in info due to recent species recognition	No
Nyctimystes dayi	Australian lacelid	Occurs in the mid Barron and low altitude tributaries	Requires rapid flow through riffle habitats during breeding season and perennial high flow for over-wintering tadpoles	Good but some gaps in life history info	Yes
Birds					
Alcedo azurea	Azure kingfisher	Upper, mid and lower Barron, Tinaroo dam, regulated tributaries of the mid Barron	Requires water levels that do not fluctuate artificially during breeding season Aug–Jan	Moderate	No
Aythya australis	Hardhead	Upper, mid and lower Barron, Tinaroo dam	Requires steady wetted width Apr–May, stable flow levels to maintain littoral plants	Moderate	No
Cygnus atratus	Black swan	Upper and mid Barron catchment, also in Tinaroo dam	Seasonal flooding acts as a breeding cue, maintenance of water levels needed through breeding season as nests are at the water line	Moderate	No
Podiceps cristatus	Great crested grebe	Lake Tinaroo, but may also be present throughout Barron catchment	Requires that water levels do not fluctuate artificially during breeding season, fluctuating levels known to diminish breeding success	Moderate	No
Threskiornis spinicollis	Straw necked ibis	Occurs throughout Barron River and larger tributaries.	Breeding is stimulated by high water levels (flooding), fluctuating levels cause adults to abandon nests/chicks	Moderate	No
Fish					
Amniataba percoides	Barred grunter	Widespread	Low flow spawning fish which requires longitudinal and lateral connectivity for access to habitat.	Low–moderate	No
Anguilla reinhardtii	Long-finned eel	Widespread, but rare upstream of and including Lake Tinaroo	Requires longitudinal connectivity for downstream spawning migrations during summer and autumn, and for upstream migrations of glass eels and elvers during spring and summer	Low	No
Awaous acritosus	Roman nosed goby	Confined to lower Barron and coastal tributaries.	Requires freshwater/marine connectivity for spawning migration, elevated summer flows and oxygenated riffle habitats	Moderate	No

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Hephaestus carbo	Coal grunter	Occurs in the upper reaches of Mitchell and Walsh rivers	Rising water level is spawning cue. Floodplain inundation as larval habitat	Moderate	No
Hephaestus fuliginosus	Sooty grunter	Occurs in the Mitchell and Barron rivers	Requires longitudinal connectivity for spawning migration, and riffle habitats for oxygenation of eggs. Flooding enhances recruitment	Low–moderate	No
Hypseleotris compressa	Empire gudgeon	Presumed to be naturally distributed in the lower Barron, may be translocated above Barron Falls	Spawning associated with increased temperature and elevated flows during summer/ autumn	Low	No
Kuhlia rupestris	Jungle perch	Naturally occurring in the lower Barron, translocated into the upper Barron	Rising flow and longitudinal connectivity required for downstream spawning migration and subsequent return upstream	Low	No
Lates calcarifer	Barramundi	Naturally occurring in the coastal freshwater and estuarine areas of the Barron	Floods required for migration, growth and recruitment Lateral connectivity required for upstream migrations of juvenile fish to freshwater habitats during migration period (Oct–Dec)	Moderate	No
Leiophtherapon unicolor	Spangled perch	Abundant in Barron catchment Mitchell catchment	Spawning induced by rising water levels. Lateral and longitudinal connectivity, floods are an important stimulus for movement	Moderate	No
Melanotaenia eachamensis	Lake Eacham rainbowfish	Present in the upper Barron and tributaries, formerly known to occur down to Barron Falls but current presence in this section is unconfirmed	Stable low flows provide habitat for spawning and successful larval recruitment	Moderate	No
Melanotaenia splendida splendida Melanotaenia splendida inornata	Eastern rainbowfish	*M. s. splendida* abundant in Barron catchment, *M. s. inornata* abundant in the Mitchell catchment	Stable low flows required for the breeding season for spawning and successful larval recruitment	Moderate–good	Yes
Mogurnda adspersa	Purple spotted gudgeon	Widespread/common	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Nov)	Moderate–good	Yes
Nematalosa erebi	Bony bream	Widespread/common	Longitudinal connectivity is required to allow migration for spawning	Low	No
Neosilurus ater	Black catfish/ Black tandan	Coastal areas of the Barron, upper reaches of Barron and Mitchell rivers	High flow events during the spawning period required for spawning migration and spawning	Moderate–good	No
Neosilurus hyrtlii	Hyrtl's tandan/ Hyrtl's catfish	Clohesy River and upper reaches of Barron and Mitchell rivers	Migrate and spawn on medium to high flows	Moderate	No
Oxyeleotris lineolata	Sleepy cod	Natural distribution in Walsh and Mitchell rivers	Stable low flows required with summer flushes to maintain habitat for spawning. Cover, refuge from flow and sufficient DO are major breeding requirements	Moderate	No
Schismatogobius sp.	Gobies/mud skippers	Coastal freshwater areas of the Barron River and Freshwater Creek	Persistent flow required to maintain riffle habitat for growth and spawning. Connectivity with marine environment to allow downstream migration of larvae	Moderate	No
Mammals					
Ornithorynchus anatinus	Platypus	Common	Require stable low flows during breeding season	Moderate	No

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Macrophytes					
Aponogeton bullosus	Laceplant	Upper Barron between Pinks Bridge and Picnic Crossing	Perennial clear flow with additional high flow events to stimulate reproduction	Good–moderate	No
Aponogeton elongatus	Laceplant	Possible limited distribution in the upper Barron	Permanent flows to prevent drying. High flows stimulate growth and reproduction	Moderate	No
Aponogeton lancesmithii	Laceplant	Possible limited distribution in the Barron	High flows stimulate growth and reproduction	Low	No
Aponogeton proliferus	Laceplant	Possible limited distribution in the Barron	Perennial inundation. High flows stimulate growth and reproduction	Moderate	No
Aponogeton queenslandicus	Laceplant	Possible limited distribution in the Barron	Requires inundation of temporary pools, and a drying period is mandatory to prevent tuber rot in the Barron region	Low	No
Aponogeton vanbruggenii	Laceplant	Mid Barron area: 6 km north of Mareeba	Requires seasonal high flows stimulate growth and reproduction	Low	No
Blyxa sp.	No common name	Upper Barron near Yungaburra, Davies Creek, Flaggy and Freshwater creeks	Requires inundation from Sep–Apr for germination through to seed set	Good	No
Cladopus queenslandicus	No common name	Upper Barron River between Pinks Bridge and Picnic Crossing	Requires perennial rapids or riffles as habitat	Low	No
Ottelia alismoides	No common name	Mapee/Rocky Creek, Barney Springs and Barron main channel near Biboorha	Permanent flows required for persistence, intolerant of drying periods	Moderate	No
Triglochin dubium	Water ribbons	Flaggy Creek; Freedom County (6.5 km south-west of Kuranda); Cattle Creek	Rising water level: annual flooding increases flowering and seed production exponentially. Static or slowly changing water levels enhance germination and seedling recruitment	Good	No
Vallisneria nana	Ribbonweed	Barron River between Mareeba and Kuranda, Flaggy Creek, and Freshwater Creek	Permanent flows required for persistence, intolerant of drying periods.	Moderate–good	No

Table 2—Details of ecological monitoring and assessment for the Barron WRP

Ecological outcomes[1]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs
General ecological outcomes (under section 12 of the WRP)		
a. Maintain habitats of native plants and animals in watercourses lakes and springs	• Stable flow spawning fish • In-stream carbon cycling • Hylid frogs	• Monitoring by NRW is occurring to identify key flow requirements for successful recruitment during dry season • Determine linkages between flow disturbance and in stream carbon cycling, including primary production, respiration and periphyton, during the dry season • Monitor key flow requirements for successful larval recruitment
b. Maintain riparian systems and their functions influencing the riverine ecosystems	• No assets representative	
c. Maintain and favour native plants and animals associated with water courses and lakes and springs and riparian zones	• Stable flow spawning fish • In-stream carbon cycling • Hylid frogs	• NRW is monitoring to identify key flow requirements for successful recruitment during dry season • Determine linkages between flow disturbance and in-stream carbon cycling, including primary production, respiration and periphyton, during the dry season. • Monitor key flow requirements for successful larval recruitment
d. Provide wet season flow to benefit native plants and animals in estuaries		
e. Maintain long term water quality suitable for riverine and estuarine ecosystems	• In-stream carbon cycling	• Intensive monitoring of stream metabolism which includes a range of water quality parameters
f. Maintain existing geomorphic features and processes		
g. Maintain the capability of one part of the river system to be connected to another through the flow of water i. Throughout watercourse network ii. Within the riparian zone, floodplain and water courses, lakes and springs		
h. Maintain ecosystem food chains, their balance and the movement of carbon energy	• In-stream carbon cycling	• Determine linkages between flow disturbance and in stream carbon cycling, including primary production, respiration and periphyton, during the dry season
i. Subartesian water is to be managed to maintain contributions to the flow of water in watercourses, lakes and springs and to ground water dependent ecosystems		
Barron River catchment (under section 14 of the WRP)		
To provide a flow regime to:		
a. Maintain delivery of freshwater, sediment, nutrients and organic matter to the river's estuary		
b. Maintain the brackish water habitat in the estuary		
Flaggy Creek (under section 15 of the WRP)		
Protect species of significant conservation value associated with creek		

[1] Listed under actual location in the WRP

Table 1—Border Rivers assets identified as having a critical link to flow

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring?
Cygnus altratus	Black swan	Reported from the Border Rivers WRP area	Seasonal flooding acts as breeding cue	Moderate	No
Ephippiorhynchus asiaticus	Black-necked stork	Reported from the Border Rivers WRP area	Breeding in wetlands but unknown links	Poor	No
Anas castanea	Chestnut teal	Reported from the Border Rivers WRP area	Successful breeding related to wetlands remaining full for 3 to 6 months	Poor	No
Stictonetta naevosa	Freckled duck	Reported from the Border Rivers WRP area	Successful breeding related to wetland filling and maintaining water for 4 months	Moderate	No
Ardea alba	Great egret	Reported from the Border Rivers WRP area	Inundation of wetland required for successful breeding	Moderate	No
Anas gracilis	Grey teal	Reported from the Border Rivers WRP area	Maintenance of water in breeding wetlands is required until fledging (recruitment)	Low	No
Phalacrocorax sulcirostris	Little black cormorant	Reported from the Border Rivers WRP area	Successful breeding related to wetland inundation	Moderate	No
Chenonetta jubata	Maned duck/ Australian Wood Duck	Reported from the Border Rivers WRP area	Stable low flows during the spawning season required for egg and larval development	Low–Moderate	No
Anas superciliosa	Pacific black duck	Reported from the Border Rivers WRP area	Requires permanent water or wetland inundation	Poor	No
Pelecanus conspicillatus	Australian pelican	Reported from the Border Rivers WRP area	Flooding acts as breeding stimuli	Poor	No
Threskiornis molucca	Australian white ibis	Reported from the Border Rivers WRP area	Seasonal flooding acts as breeding stimuli	Low	No
Oxyura australis	Blue-billed duck	Reported from the Border Rivers WRP area	Flooding drives movement and later breeding	Poor	No
Grus rubicundus	Brolga	Reported from the Border Rivers WRP area	Flooding is required as breeding stimuli	Moderate	No
Plegadis falcinellus	Glossy ibis	Reported from the Border Rivers WRP area	Flooding is required as breeding stimuli	Poor	No
Ardea intermedia	Intermediate egret	Reported from the Border Rivers WRP area	Breeding is usually dictated by flooding	Moderate	No
Phalacrocorax melanoluecos	Little pied cormorant	Reported from the Border Rivers WRP area	Flooding induces breeding	Moderate	No
Rostratula benghalensis	Painted snipe	Reported from the Border Rivers WRP area	Breeding in wetlands but unknown links	Moderate	No
Malacorhynchus membranaceus	Pink-eared duck	Reported from the Border Rivers WRP area	Breeds in residual flood waters or flood plains. Flooding acts as breeding stimuli	Moderate	No
Platalea regia	Royal spoonbill	Reported from the Border Rivers WRP area	Breeding is influenced by flooding	Moderate	No
Nycticorax caledonicus	Rufous night Heron	Reported from the Border Rivers WRP area	Breeding is usually dictated by flooding	Moderate	No
Threskiornis spinicollis	Straw-necked ibis	Reported from the Border Rivers WRP area	Breeding is stimulated by high water levels (flooding), fluctuating levels cause adults to abandon nests/chicks	Moderate	No
Chlidonias hybrida	Whiskered tern	Reported from the Border Rivers WRP area	Breeding depends on rainfall and flooding	Poor	No
Biziura lobata	Musk duck	Reported from the Border Rivers WRP area	Season, rain and rising water act as breeding cues	Poor	No
Macquaria ambigua	Golden perch	Reported from the Border Rivers WRP area	Any major rise in river level induces spawning	Good	Yes*
Maccullochella peelii peelii	Murray cod	Reported from the Border Rivers WRP area	Onset of upstream migration coincides with elevated water levels	Poor	No
Bidyanus bidyanus	Silver perch	Reported from the Border Rivers WRP area	Assumed to require flooding to initiate spawning	Poor	No

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring?
Leiopotherapon unicolour	Spangled perch	Reported from the Border Rivers WRP area	Flooding important stimuli for movement	Moderate	No
Hypseleotris spp.	Carp gudgeon	Reported from the Border Rivers WRP area	Peak spawning coincides with low and stable flows	Low	No
Melanotaenia fluviatilis	Rainbowfish	Reported from the Border Rivers WRP area	Stable low flows required for the breeding season for spawning and successful larval recruitment	Moderate–good	No
Galaxias olidus	Mountain galaxias	Reported from the Border Rivers WRP area	Adults of mountain galaxias move upstream into shallow riffle areas for spawning	Moderate	No
Gadopsis marmoratus	River blackfish	Reported from the Border Rivers WRP area	River blackfish requires slow flowing waters for spawning	Good	No
Mogurnda adspersa	Purple spotted gudgeon	Reported from the Border Rivers WRP area	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Nov)	Moderate–good	No
Litoria wilcoxii	Stony Creek frog	Reported from the Border Rivers WRP area	Requires periods of stable flows through riffle zones for spawning	Moderate	No
Eucalyptus largiflorens	Black box	Reported from the Border Rivers WRP area	Flooding is important for maintenance and recruitment	Moderate	No
Eucalyptus coolabah	Coolibah	Reported from the Border Rivers WRP area	Flooding is essential for maintenance	Moderate	No
Muehlenbeckia florulenta	Lignum	Reported from the Border Rivers WRP area	Inundation is essential for maintenance	Moderate	No
Eucalyptus camaldulensis	River red gum	Reported from the Border Rivers WRP area	Inundation is critical for maintenance and recruitment of seedlings	Moderate	Yes*
	Waterholes as refugia	Present in Border Rivers WRP area	Important refugia during dry times	Good	Yes*
	Sundown National Park	Located within Stanthorpe shire boundary of the Border Rivers	Flows from the Severn River through the park provide important habitat for range of flora and fauna	Moderate	No
	Inundation of floodplain and benches	Occurs in Border Rivers WRP area on the floodplain and benches within river channel.	Inundation facilitates transport of sediments and nutrients	Moderate	No

* Asset prioritisation resulted in golden perch and waterholes as refugia obtaining high priority (rank 1), painted snipe ranked second and River red gum third. River red gum is present in almost all assessment zones of Border Rivers thus were prioritised over painted snipe which is present in one zone only.

Table 2—Details of ecological monitoring and assessment for the Border Rivers Water Resource Plan

Border Rivers Ecological outcomes[2]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Outcomes, including ecological outcomes, for the plan area (under Section 9 of the WRP)			
Water is to be allocated and managed in a way that seeks to achieve a balance in the following outcomes – f. to achieve ecological outcomes consistent with maintaining a healthy riverine environment, floodplain and wetlands, including, for example:			
i. maintaining pool habitats, and native plants and animals associated with the habitats, in watercourses	Waterholes as refugia	Waterhole persistence and depth is being monitored at six locations in Weir River (Border Rivers), as they provide a refuge for aquatic species during periods of low and no flow	A joint project between NRW Science and southwest region is underway in Weir River
	Golden perch	Monitoring golden perch spawning and recruitment and flow conditions in the Border Rivers is commencing in October 2008	The project is commencing in October 2008 with four sites being sampled in Border Rivers
ii. maintaining natural riverine habitats that sustain native plants and animals	Waterholes as refugia	Waterhole persistence and depth is being monitored at six locations in Weir River (Border Rivers), as they provide a refuge for aquatic species during periods of low and no flow	A joint project between NRW Science and southwest region is underway in Weir River
iii. maintaining the natural abundance and species richness of native plants and animals associated with habitats within watercourses; riparian zones, floodplains and wetlands	Waterholes as refugia	Waterhole persistence and depth is being monitored at six locations in Weir River (Border Rivers), as they provide a refuge for aquatic species during periods of low and no flow	A joint project between NRW Science and southwest region is underway in Weir River
	Golden perch	Monitoring golden perch spawning and recruitment and flow conditions in the Border Rivers is commencing in October 2008	The project is commencing in October 2008 with four sites being sampled in Border Rivers
iv. maintaining active river forming processes, including sediment transport	Waterholes as refugia	Waterhole persistence and depth is being monitored at six locations in Weir River (Border Rivers), as they provide a refuge for aquatic species during periods of low and no flow	A joint project between NRW Science and southwest region is underway in Weir River
v. improving wetland inundation to provide for ecological processes	Waterholes as refugia	Waterhole persistence and depth is being monitored at six locations in Weir River (Border Rivers), as they provide a refuge for aquatic species during periods of low and no flow	A joint project between NRW Science and southwest region is underway in Weir River

[2] Listed under actual location in the WRP

Boyne Water Resource Plan

Table 1—Boyne Water Resource Plan assets identified as having a critical link to flow

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for Monitoring?
Mugil cephalus	Striped mullet/sea Mullet	Common	Flows required for spawning migration(downstream) and re-colonisation/dispersal (upstream)	Moderate	Yes
Lates calcarifer	Barramundi	Common	Floods required for migration, growth and recruitment Lateral connectivity required for upstream migrations of juvenile fish to freshwater habitats during migration period (Oct–Dec)	Moderate	Yes
Litoria wilcoxii	Stony Creek frog	Limited	Requires periods of stable flows through riffle zones for spawning	Moderate	Yes
Hydropsychidae larvae	Caddisfly	Common	Require flowing riffle zones for settlement and recruitment	Poor	No
Elmidae	Riffle beetle	Common	Require flowing riffle zones for persistence	Poor	No
Simuliidae larvae	Blackfly	Common	Require flowing riffle zones for feeding	Poor	No
Chara globularis/ Chara fibrosa	Stonewort	Common	Require low flows for germination	Poor	No
Ornithorhynchus anatinus	Platypus	Limited	Requires stable low flows during the breeding season to prevent burrow flooding	Moderate	No
Cygnus atratus	Black swan	Common	Seasonal flooding acts as a breeding cue	Moderate	No
	Waterholes as refugia*	Common	Flows for persistence and connectivity	Good	Yes
	Estuaries*	River mouth	Freshwater flows for habitat quality	Good	No

* Places such as waterholes and estuaries implicitly provide the habitat for many species. It is the critical links for the individual species that will be investigated in the future risk assessment as information becomes available.

Table 2—Details of ecological monitoring and assessment for the Boyne Water Resource Plan

Ecological Outcomes[3]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Ecological outcomes (under section 7 of the WRP)			
Under s. 7 of the WRP, ecological outcomes for plan area river flows are to be managed: a. to maintain existing habitats that sustain native plants and animals: i. associated with watercourses, waterholes and riparian zones upstream of Awoonga Dam full supply level; or ii. dependant on pool and associated riparian habitat in the freshwater reach downstream of Awoonga Dam b. to provide water for fine sediment removal and long term water quality suitable for: i. riverine ecosystems upstream of Awoonga Dam full supply level ii. ecosystems downstream of Awoonga Dam c. to allow movement by estuarine and marine fish over or around the weir at Boyne River adopted middle thread distance (AMTD) 17.2 km d. to provide water to stimulate reproductive processes for estuarine animals downstream of Awoonga Dam e. to provide water for delivery of catchment based nutrients from upstream of Awoonga Dam to the riverine and estuarine reaches downstream of the dam f. to allow river forming flows upstream of Awoonga Dam full supply level and in the riverine and estuarine reaches downstream of the dam g. to allow for an increase in the frequency and duration of marine conditions in the estuarine reach downstream of Awoonga Dam leading to a shift towards plant and animal species that favour or tolerate the increase	• Striped mullet • Barramundi • Stony Creek frog • Waterholes	• Connectivity between estuarine and freshwater reaches of the Boyne River downstream of Awoonga Dam will be monitored at Manns Weir. Connectivity at Manns Weir provides opportunities for reproductive requirements of many aquatic species • Connectivity between estuarine and freshwater reaches of the Boyne River downstream of Awoonga Dam will be monitored at Manns Weir. Connectivity at Manns Weir provides opportunities for reproductive requirements of many aquatic species • Frog populations in the upper Boyne River will be monitored at important riffle zones • Important waterholes in the upper catchment will be monitored with depth/temperature loggers to determine risk from water regulation and rates of connectivity through the dry season and important breeding periods for important species such as the Stony Creek frog	Ongoing Ongoing Proposed 2009 Ongoing

[3] Listed under actual location in the WRP

Table 1—List of ecological assets prioritised for further assessment

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Neoceratodus forsteri	Qld lungfish	Limited	Stable low flows required for spawning and recruitment	Moderate	Yes
Aponogeton elongatus	Laceplant	Rare—Barambah Creek between Silverleaf Weir and Ficks Crossing	Permanent flows to prevent drying. High flows stimulate growth and reproduction	Moderate	Yes
Aponogeton queenslandicus	Qld laceplant	Rare—Barambah Creek between Silverleaf Weir and Ficks Crossing	Permanent flows required to avoid drying of laceplant in the Burnett River	Moderate	Yes. Data will be collected on this species as part of the Laceplant program
	Waterholes as refugia	Common	Flows for persistence and connectivity	Good	Yes
Estuaries		River mouth	Freshwater flows for habitat quality	Good	Yes
Mugil cephalus	Striped mullet/sea mullet	Common	Flows required for spawning migration(downstream) and re-colonisation/dispersal (upstream)	Moderate	Prioritised for monitoring in the Boyne, Moreton, Gold Coast and Logan WRP areas
Lates calcarifer	Barramundi	Common	• Floods required for migration, growth and recruitment • Lateral connectivity required for upstream migrations of juvenile fish to freshwater habitats during migration period (Oct–Dec)	Moderate	No. Prioritised for monitoring in the Boyne WRP area
Retropinna semoni	Australian smelt	Common	Migrate on flows for spawning (downstream) and re-colonisation/ dispersal (upstream)	Good	Will be addressed in the Boyne and Calliope WRP areas
Potamogeton tricarinatus	Floating pondweed	Common	Flood-dependent germination	Moderate	No
Hydropsychidae larvae	Caddisfly	Common	Require flowing riffle zones for settlement and recruitment	Poor	No
Vallisneria nana	Ribbonweed	Common	Permanent flows required for persistence, intolerant of drying periods.	Moderate–good	Data will be collected on this species as part of the Qld lungfish program in the Burnett and Mary WRP areas. Also prioritised for monitoring in the Gold Coast WRP area
Elmidae	Riffle beetle	Common	Require flowing riffle zones for persistence	Poor	No
Simuliidae larvae	Blackfly	Common	Require flowing riffle zones for feeding	Poor	No
Elseya albagula	Southern snapping turtle	Limited	Require stable low flows for nesting and recruitment success	Poor	Data will be collected on this species in the Mary WRP area
Chara globularis/ Chara fibrosa	Stonewort	Common	Require low flows for germination	Poor	No
Macquaria ambigua	Golden perch	Limited	Migrate and spawn on high flows	Good	Data will be collected on this species in the Fitzroy, Moonie and WPBN WRP areas
Macquaria novemaculeata	Bass	Limited	Spawn on medium to high flows and juveniles migrate upstream on flows	Good	Data will be collected on this species in the Moreton, Gold Coast and Logan WRP areas
Litoria wilcoxii	Stony Creek frog	Common	Requires periods of stable flows through riffle zones for spawning	Moderate	Data will be collected on this species in the Boyne WRP area

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Malacorhynchus membranaceus	Pink-eared duck	Common	Breeds in residual flood waters or flood plains. Flooding acts as breeding stimuli	Moderate	No
Marsilea drummondii	Common nardoo	Common	Requires medium to high flows for germination	Moderate	No
Myriophyllum verrucosum	Red water milfoil	Common	Germinates soon after flood recession. Falling water levels trigger flowering	Low	No
Ottelia alismoides	Duck lettuce	Common	Permanent flows for persistence—intolerant of drying periods	Moderate	No
Myxus petardi	Freshwater mullet	Limited	Migrate on flows for spawning and re-colonisation/dispersal	Moderate	Data will be collected on this species in the Boyne, Mary, Gold Coast, Logan and Moreton WRP areas
Triglochin striatum	Arrowgrass	Common	Flood-dependent reproduction	Poor	No
Neosilurus hyrtlii	Hyrtl's tandan/ Hyrtl's catfish	Limited	Migrate and spawn on medium to high flows	Moderate	Data will be collected on this species in the Fitzroy WRP area
Potamogeton crispus	Curly pondweed	Common	Permanent flow for persistence	Moderate	No
Pseudoraphis spinescens	Mud grass	Common	Frequent flooding for survival and flowering	Moderate	No

Table 2—Links between ecological outcomes and ecological assets in the Burnett Basin

Ecological outcomes[4]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
General outcomes (under s. 6(e) (i) of the WRP) Water is to be managed and allocated to provide for community aspirations about: • maintaining areas of significant conservation • value, including, for example, the Auburn National Park and fish habitat areas	• Estuaries	Changes in mangrove area and community composition are analysed over large temporal scales to determine if changes can be attributed to flow regulation. Comparisons are made between estuaries that are both impacted and not impacted by flow regulation	Complete early 2009
General outcomes (under s. 6(e) (ii) of the WRP) • protecting species of significant conservation value, including, for example, lungfish and turtles	• Qld lungfish • Laceplant	Qld lungfish spawning events monitored in 12 sites in the Burnett catchment together with flow patterns, macrophyte densities and water quality Limited macrophyte beds on Barambah Creek will be monitored over time and related to the hydrograph	Ongoing Commence 2009
Ecological outcomes for plan area (under s. 7 of the WRP) Water is to be managed and allocated: a. to maintain pool habitats, and native plants and animals associated with the habitats, in watercourses b. to maintain long term water quality suitable for riverine and estuarine ecosystems c. to provide flow regimes that favour native plants and animals associated with watercourses and riparian zones d. to reduce saltwater intrusion in: i. the Gooburrum area groundwater system near Moore Park ii. the Woongarra area groundwater system near Elliott Heads e. to provide wet season flow to benefit native plants and animals, including, for example, fish and prawns, in estuaries f. to improve stream flow conditions	• Qld lungfish • Waterholes • Estuaries	Qld lungfish spawning events monitored in 12 sites in the Burnett catchment together with flow patterns, macrophyte densities and water quality Important waterholes across the catchment will be monitored with depth/temperature loggers to determine risk from flow regulation and impacts on refuge functions Changes in mangrove area and community composition are analysed over large temporal scales to determine if changes can be attributed to flow regulation. Comparisons are made between estuaries that are both impacted and not impacted by flow regulation	Ongoing Ongoing Complete early 2009
Auburn River catchment (under s. 8 of the WRP) Water in the Auburn River catchment is to be managed and allocated: a. to maintain existing riverine habitats upstream of AMTD 6 km that sustain native plants and animals b. to maintain near natural river forming processes upstream of AMTD 6 km	• Waterholes	Important waterholes across the catchment will be monitored with depth/temperature loggers to determine risk from flow regulation and impacts on refuge functions	Ongoing
Barambah Creek and Stuart River catchments (under s. 9 of the WRP) Water in the Barambah Creek and Stuart River catchments is to be managed and allocated to maintain and improve existing riverine habitats, that sustain native plants and animals, in the catchments	• Qld lungfish • Laceplant	Qld lungfish spawning events monitored in 12 sites in the Burnett catchment together with flow patterns, macrophyte densities and water quality Limited macrophyte beds on Barambah Creek will be monitored over time and related to the hydrograph	Ongoing Commence 2009
Boyne River catchment (under s. 10 of the WRP) Water in the Boyne River catchment is to be managed and allocated: a. to maintain existing riverine habitats upstream of AMTD 5.0 km that sustain native plants and animals b. to maintain and improve existing river forming processes upstream of AMTD 5.0 km	• Waterholes	Important waterholes across the catchment will be monitored with depth/temperature loggers to determine risk from flow regulation and impacts on refuge functions	Ongoing

[4] Listed under actual location in the WRP

Ecological outcomes[4]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Burnett River Basin and Burnett River (under s. 11(1) of the WRP) Water in the Burnett River basin is to be managed and allocated to, if practicable, minimise the frequency and duration of marine conditions in the estuary of the Burnett River **Burnett River Basin and Burnett River (under s. 11(2) of the WRP)** Water in the Burnett River is to be managed and allocated to provide for lungfish habitat in the river particularly lungfish habitat downstream of Gayndah at AMTD 200 km.	• Qld lungfish • Estuaries	Qld lungfish spawning events monitored in 12 sites in the Burnett catchment together with flow patterns, macrophyte densities and water quality Changes in mangrove area and community composition are analysed over large temporal scales to determine if changes can be attributed to flow regulation. Comparisons are made between estuaries that are both impacted and not impacted by flow regulation	Ongoing Complete early 2009
Elliott, Gregory and Isis River basins (under s. 12 of the WRP, as per numbering below) Water in the Elliott, Gregory and Isis river basins is to be managed and allocated: a. to maintain existing riverine habitats, that sustain native plants and animals, in the basins b. to maintain existing estuarine habitats, particularly in fish habitat areas, that: i. sustain native plants and animals ii. are dependant on estuarine processes c. to maintain near natural river forming processes in the basins	• Waterholes • Estuaries	Important waterholes across the catchment will be monitored with depth/temperature loggers to determine risk from flow regulation and impacts on refuge functions Changes in mangrove area and community composition are analysed over large temporal scales to determine if changes can be attributed to flow regulation. Comparisons are made between estuaries that are both impacted and not impacted by flow regulation	Ongoing Complete early 2009
Kolan River Basin (under s. 13 of the WRP, as per numbering below) Water in the Kolan River basin is to be managed and allocated: a. to maintain and improve existing riverine habitats, that sustain native plants and animals, in the basin b. to maintain and improve existing estuarine habitats, particularly in fish habitat areas that: i. sustain native plants and animals; and ii. are dependant on estuarine processes; and c. to maintain and improve river forming processes in the basin.	• Waterholes • Estuaries	Important waterholes across the catchment will be monitored with depth/temperature loggers to determine risk from flow regulation and impacts on refuge functions Changes in mangrove area and community composition are analysed over large temporal scales to determine if changes can be attributed to flow regulation. Comparisons are made between estuaries that are both impacted and not impacted by flow regulation	Ongoing Complete early 2009

[4] Listed under actual location in the WRP

Table 1—Calliope Water Resource Plan assets identified as having a critical link to flow

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Ambassis agassizii	Olive perchlet	Common	Requires stable low flows for spawning	Low	No
Lates calcarifer	Barramundi	Common	1. Floods required for migration, growth and recruitment 2. Lateral connectivity required for upstream migrations of juvenile fish to freshwater habitats during migration period (Oct–Dec)	Moderate	Yes
Mugil cephalus	Striped mullet/sea mullet	Common	Flows required for spawning migration (downstream) and re-colonisation/ dispersal (upstream)	Moderate	Yes. Will also be monitored in the Gold Coast, Logan and Moreton WRP areas
Megalops cyprinoides	Indo-Pacific tarpon	Common	Requires longitudinal connectivity during the spawning season (summer wet season) for downstream migrations, and also connectivity for upstream juvenile dispersal after metamorphosis (during periods of low flow in the late wet season or early dry season)	Low	Yes
Anguilla reinhardtii	Long-finned eel	Common	Requires longitudinal connectivity for downstream spawning migrations during summer and autumn, and for upstream migrations of glass eels and elvers during spring and summer	Low	Yes
Hypseleotris compressa	Empire gudgeon	Common	Spawning associated with increased temperature and elevated flows during summer and autumn	Low	No
Melanotaenia splendida splendida	Rainbow fish	Common	Stable low flows are required during the breeding season	Moderate	No
Glossamia aprion	Mouth almighty	Common	Longitudinal connectivity and stable low flows are required during the spawning season	Low	No
Lutjanus argentimaculatus	Mangrove jack	Common	Requires freshwater flows to the estuary to trigger juvenile recruitment	Low	No
Terapon jarbua	Crescent perch	Common	Requires longitudinal connectivity during the breeding season for adult downstream spawning migrations	Low	Yes
Thryssa hamiltoni	Hamiltons anchovy	Common	Amphidromous. Requires longitudinal connectivity between the sea and freshwater	Low	Yes
Strongylura kreffti	Freshwater longtom	Common	Requires longitudinal and lateral connectivity for movement and dispersal. Requires high flows for inundation of floodplains lagoons	Low	No
Arius graeffei	Blue catfish	Common	Longitudinal connectivity for upstream migrations, mostly during the warmer months	Low	No
Neosilurus hyrtlii	Hyrtls tandan/Hyrtls catfish	Common	Migrate and spawn on medium to high flows	Moderate	No. Prioritised for monitoring in the Moonie and WPBN WRP areas
Tandanus tandanus	Eel-tailed catfish/ freshwater catfish	Common	Stable low flows facilitate nest construction, spawning and larval development during spring/early summer	Moderate	No. Prioritised for monitoring in the Logan, Moreton, Pioneer and Fitzroy WRP areas

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Pseudomugil signifer	Pacific blue-eye	Common	Stable low flows during the spawning season required for egg and larval development	Moderate	No
Notesthes robusta	Bullrout	Common	Requires longitudinal connectivity during the spawning season (between winter and spring) for adult downstream spawning migrations	Moderate	No
Hephaestus fuliginosus	Sooty grunter	Translocated	Requires longitudinal connectivity for spawning migration, and riffle habitats for oxygenation of eggs. Flooding enhances recruitment	Low–moderate	No
Amniataba percoides	Barred grunter	Common	Low flow spawning fish which requires longitudinal and lateral connectivity for access to habitat	Low–moderate	No
Liza subviridus	Greenback mullet	Common	Requires longitudinal connectivity during the breeding season (June–Nov) for adult downstream spawning migrations	Moderate	Yes
Gobiomorphus australis	Striped gudgeon	Common	Requires longitudinal connectivity to the estuary during the spawning season (late summer to autumn) to wash newly-hatched, free-swimming larvae to the estuary. Connectivity also required during spring for upstream juvenile dispersal	Moderate	No
Eleutheronema tetradactylum	Giant threadfin	Common	Amphidromous, adults ascend the rivers during winter, thus requiring connectivity	Low	Yes
Litoria wilcoxii	Stony Creek frog	Limited	Requires periods of stable flows through riffle zones for spawning	Moderate	No, but will be monitored in the Boyne WRP area
Anas gracilis	Grey teal	Common	Maintenance of water in breeding wetlands is required until fledging (recruitment)	Low	No
Anas superciliosa	Pacific black duck	Common	Requires inundation of wetlands for 3 to 6 months minimum during the wet season to successfully breed and recruit	Low	No
Cygnus atratus	Black swan	Common	Seasonal flooding acts as a breeding cue	Low	No
Ardea alba	Great egret	Common	Inundation of wetland required for successful breeding	Moderate	No
Grus rubicunda	Brolga	Common	Flooding is required as a breeding stimuli	Low	No
Pelecanus conspicillatus	Australian pelican	Common	Flooding is a breeding stimuli	Low	No
Phalacrocorax sulcirostris	Little black cormorant	Common	Breeding is stimulated by seasonal flooding and wetland inundation	Moderate	No
Threskiornis molucca	White ibis	Common	Seasonal flooding acts as breeding stimuli	Low	No
Egretta garzetta	Little egret	Common	Breeding is stimulated by seasonal flooding	Low	No
Tachybaptus novaehollandiae	Australasian grebe	Common	Total dependence on wetlands Stable water levels during the breeding season need to be maintained for nesting purposes	Low	No
Chenonetta jubata	Maned duck/ Australian wood duck	Common	Stable low flows during the spawning season required for egg and larval development	Low-moderate	No
Ludwigia perennis	Primrose	Common	Requires flooding for germination	Low	No
Ludwigia octovalvis	Willow primrose	Common	Requires flooding for germination	Low	No
Ludwigia peploides	Primrose	Common	Requires flooding for germination	Low	No
Ceratophyllum demersum	Hornwort	Common	Requires stationary or slow-moving water for fertilisation	Moderate	No

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Myriophyllum verrucosum	Red Watermilfoil	Common	Germinates after flood recession. Falling water levels trigger flowering	Low	No
Ottelia alismoides	Duck lettuce	Common	Permanent flows for persistence-intolerant of drying periods	Moderate	No
Potamogeton crispus	Curly pondweed	Common	Permanent flow for persistence	Moderate	No
Potamogeton tricarinatus	Floating pondweed	Common	Flood dependent germination	Low	No
Utricularia gibba	Yellow bladderwort	Common	Falling water levels to trigger flowering response	Low	No
Vallisneria gigantea	Ribbonweed	Common	Stable low flows for persistence	Good	No, but will be monitored in the Gold Coast WRP area and data will be collected on this species during lungfish egg sampling in the Burnett and Mary WRP areas
	Waterholes as refugia (biological function)*		Flows for persistence and connectivity	Good	Yes
	Estuarine and near shore ecosystem complexes (including wetlands in the directory of important wetlands) (place)*		Requires maintenance of freshwater flows to the estuary	Good	No. Prioritised for monitoring in the Burnett WRP area
	Riffle zones (biological function)		Requires maintenance of freshwater flows to the estuary	Good	No

* Places such as waterholes and estuaries implicitly provide the habitat for many species. It is the critical links for the individual species that will be investigated in the future risk assessment as information becomes available.

Table 2—Details of ecological monitoring and assessment for the Calliope Water Resource Plan

Ecological Outcomes	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Ecological outcomes (under s. 9 of the WRP)			
a. to support natural ecosystems by minimising changes to natural flow regimes b. to maintain adequate water flows to protect the health of riparian vegetation and aquatic ecosystems in the plan area c. to maintain adequate freshwater outflows to The Narrows and the natural wetlands in the plan area	• Waterholes as refugia • Diadromous fish guild	• Waterhole drawdown rates and connectivity opportunities will be monitored through the installation of a depth/temperature data logger in the first fresh waterhole upstream of the estuary • Geomorphic changes in key waterholes will be monitored by means of conducting bathymetric surveys every four years • Biological surveys of key waterholes will be undertaken to confirm the assumption that the waterholes are functioning as refugia during dry periods • Hydraulic habitat requirements of diadromous fish species will be confirmed through a dedicated monitoring program involving real time event based monitoring of fish movement at the freshwater/saltwater interface	• Proposed (expect to commence monitoring 2008)
		• Genetic monitoring of mullet populations in the Calliope and comparisons to Baffle and the lower Boyne	• Proposed (expect to commence monitoring 2008)

Table 1—Fitzroy Water Resource Plan assets identified as having a critical link to flow

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Ambassis agassizii	Olive perchlet	Widespread	Requires stable low flows for spawning	Low	No
Amniataba percoides	Barred grunter	Widespread	Low flow spawning fish which requires longitudinal and lateral connectivity for access to habitat	Low–moderate	No
Anguilla obscura and reinhardtii	Pacific short- finned eel and long-finned eel	Widespread	Upstream & downstream migration on flows	Good	No
Bidyanus bidyanus	Silver perch	Widespread	Migrate and spawn on high flows	Very good	No—translocated species
Eucalyptus camaldulensis	River red gum	Widespread, but low abundances	Floods promote growth and benefit seedling establishment	Very good	No
Eucalyptus coolabah	Coolabah	Widespread	Floods promote growth and benefit seedling establishment	Low	No
Hephaestus fuliginosus	Sooty grunter	Widespread	Requires longitudinal connectivity for spawning migration, and riffle habitats for oxygenation of eggs. Flooding enhances recruitment	Low–moderate	No—translocated species
Lates calcarifer	Barramundi	Mid to lower Fitzroy basin	1. Floods required for migration, growth and recruitment 2. Lateral connectivity required for upstream migrations of juvenile fish to freshwater habitats during migration period (Oct–Dec)	Moderate	No—monitoring already conducted by Department of Primary Industries and Fisheries (DPI&F) and InfoFish
Macquaria ambigua oriens	Golden perch	Widespread	Migrate and spawn on high flows	Very good	Yes—since 2003
Melanotaenia splendida splendida	Eastern rainbowfish	Widespread	Low flow spawning fish	Good	No
Mogurnda adspersa	Purplespotted gudgeon	Widespread	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Nov)	Moderate–good	No
Mugil cephalus	Striped mullet/sea mullet	Lower Fitzroy	Flows required for spawning migration(downstream) and re-colonisation/dispersal (upstream)	Moderate	No
Neosilurus ater	Black catfish/black tandan	Limited	High flow events during the spawning period required for spawning migration and spawning.	Moderate–good	Yes—since 2003
Neosilurus hyrtlii	Hyrtls tandan/Hyrtl's catfish	Widespread	Migrate and spawn on medium to high flows	Moderate	Yes—since 2003
Notesthes robusta	Bullrout	Limited to lower Fitzroy	Migrate on low winter flows	Low	No
Penaeus merguiensis	Banana prawns	Estuary	Growth and recruitment favoured by high flows	Very good	No—monitoring already conducted by DPI&F
Polydactylus macrochir	King threadfin salmon	Estuary	Floods promote growth and recruitment	Very good	No- monitoring already conducted by DPI&F and InfoFish

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
	Riffles as habitat	Widespread apart from lower Fitzroy	Flows for persistence, productivity and river connectivity	Good	No—monitoring undertaken as a part of River Health monitoring programs (Stream and Estuary Assessment Program (SEAP) and Ambient Biological Monitoring and Assessment Program (ABMAP))
Scortum hillii	Leathery grunter	Widespread	Migrate and spawn on high flows	High	Yes—since 2003
Tandanus tandanus	Eel tail catfish / freshwater catfish	Widespread	Stable low flows facilitate nest construction, spawning and larval development during spring/early summer	Moderate	No—monitoring occurring in the Pioneer Basin
	Waterholes as refugia	Widespread	Flows for persistence and connectivity	Good	Yes—bathymetric surveys and water level monitoring
	Wetlands/lagoons—Fitzroy River Delta (QLD012)	Estuary	Flood flows for waterbird nesting sites and connectivity for fish migration	Low	No
	Wetlands/lagoons—Lower Fitzroy River Floodplain (QLD013)	Lower Fitzroy	Flood flows for waterbird nesting sites and connectivity for fish migration	Low	No
	Wetlands/lagoons—Lower Callide/Don River (Lake Pleasant, Lake Victoria, Tee Holes)	Lower Callide/ Don River	Flood flows for waterbird nesting sites and connectivity for fish migration	Low	No
	Wetlands/lagoons—lower/mid Dawson (Bears Lagoon)	Mid Dawson	Flood flows for waterbird nesting sites and connectivity for fish migration	Low	No
	Wetlands/lagoons—Lower Mackenzie (10 Mile and Lake Mary floodplains)	Lower Mackenzie	Flood flows for waterbird nesting sites and connectivity for fish migration	Low	No

Table 2—Details of ecological monitoring and assessment for the Fitzroy WRP

Ecological outcomes[5]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Outcomes (under s. 9 of the WRP)			
a Water in the plan area must be managed in an integrated and sustainable way that seeks to achieve a balance in providing for environmental water requirements for natural ecosystems in the plan area.	• All assets	NRW • Golden Perch, Leathery Grunter, Hyrtlls tandan—monitoring has involved identifying spawning requirements of these species, specifically the flow and water temperature requirements	• Monitoring has been occurring since 2003 to present
		• Waterhole persistence and depth is being monitored across the landscape, as waterholes provide a refuge for aquatic species in times of low flow	• Monitoring has been occurring since 2005 to present
		DPI&F • Barramundi, banana prawns and threadfin salmon project entitled 'Environmental flows for sub-tropical estuaries' investigated the effects of flow on recruitment and growth.	• Completed. The research project occurred from July 2000–June 2006

[5] Listed under actual location in the WRP

Table 1—Moonie Water Resource Plan assets identified as having a critical link to flow

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring
Cygnus altratus	Black swan	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Seasonal flooding acts as breeding cue	Moderate	No
Ephippiorhynchus asiaticus	Black-necked stork	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Breeding in wetlands but unknown links	Poor	No
Anas castanea	Chestnut teal	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Successful breeding related to wetlands remaining full for 3 to 6 months	Poor	No
Stictonetta naevosa	Freckled duck	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Successful breeding related to wetland filling and maintaining water for 4 months	Moderate	No
Ardea alba	Great egret	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Inundation of wetland required for successful breeding	Moderate	No
Anas gracilis	Grey teal	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Maintenance of water in breeding wetlands is required until fledging (recruitment)	Low	No
Phalacrocorax sulcirostris	Little black cormorant	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Successful breeding related to wetland inundation	Moderate	No
Chenonetta jubata	Maned duck/ Australian wood duck	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Stable low flows during the spawning season required for egg and larval development	Low–Moderate	No
Anas superciliosa	Pacific black duck	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Requires permanent water or wetland inundation	Poor	No
Pelecanus conspicillatus	Australian pelican	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Flooding acts as breeding stimuli	Poor	No
Threskiornis molucca	Australian white ibis	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Seasonal flooding acts as breeding stimuli	Low	No
Oxyura australis	Blue-billed duck	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Flooding drives movement and later breeding	Poor	No
Grus rubicundus	Brolga	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Flooding is required as breeding stimuli	Moderate	No
Plegadis falcinellus	Glossy ibis	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Flooding is required as breeding stimuli	Poor	No
Ardea intermedia	Intermediate egret	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Breeding is usually dictated by flooding	Moderate	No
Phalacrocorax melanoluecos	Little Pied Cormorant	Reported from the Moonie WRP area but breeding likely to occur in Thallon wetland	Flooding induces breeding	Moderate	No
Biziura lobata	Musk duck	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Rising water can trigger breeding	Poor	No
Rostratula benghalensis	Painted snipe	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Breeding in wetlands but unknown links	Moderate	No
Malacorhynchus membranaceus	Pink-eared duck	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Breeds in residual flood waters or flood plains. Flooding acts as breeding stimuli	Moderate	No
Platalea regia	Royal spoonbill	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Breeding is influenced by flooding	Moderate	No

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring
Nycticorax caledonicus	Rufous night heron	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Breeding is usually dictated by flooding	Moderate	No
Threskiornis spinicollis	Straw-necked ibis	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Breeding is stimulated by high water levels (flooding), fluctuating levels cause adults to abandon nests/chicks	Moderate	No
Chlidonias hybrida	Whiskered tern	Reported from the Moonie WRP area and breeding likely to occur in wetlands	Breeding depends on rainfall and flooding	Poor	No
Macquaria ambigua	Golden perch	Reported from the Moonie WRP area	Any major rise in river level induces spawning	Good	Yes*
Neosilurus hyrtlii	Hyrtls tandan/Hyrtls catfish	Reported from the Moonie WRP area	Migrate and spawn on medium to high flows	Moderate	No
Maccullochella peelii peelii	Murray cod	Reported from the Moonie WRP area	Onset of upstream migration coincides with elevated water levels	Poor	No
Bidyanus bidyanus	Silver perch	Reported from the Moonie WRP area	Assumed to require flooding to initiate spawning	Poor	No
Leiopotherapon unicolour	Spangled perch	Reported from the Moonie WRP area	Flooding important stimuli for movement	Moderate	No
Hypseleotris spp.	Carp gudgeon	Reported from the Moonie WRP area	Peak spawning coincides with low and stable flows	Low	No
Mogurnda adspersa	Purple spotted gudgeon	Reported from the Moonie WRP area	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Nov)	Moderate–good	No
Melanotaenia fluviatilis	Rainbowfish	Reported from the Moonie WRP area	Likely to spawn during low flows	Low	No
Eucalyptus largiflorens	Black box	Reported from the Moonie WRP area	Flooding is important for maintenance and recruitment	Moderate	No
Eucalyptus coolabah	Coolibah	Reported from the Moonie WRP area	Flooding is essential for maintenance	Moderate	No
Muehlenbeckia florulenta	Lignum	Reported from the Moonie WRP area	Inundation is essential for maintenance	Moderate	No
Eucalyptus camaldulensis	River red gum	Reported from the Moonie WRP area	Inundation is critical for maintenance and recruitment of seedlings	Moderate	Yes*
	Waterholes as refugia	Present in Moonie WRP area	Important refugia during dry times	Good	Yes*
	Thallon wetland	Present in Moonie WRP area	Magnitude, frequency and duration of inundation is important	Low	No
	Inundation of floodplain and benches	Occurs in Moonie WRP area as floodplain and benches within river channel	Inundation facilitates transport of sediments and nutrients	Moderate	No

* Asset prioritisation resulted in golden perch, waterholes as refugia and river red gum as the three top priority assets. Golden perch and permanent waterholes have priority one while as river red gum has priority two.

Table 2—Details of ecological monitoring and assessment for the Moonie Water Resource Plan

Moonie ecological outcomes[6]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Outcomes, including ecological outcomes for the plan area (under s. 9 of the WRP)			
Water is to be allocated and managed in a way that seeks to achieve a balance in the following outcomes – e. to achieve ecological outcomes consistent with maintaining a healthy riverine environment, floodplain and wetlands, including, for example, maintaining:			
i. pool habitats, and native plants and animals associated with the habitats, in watercourses	Waterholes as refugia	Waterhole persistence and depth was monitored at 15 locations in Moonie River during 2006–07. Waterholes provide a refuge for aquatic species during periods of low and no flow. Biological sampling was also undertaken to confirm which species are using these waterholes	A joint project between NRW Science and southwest region was completed in 2007 in the Moonie River
ii. natural riverine habitats that sustain native plants and animals	Waterholes as refugia	Waterhole persistence and depth was monitored at 15 locations in Moonie River during 2006–07, as they provide a refuge for aquatic species during periods of low and no flow. Biological sampling was also undertaken to confirm which species are using these waterholes	A joint project between NRW Science and southwest region was completed in 2007 in the Moonie River
iii. the natural abundance and species richness of native plants and animals associated with habitats within watercourses; riparian zones, floodplains and wetlands	Waterholes as refugia	Waterhole persistence and depth was monitored at 15 locations in Moonie River during 2006–07, as they provide a refuge for aquatic species during periods of low and no flow. Biological sampling was also undertaken to confirm which species are using these waterholes	A joint project between NRW Science and southwest region was completed in 2007 in the Moonie River
iv. active river forming processes, including sediment transport	Waterholes as refugia	Waterhole persistence and depth was monitored at 15 locations in Moonie River during 2006–07, as they provide a refuge for aquatic species during periods of low and no flow. Biological sampling was also undertaken to confirm which species are using these waterholes	A joint project between NRW Science and southwest region was completed in 2007 in the Moonie River

[6] Listed under actual location in the WRP

Table 1—Pioneer Water Resource Plan assets identified as having a critical link to flow

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Lates calcarifer	Barramundi	Lower Pioneer	• Floods required for migration, growth and recruitment • Lateral connectivity required for upstream migrations of juvenile fish to freshwater habitats during migration period (Oct-Dec)	Moderate	Yes—begin 2009 (Diadromous[7] fish project)
Mugil cephalus	Striped mullet/sea mullet	Lower Pioneer	Flows required for spawning migration(downstream) and re-colonisation/dispersal (upstream)	Moderate	Yes—begin 2009 (Diadromous fish project)
Tandanus tandanus	Eel tail catfish/ freshwater catfish	Found throughout	Stable low flows facilitate nest construction, spawning and larval development during spring/early summer	Moderate	Yes—first monitoring round began in September 2008
Litoria wilcoxii (lesueuri sensu lat)	Stony Creek frog	Found mainly in higher altitudes	Requires periods of stable flows through riffle zones for spawning	Moderate	No
Notesthes robusta	Bullrout	Patchy distribution lower Pioneer	Requires baseflows during winter as migrates during this period	Low	Yes—begin 2009 (Diadromous fish project)
Neosilurus ater	Black tandan/black catfish	Found throughout	High flow events during the spawning period required for spawning migration and spawning	Moderate–good	No
Neosilurus hyrtlii	Hyrtls tandan/ Hyrtls catfish	Found throughout	Migrate and spawn on medium to high flows	Moderate	No
Kuhlia rupestris	Jungle perch	Uncertain distribution; probably lower section	Downstream migrations triggered by flow events during Oct–Dec	Low	Yes—begin in 2009 (Diadromous fish project)
Melanotaenia splendida splendida	Eastern rainbowfish	Found throughout	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment (Sep–Dec)	Moderate	No
	Macrophyte communities (excl. weir pools)	Found throughout	Provide habitat required for spawning of small bodied fish during Sep–Oct	Low–moderate	Yes—begin 2009
Pseudomugil signifer	Pacific blue-eye	Found throughout	Stable low flows during the spawning season required for egg and larval development	Moderate	No
Mogurnda adspersa	Purple spotted gudgeon	Found throughout	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Nov)	Moderate–good	No
Ambassis agrammus and agassizii	Sailfin perchlet	Found throughout	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Dec)	Low–moderate	No
Craterocephalus stercusmuscarum	Fly-specked hardyhead	Found throughout	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment (Sep–Oct)	Low–moderate	No
Hypseleotris sp.	Gudgeon	Found throughout	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment (Sep–Oct)	Low–moderate	No
	In-stream rheophytic shrubfield/ herbfields	Between Mirani, Marian and Dumbleton weirs	Flood flows maintain populations	Low	Yes—begin 2009

[7] Diadromous are fish that regularly migrate between freshwater and seawater.

Asset—scientific name	Asset—common name/ description	Current distribution in WRP area	Summary of critical link to flow	Information level	Prioritised for monitoring?
Hephaestus fuliginosus	Sooty grunter	Found throughout	Requires longitudinal connectivity for spawning migration, and riffle habitats for oxygenation of eggs. Flooding enhances recruitment	Low–moderate	No—translocated species
	Dumbleton Rocks Waterhole	Lower Pioneer	Flows for persistence and connectivity	Low	Yes—bathymetric surveys and water level monitoring
Penaeus sp.	Prawn	Estuary	Long-term population integrity favoured by high flows	Moderate	No
Scylla serrata	Mud crab	Estuary	Long-term population integrity favoured by high flows	Moderate	No
Vallisneria nana	Ribbonweed	Found throughout	Permanent flows required for persistence, intolerant of drying periods.	Moderate–good	Yes—begin 2009
Aponogeton elongates	Qld lace plant	Uncertain distribution	Permanent flows to prevent drying. High flows stimulate growth and reproduction.	Moderate	Yes—begin 2009
Anguilla reinhardtii and obsecura	Long-finned and short-finned eel	Found throughout	Requires longitudinal connectivity for downstream spawning migrations during summer and autumn, and for upstream migrations of glass eels and elvers during spring and summer	Low	Yes—begin 2009 (Diadromous fish project)
	Riffles as habitat	Widespread apart from lower Pioneer	Flows for persistence, productivity and river connectivity	Good	Yes—bathymetric surveys and water level monitoring. Macroinvertebrate monitoring also undertaken as a part of departmental river health monitoring programs (SEAP & ABMAP)
Amniataba percoides	Banded grunter	Found throughout	Unnatural reduction and increases in flow velocities are likely to reduce the population sizes	Low	No

Table 2—Details of ecological monitoring and assessment for the Pioneer Valley Water Resource Plan

Ecological outcomes[8]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
General ecological outcomes (under s. 10 of the WRP) Water is to be allocated and managed in a way that seeks to achieve a balance in the following outcomes while recognising the natural state of watercourses, lakes and springs has changed because of water infrastructure, flow supplementation and the taking of water: a. to maintain habitats of native plants and animals in watercourses, lakes and springs b. to maintain riparian systems and their functions influencing the riverine ecosystems c. to maintain and favour native plants and animals associated with watercourses, lakes and springs and riparian zones d. to provide wet season flow to benefit native plants and animals in estuaries e. to maintain long term water quality suitable for riverine and estuarine ecosystems f. to maintain existing geomorphic features and processes g. to maintain the capability of one part of the river system to be connected to another through the flow of water: i throughout the watercourse network ii within the riparian zone, floodplain and watercourses, lakes and springs h. to maintain ecosystem food chains, their balance and the movement of carbon energy **Estuaries (under s. 12 of the WRP)** a. Water is to be allocated and managed to provide a flow regime: i to maintain delivery of freshwater, sediment, nutrients and organic matter to the estuaries of watercourses ii to maintain the brackish water habitat in the estuaries b. Water is to be allocated and managed to protect and improve the ecology of the Pioneer River estuary by reducing the frequency and duration of periods of no flow to the estuary **Blacks Creek and Pioneer River (under s. 13 of the WRP, as per numbering below)** 1. This section applies to water in: a. Blacks Creek downstream of Teemburra Creek b. the Pioneer River upstream of Mirani Weir 2. The water is to be allocated and managed to minimise adverse impacts on environmental conditions and geomorphic processes in Blacks Creek and the river while recognising the likelihood of changes to the conditions and processes resulting from the existence and operation of Teemburra Dam	• Tandanus tandanus (Eel-tailed catfish/ freshwater catfish)	• Intensive monitoring program investigating the flow and habitat requirements during the species spawning and larval recruitment period	• Began in September 2008
	• In-stream rheophytic shrubfield/ herbfields	• Annual monitoring of community characteristics, including recruitment and age class structure	• Scheduled to commence in late 2009
	• Macrophyte communities, including V.nana and A.elongatus	• Monitoring program investigating the flow and habitat requirements of macrophyte communities throughout the basin	• Scheduled to commence in 2009
	• Dumbleton Rocks Waterhole	• Bathymetric surveys of Dumbleton Rocks Waterhole • Installation of water quality sensors to identify changes in quality over time	• Scheduled to commence in late 2009
	• Diadromous fish including barramundi, sea mullet, bullrout, jungle perch and eels	• Assessment of the effectiveness of the flow rules associated with Dumbleton Rocks Weir Fishway	• Scheduled to commence in 2010
	• Riffles as habitat	• Bathymetric surveying of riffles within the valley	• Scheduled to commence in 2010

[8] Listed under actual location in the WRP

Ecological outcomes[8]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Subcatchment areas 2, 3 and 4 (under s. 14 of the WRP) Water in subcatchment area 2, 3 or 4 is to be allocated and managed to maintain areas and species of significant conservation value in the creeks in the subcatchment areas Subcatchment area 12 (under s. 15 of the WRP) Water in subcatchment area 12 is to be allocated and managed to reduce saltwater intrusion in the coastal section of the Pioneer Valley groundwater system associated with the area **Palm Tree Creek (under s. 16 of the WRP)** Water in Palm Tree Creek downstream of the diversion pipeline outlet from Teemburra Dam is to be allocated and managed to minimise adverse impacts on environmental conditions and geomorphic processes in the creek while recognising the likelihood of: a. erosion of the creek's bed and banks, and loss of riparian vegetation, because of flow supplementation; and b. changes to the creek's in stream and riparian habitats resulting from a more perennial flow regime. **Silver Creek (under s. 17 of the WRP)** Water in Silver Creek downstream of the outlet for the diversion channel for water from Cattle Creek is to be allocated and managed to minimise adverse impacts on environmental conditions and geomorphic processes in Silver Creek while recognising the likelihood of changes to the creek's in stream and riparian habitats resulting from a more perennial flow regime **Teemburra Creek (under s. 18 of the WRP)** Water in Teemburra Creek downstream of Teemburra Dam is to be allocated and managed to minimise adverse impacts on environmental conditions and geomorphic processes in the creek while recognising the likelihood of the following resulting from the existence and operation of the dam: a. reduction of sediment, and changed geomorphic processes, in the creek b. spread of riparian vegetation into the creek c. increased opportunity for weed growth in the creek's riparian zones d. depletion of flood-spawning species, including, for example, spangled perch and neosilurid catfishes			

[8] Listed under actual location in the WRP

Warrego, Paroo, Bulloo and Nebine Water Resource Plan

Table 1—WPBN Water Resource Plan assets identified as having a critical link to flow

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring
Cygnus altratus	Black swan	Warrego, Paroo, Bulloo, Nebine	Seasonal flooding acts as breeding cue	Moderate	No
Ephippiorhynchus asiaticus	Black-necked stork	Warrego, Paroo, Bulloo, Nebine	Breeding in wetlands but unknown links	Poor	No
Anas castanea	Chestnut teal	Warrego, Paroo, Bulloo, Nebine	Successful breeding related to wetlands remaining full for three to six months	Poor	No
Stictonetta naevosa	Freckled duck	Warrego, Paroo, Bulloo, Nebine	Successful breeding related to wetland filling and maintaining water for four months	Moderate	No
Biziura lobata	Musk duck	Bulloo	Season, rain and rising water act as breeding cues	Poor	No
Ardea alba	Great egret	Warrego, Paroo, Bulloo, Nebine	Inundation of wetland required for successful breeding	Moderate	No
Anas gracilis	Grey teal	Warrego, Paroo, Bulloo, Nebine	Maintenance of water in breeding wetlands is required until fledging (recruitment)	Low	No
Phalacrocorax sulcirostris	Little black cormorant	Warrego, Paroo, Bulloo, Nebine	Successful breeding related to wetland inundation	Moderate	No
Chenonetta jubata	Maned duck/ Australian wood duck	Warrego, Paroo, Bulloo, Nebine	Breeding is stimulated by seasonal flooding of wetland habitat	Low–moderate	No
Anas superciliosa	Pacific black duck	Warrego, Paroo, Bulloo, Nebine	Requires permanent water or wetland inundation	Poor	No
Pelecanus conspicillatus	Australian pelican	Warrego, Paroo, Bulloo, Nebine	Flooding acts as breeding stimuli	Poor	No
Threskiornis molucca	Australian white ibis	Warrego, Paroo, Bulloo, Nebine	Seasonal flooding acts as breeding stimuli	Low	No
Oxyura australis	Blue-billed duck	Warrego, Paroo, Bulloo, Nebine	Flooding drives movement and later breeding	Poor	No
Grus rubicundus	Brolga	Warrego, Paroo, Bulloo, Nebine	Flooding is required as breeding stimuli	Moderate	No
Plegadis falcinellus	Glossy ibis	Warrego, Paroo, Bulloo, Nebine	Flooding is required as breeding stimuli	Poor	No
Ardea intermedia	Intermediate egret	Warrego, Nebine	Breeding is usually dictated by flooding	Moderate	No
Phalacrocorax melanoluecos	Little pied cormorant	Warrego, Paroo, Bulloo, Nebine	Flooding induces breeding	Moderate	No
Rostratula benghalensis	Painted snipe	Warrego, Paroo, Bulloo, Nebine	Breeding in wetlands but unknown links	Moderate	No
Malacorhynchus membranaceus	Pink-eared duck	Warrego, Paroo, Bulloo, Nebine	Breeds in residual flood waters or flood plains Flooding acts as breeding stimuli	Moderate	No
Platalea regia	Royal spoonbill	Warrego, Paroo, Bulloo, Nebine	Breeding is influenced by flooding	Moderate	No
Nycticorax caledonicus	Rufous night heron	Warrego, Paroo, Bulloo, Nebine	Breeding is usually dictated by flooding	Moderate	No
Threskiornis spinicollis	Straw-necked ibis	Warrego, Paroo, Bulloo, Nebine	Breeding is stimulated by high water levels (flooding), fluctuating levels cause adults to abandon nests/ chicks	Moderate	No
Chlidonias hybrida	Whiskered tern	Warrego, Paroo, Bulloo, Nebine	Breeding depends on rainfall and flooding	Poor	No
Macquaria ambigua	Golden perch	Warrego, Paroo, Nebine	Any major rise in river level induces spawning	Good	Yes*

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring
Macquaria sp.	Bulloo yellowbelly	Bulloo	Any major rise in river level induces spawning	Moderate	No
Neosilurus hyrtlii	Hyrtls tandan/ Hyrtls catfish	Warrego, Paroo, Bulloo, Nebine	Migrate and spawn on medium to high flows	Moderate	No
Porochilus argenteus	Silver tandan	Bulloo	Possibly flood cued spawner.	Poor	No
Bidyanus welchi	Welchs grunter	Bulloo	Possibly flood cued spawner	Poor	No
Mogurnda sp.	Bulloo mogurnda	Bulloo	Possibly low flow spawner	Poor	No
Scortum barcoo	Barcoo grunter	Bulloo	Possibly flood cued spawner	Poor	No
Maccullochella peelii peelii	Murray cod	Warrego, Paroo, Nebine	Onset of upstream migration coincides with elevated water levels	Poor	No
Bidyanus bidyanus	Silver perch	Warrego, Paroo, Nebine	Assumed to require flooding to initiate spawning	Poor	No
Leiopotherapon unicolour	Spangled perch	Warrego, Paroo, Bulloo, Nebine	Flooding important stimuli for movement	Moderate	No
Hypseleotris spp.	Carp gudgeon	Warrego, Paroo, Bulloo, Nebine	Peak spawning coincides with low and stable flows	Low	No
Melanotaenia fluviatilis	Rainbowfish	Warrego, Paroo, Bulloo, Nebine	Likely to spawn during low flows	Low	No
Mogurnda adspersa	Purple spotted gudgeon	Nebine	Vulnerable to fluctuations in water levels that may impact on reproduction and recruitment by exposing fish eggs (Sep–Nov)	Moderate–good	
Eucalyptus largiflorens	Black box	Warrego, Paroo, Bulloo, Nebine	Flooding is important for maintenance and recruitment	Moderate	No
Eucalyptus coolabah	Coolibah	Warrego, Paroo, Bulloo, Nebine	Flooding is essential for maintenance	Moderate	No
Muehlenbeckia florulenta	Lignum	Warrego, Paroo, Bulloo, Nebine	Inundation is essential for maintenance	Moderate	
Eucalyptus camaldulensis	River red gum	Warrego, Paroo, Bulloo, Nebine	Inundation is critical for maintenance and recruitment of seedlings	Moderate	Yes*
Ludwigia sp	Ludwigia	Bulloo	Seed germination occurs under water and on wet soil but requires light	Low	No
	Waterholes as refugia	Warrego, Paroo, Bulloo, Nebine	Important refugia during dry times	Good	Yes*
	Lake Dartmouth	Warrego	Magnitude, frequency and duration of inundation is important	Poor	No
	Wyandra–Cunnamulla claypans aggregation	Warrego	Magnitude, frequency and duration of inundation is important	Poor	No
	Murrawondah Lakes	Warrego	Magnitude, frequency and duration of inundation is important	Poor	No
	Warrego River Distributary system	Warrego	Persistence and connectivity	Poor	No
	Lake Numalla	Paroo	Timing, magnitude, frequency and duration of inundation is important	Poor	No
	Lake Wyara	Paroo	Timing, magnitude, frequency and duration of inundation is important	Poor	No
	Lake Wombah–Kungie Lake group	Paroo	Timing, magnitude, frequency and duration of inundation is important	Poor	No
	Bulloo Lake	Bulloo	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of the Lake	Poor	No

Asset—scientific name	Asset—common name	Current distribution in WRP area	Critical link to flow	Information level	Prioritised for monitoring
	Lake Bindegolly and Toomaroo	Bulloo	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of the Lake	Poor	No
	Quilpie (Bullo River floodplain) waterholes	Bulloo	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of the Lake	Poor	No
	Lake Bullawarra	Bulloo	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of the Lake	Poor	No
	Mitchell Swamp	Bulloo	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of the Lake	Poor	No
	Nooyeah Downs Swamps Aggregation	Bulloo	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of the Lake	Poor	No
	Myola–Mulga Downs salt lake and claypans	Nebine	Timing, magnitude, frequency and duration of inundation is important to ensure persistence of this lake	Poor	No
	Inundation of floodplain and benches	Warrego, Paroo, Bulloo, Nebine	Inundation facilitates transport of sediments and nutrients	Moderate	No

Table 2—Details of ecological monitoring and assessment for the WRP

Ecological outcomes[9]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
Outcomes, including ecological outcomes for the plan area (under s. 9 of the WRP, as per numbering below)			
For Warrego, Paroo, Bulloo and Nebine WRP— f. to achieve ecological outcomes consistent with maintaining a healthy riverine environment, floodplains and wetlands, including, for example, maintaining:			
i pool habitats, and native plants and animals associated with the habitats, in watercourses	• Waterholes as refugia • Golden perch • River red gum	Assessment plan and project proposal to be developed for these assets in Warrego WRP area. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP	To be developed for Warrego WRP. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP
ii natural riverine habitats that sustain native plants and animals	• Waterholes as refugia	Assessment plan and project proposal to be developed for this asset in Warrego WRP area. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP	To be developed for Warrego WRP. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP
iii the natural abundance and species richness of native plants and animals associated with habitats within watercourses; riparian zones, floodplains and wetlands	• Waterholes as refugia • Golden perch • River red gum	Assessment plan and project proposal to be developed for these assets in Warrego WRP area. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP	To be developed for Warrego WRP. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP

[9] Listed under actual location in the WRP

Ecological outcomes[9]	Ecological assets representative of ecological outcomes	Detail of monitoring or assessment programs	Status of monitoring
iv active river forming processes, including sediment transport	Waterholes as refugia	Assessment plan and project proposal to be developed for this asset in Warrego WRP area. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP	To be developed for Warrego WRP. For three other catchments no monitoring is planned as the critically linked assets are at low risk under the current WRP
v the success of bird-breeding in the Currawinya Lakes system, the Paroo Overflow Lakes, the Bulloo Lakes and other significant wetland systems in the Paroo and Bulloo basins		For Paroo and Bulloo no monitoring is planned as the critically linked assets are at low risk under the current WRP	
vi the unique genetic diversity of aquatic plants and animals within the Bulloo basin		For Bulloo WRP area no monitoring is planned as the critically linked assets are at low risk under the current WRP	
vii the near pristine condition of riverine habitats and associated native plants and animals within the Paroo and Bulloo basins		For Paroo and Bulloo no monitoring is planned as the critically linked assets are at low risk under the current WRP	

[9] Listed under actual location in the WRP