Environmental flow response and socio-economic monitoring
Macquarie Valley - progress report 2009
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The NSW Office of Water is a separate office within the Department of Environment, Climate Change and Water. The Office manages the policy and regulatory frameworks for the State’s surface water and groundwater resources to provide a secure and sustainable water supply for all users. The Office also supports water utilities in the provision of water and sewerage services throughout New South Wales.

Environmental flow response and socio-economic monitoring.
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introduction

WHAT IS THE PURPOSE OF THIS REPORT?
This report provides an update on the monitoring and evaluation needs undertaken to assess the ecological and socio-economic performance of the water sharing plans adopted in the Macquarie Valley. It summarises activities undertaken in the 2008–09 water year and provides an interim assessment of outcomes from the investigations. It also identifies priority needs for future monitoring and evaluation activities in the Macquarie Valley.

WHY DO WE NEED TO MONITOR PLANS?
Water sharing plans provide water to meet environmental and socio-economic needs, and certainty to water users on the rules governing access to water. The Macquarie Valley contains a number of important environmental assets and supports a valuable irrigation industry. Important environmental assets include the Macquarie Marshes, a major breeding ground for wetland birds (Figure 1 page 5), and important riverine habitat for fish and other aquatic animals. It is important to know whether the water sharing plans are meeting their environmental objectives, so that their effectiveness can be reviewed at the end of their 10-year period of operation. This information will be used to make informed decisions on how the plans might be changed to improve their performance when they are renewed after the current 10-year plans end. To achieve this, ecological monitoring and evaluation activities undertaken by the NSW Office of Water focus on specific clauses and performance indicators within the plans.

WHAT WATER SHARING PLANS ARE CURRENTLY IN PLACE?
Three water sharing plans in the Macquarie Valley are currently gazetted (Figure 2 page 6):

- Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2004
- Water Sharing Plan for the Castlereagh River above Binnaway Water Source 2004 (Unregulated River)

More details of these plans can be found on the NSW Office of Water’s website www.water.nsw.gov.au
FIGURE 1
Waterbird activity resulting from the 2009-10 environmental flow event in Will ancorah Swamp, Macquarie Marshes
FIGURE 2
Location of the current water sharing plans in the Macquarie Valley.
WHAT HAS INFLUENCED THE WATER SHARING PLANS’ OPERATIONS IN 2008-09?

Regulated rivers—water availability

Owing to the lack of sufficient rain and inflows, annual allocations for general security access licences for the Macquarie and Cudgegong Regulated Rivers Water Source were 0 per cent at the start of the 2008–09 water year and only 10 per cent in March 2009. Figures 4 to 7 shows the available water determinations for general security access licences for the Macquarie River since 1980 and 1999, and the Cudgegong River since 1985 and 1999.

FIGURE 3
Monitoring sites for the Macquarie and Cudgegong Regulated Rivers Water Source, all in the Macquarie Marshes.
FIGURE 4
Available water determinations for the Macquarie River 1980–2008 (indicative only).

FIGURE 5
Available water determinations for the Macquarie River 1999–2008 (indicative only).
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The Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source was suspended in July 2007 as a result of the current drought.

Unregulated rivers and groundwater—water availability

Annual allocations to all categories of access licences for the Castlereagh River above Binnaway Water Source were 100 per cent, although given the low flows in most streams in the Castlereagh River above Binnaway Water Source this may not have been extractable. The allocation for Supplementary Water Access Licences in the groundwater sources of Zones 1, 3 and 4 was 0.7ML/share for the 2008/09 year. All other categories of groundwater licences were at 1ML/share or 100%.
WHAT ENVIRONMENTAL ISSUES ARE ADDRESSED BY THE WATER SHARING PLANS?

Regulated rivers water sharing plan
The Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source aims to reserve all flows above the extraction limit for the environment; provide more natural flows in the upper reaches of the Cudgegong River by releasing a portion of inflows to Windamere Dam; and establish an environmental water allowance, so that a proportion of dam inflows can be released, for specific environmental purposes (e.g. bird breeding in the Macquarie Marshes).

Unregulated rivers water sharing plan
The Water Sharing Plan for the Castlereagh River above Binnaway Water Source sets very low flow cease-to-pump rules to protect low flows; and establishes daily flow sharing rules to protect a proportion of flows for the environment on any given day.

Groundwater water sharing plan
The proportion of recharge water that can be extracted without compromising the integrity of the groundwater source and the ecosystems that depend on it is the extraction limit or sustainable yield. Over the 10-year term of this plan, entitlements will be reduced to be within the sustainable yield. This water sharing plan also provides for managing extraction limits and for reviewing recharge and environmental water on the basis of further information on the requirements of groundwater-dependent ecosystems.
WHAT ECOLOGICAL MONITORING IS OCCURRING?

Regulated rivers water sharing plan

The Integrated Monitoring of Environmental Flows (IMEF) program is a scientific program that was originally established in 1997 to assess the ecological benefits of the environmental flow rules in the State’s regulated rivers and the Barwon–Darling River. The program has since been reviewed and aligned to monitor and evaluate the ecological performance of the water sharing plans for regulated rivers. Monitoring in the Macquarie Marshes, to support the development of the Water Sharing Plan of the Macquarie and Cudgegong Regulated Rivers Water Source, commenced in 1999. The monitoring has included recording ecological responses both before and during environmental flows to monitor the responses of key ecosystem indicators to flows (Figures 9 and 10).

Two projects are under way in the Macquarie and Cudgegong Regulated Rivers Water Source:

- The University of NSW and the NSW Office of Water are collaborating on developing models of the interactions between wetland productivity, food webs, flooding and the effectiveness of the environmental water provisions in the water sharing plan. Food webs are described in terms of the composition of macroinvertebrates (eg. damselflies, Figure 8) and microinvertebrates (eg. water fleas), which form the basis of many food chains, and are a major part of the diets of fish and birds. The invertebrate–flood models will be conceptually linked to vertebrate responses. This project is one component of IMEF work in the Macquarie Marshes, which is focused on how best to manage releases of environmental water allowances from the dam.

- Wetland plants provide important habitat for fish, birds...
FIGURE 10
Extent of high-resolution airborne laser mapping in the Macquarie Marshes, as determined through IMEF consultation with stakeholders during the preparation of the project specifications.

Archiving

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Information provided by DNR Spatial Products & Services Unit. Wagga Wagga; March, 2007.
and macroinvertebrates. The health, species diversity and distribution of water plants are highly linked to inundation. Monitoring of wetland plants has been conducted in the Macquarie Marches since 1999, providing a comprehensive picture of how wetland plants change in response to flows. In combination with the information from the above University of NSW and the NSW Office of Water project, it will be used to work out how best to manage releases of environmental water allowances from the dam.

**Unregulated rivers water sharing plan**

The NSW Office of Water has established a program to assess the ecological outcomes of the 20 water sharing plans for unregulated water sources that were gazetted in 2004. The first aim of ecological monitoring in unregulated rivers is to determine whether the environmental objectives of the water sharing plans are being achieved. A monitoring program is being established in the unregulated river sections covered by the Water Sharing Plan for the Castlereagh River above Binnaway. It will begin this year and will consist primarily of a field verification study to assess the adequacy of the cease-to-pump levels in meeting the water sharing plan’s environmental objectives. Initial work has involved the establishment of photo point monitoring sites (eg. Figure 11) and an assessment of the catchment hydrology during periods of low flow. Depending on the results of these initial studies, more detailed monitoring of vulnerable habitats may be undertaken during the term of the water sharing plan.

Fish sampling is planned as part of the predictive ecological modelling for existing unregulated water sources. This new approach will attempt to determine whether water extraction has impacted the fish communities in the unregulated Castlereagh River.

**Groundwater water sharing plan**

In the area covered by the Water Sharing Plan for Lower Macquarie Groundwater Sources, a groundwater flow model has been developed covering the three main aquifers of the groundwater sources. This information can be used to review the proportion of water held in the aquifer as environmental water to ensure that the aquifer is managed sustainably within the context of the water sharing plan. Some 143 monitoring bores have been installed...
across the aquifer to monitor the change in groundwater levels in each of the aquifers as inputs into the model.

The model integrates the monitoring information to provide a water table plan for each specific time period, that predict water table behaviour under various pumping and climatic conditions. Groundwater-dependent ecosystems will progressively be mapped across the Macquarie alluvial aquifers so that local management rules can be developed where required.

**WHICH PLAN PROVISIONS ARE WE MONITORING?**

- **Regulated rivers water sharing plan**
  - Water sharing plan

Provisions evaluated
The effectiveness of the different provisions can be assessed only through longer-term modelling. For this reason the NSW Office of Water and the University of NSW are modelling the effects of environmental water provisions using the IQQM (Integrated Quantity and Quality Model). The project aims to develop a model of invertebrate food supply which is a key to the success of waterbirds and fish breeding, for a range of model flow scenarios, including environmental water allowances. The study will model invertebrate responses to different flow rules including the effects of different carryover provisions, end-of-system rules, sustainable diversion limits and other flow rules.

Clause 12: Environmental performance indicators
The performance of the plan is assessed against:

- (a) change in low flows
- (b) change in moderate to high flows
- (c) change in water quality in the water source
- (d) change in ecological condition of the water source and dependent ecosystems
- (e) change in economic benefits derived from water extraction and use.

The Integrated Monitoring of Environmental Flows work primarily addresses objectives (b) and (d). It also includes water quality sampling, with the potential to link this to the Integrated Quantity and Quality Model.

Clause 15 (2–8): Target flows
Target flows in the Cudgegong River at Rocky Waterhole from Windamere Dam are linked to dam storage level and inflows (150–1,500ML/day), up to 10,000ML/year. The Minister may alter the end-of-system flow target within specified boundaries each water year on the advice of the Environmental Flow Reference Group (clauses 15 (4) and 67). This is primarily a State Water Corporation responsibility.

Clause 15 (10): Environmental water allowance, Burrendong Dam: max. 160,000ML/year (split into sub-allowances 1 & 2)
This is primarily a Department of Environment Climate Change and Water responsibility, but also see below.

Clause 15 (16–21):
Environmental water allowance 1 (translucency) (EWA1)
The environmental water allowances release is triggered by dam inflows. Distributions of allowances can be altered each water year (clause 15 (13)) after advice from the Environmental Flows Reference Group. The dates of releases can be changed in accordance with these processes (clause 15 (17)) after assessment of the ecological condition of the Macquarie Marshes (clause 15 (18)). Flow triggers and targets can also be altered (clause 15 (19–20)) under planned amendments (clause 67).

This is primarily a NSW Office of Water responsibility, especially as
this relates to an adaptive environmental management provision. The NSW Office of Water and the University of NSW project aims to develop an integrated flow–flooding–invertebrate model for the Macquarie Marshes by using modelled natural and regulated flows (clause 67 (3)) and to examine relationships with modelled flow outputs from Integrated Quantity and Quality Model scenarios (natural and three regulated with various environmental water allowance scenario’s as per clause 67 (3)).

The review under clause 67 (2) should consider and make recommendations on changes to clause 15 (13) regarding:

(a) the different minimum proportion, between 0 and 100 per cent, that each sub-allowance must receive
(b) a maximum proportion, between 0 and 100 per cent, that each sub-allowance must receive.

The study will seek the optimal ratio between 1 and 100 per cent of the translucency versus the active components. The numerical models will relate river flows at reference river gauges to predicted floodplain inundation patterns and extent, and will model invertebrate productivity responses to different flow rules under the following options for release of water to the Macquarie Marshes:

1. 100 per cent translucent
2. 100 per cent environmental contingency allowance
3. 75 per cent translucent and 25 per cent environmental contingency allowance
4. 40 per cent translucent and 60 per cent environmental contingency allowance (current operating rules).

Clause 15 (22): Environmental water allowance 2 (active) (EWA2)

Released when required in accordance with plan rules for:
- native fish recruitment and dispersal in the Macquarie River or Macquarie Marshes
- colonial water bird breeding
- alleviating severe, unnatural, prolonged drought conditions for maintenance of semi-permanent wetlands defined by common reed, water couch or river red gum.

The Environmental Flow Reference Group shall determine the priority of objectives at the start of the water year for EWA2 use (clause 15 (22k)) giving regard to the overall intent.

By year 6 of the plan (2009–10 water year), the Minister may amend the EWA in regard to minimum and maximum proportions on the basis of a report documenting ecological impact of releases so far (clause 67 (2–4)). This is primarily a Department of Environment Climate Change and Water responsibility, but NSW Office of Water shares responsibility for the adaptive environmental management provision; hence the NSW Office of Water and the University of NSW project, as described above.

Clause 31: Long-term average annual extraction limit

By limiting the long-term average annual extraction to 305,000ML/year, the plan ensures that approximately three-quarters of the long-term average annual flow will be preserved and contribute to preserving ecological health. This is primarily a Murray-Darling Basin Authority responsibility.

Clause 48 (5): Supplementary access rules

This rule provides access to water downstream of the upper limit of Burrendong Dam, triggered by flows of 5,000ML/day at Warren. By year 5 of the plan (2008-09), supplementary access rules can be amended, within the terms of the plan, to improve flows that promote native fish breeding; i.e. progress in removing impediments in the Warren floodplain Marebone Choke (clause 48 (7)).

This is primarily a NSW Office of Water responsibility, especially as this is an adaptive environmental management provision.
Clause 69: Recovery of planned environmental water
Enables water recovery at the Minister’s discretion, under specified conditions.

Unregulated rivers water sharing plan
Water sharing plan

Provisions evaluated
Clause 13: Environmental performance indicators
The performance of the plan is assessed against its objectives:
(a) change in low flows
(b) change in moderate to high flows
(c) change in local water utilities access
(d) change in ecological condition of the water source and dependent ecosystems.

Clause 17: Flow classes
The plan establishes the flow classes for all management zones (excluding Management Zone 6) as the basis for sharing of daily flows.

Clause 45: Total daily extraction limits
The plan establishes a total daily extraction limit for each flow class established in clause 17.

Clause 74: Amendment of very low flow provisions
The Minister may vary the very low flow levels established in clause 17 and the cease-to-pump levels for unregulated river access licences in clause 63 (c), following field verification. Any variation made shall be limited to a specified range.

Clause 75: Amendment of high flow provisions
The Minister may verify the demand for high-flow C Class extraction in Management Zones 1 to 5 to:
(a) establish C Class flow categories and thresholds in clause 17
(b) amend clause 21 to allow for environmental health water to be established in C Class
(c) establish total daily extraction limits (TDELs) for C Class in Zones 1 to 5 in clause 44
(d) assign TDELs for C Class to categories of access licence in Zones 1 to 5 in clause 45
(e) vary the unassigned TDEL in clause 47
(f) recommend conversion factors for the surrender of A Class individual daily extraction limits (IDELs) in exchange for C Class IDELs in clause 55
(g) recommend conversion factors for the surrender of B Class IDEL in exchange for C Class IDEL in clause 55.

The verification process identified should:
(a) only assess the demand for C Class extraction by access licences that exist at the start of the plan
(b) assess the degree to which objective 3 (to protect or restore a portion of freshes and high flows) of the Water Quality and River Flow Interim Environmental Objectives (NSW Government 1999) is met.

Any establishment of C Class should not place the B Class or C Class flow threshold outside of a specified range for each management zone. Any establishment of TDELs for C Classes should not place the TDELs outside of a specified range for each management zone.

Groundwater water sharing plan
Water sharing plan
The Water Sharing Plan for the Lower Macquarie Groundwater Sources.

Provisions evaluated
The performance of the plan is assessed against its environmental objectives:
(a) change in groundwater extraction relative to the extraction limits
(b) change in climate-adjusted groundwater levels
(c) change in water levels adjacent to identified groundwater-dependent ecosystems
(d) change in groundwater quality
(e) change in economic benefits derived from groundwater extraction and use
(f) change in structural integrity of the aquifer.

Clause 16 (2): Recharge
A review of recharge for each groundwater source should be undertaken by the Minister by 30 June 2008 and recommend:
(a) an average annual recharge for Zone 5
(b) any changes to the average annual recharge for Zones 1, 2, 3, 4 and 6.

Clause 16 (4): Recharge
The Minister should undertake a second review of the average annual recharge for each groundwater source by 30 June 2014.

Clause 18 (2): Planned environmental water
A review of the proportion of recharge reserved in subclause 1(b) as planned environmental water using the best available science should be undertaken by the Minister after 30 June 2008, and should:
(a) recommend the proportion of the annual recharge to be reserved for the environment and Aboriginal cultural heritage in Zone 5
(b) recommend any change to the proportion of the annual average recharge to be reserved for the environment and Aboriginal cultural heritage in each of Zones 1, 2, 3, 4 and 6
(c) identify groundwater-dependent ecosystems to establish their groundwater requirements and recommend appropriate management options to protect them.

Note: The studies may recommend management options other than reservation of a portion of recharge to protect groundwater-dependent ecosystems.

Clause 18 (4): Planned environmental water
The Minister should undertake a second review of the proportion of the average annual recharge reserved as planned environmental water in each groundwater source by 30 June 2014.
WHAT HAS ECOLOGICAL MONITORING TOLD US SO FAR?

Regulated rivers water sharing plan

Monitoring activities
Monitoring since 1999 shows positive responses of vegetation to environmental flows, with an increase in the variety of vegetation species and an improvement in conditions at sites wetted by the flows. However, with drought the vegetation has trended towards terrestrial grass and shrub species and a loss of key wetland plant species such as *Phragmites*. Monitoring of the environmental flow events shows that a small maintenance flow (19,000ML) can be used during drought to maintain core wetland plant communities within the Macquarie Marshes, and during the event increasingly more plant species benefit from environmental flows (Figure 12). The key emerging issue is the effect of climate change on the resilience of remaining plant and animal communities within the Macquarie Marshes.

Links to other projects
The NSW Office of Water is collaborating with the eWater Cooperative Research Centre in the development of ecosystem models. The work in this catchment benefits from closely linked studies from all over NSW, including carbon cycling.

Figure 12 - Measures of success of 09–10 environmental flows in the Macquarie Marshes:

a. Increase in species richness in target southern marshes wetland.
b. Response of water couch (*Paspalum distichum*) to environmental flows. Water couch response is a performance indicator in the water sharing plan. (Percentage cover rankings: 1=<1%; 2=1–5%; 3=6–10%; 4=11–15%; 5=16–20% and 6=21–25%).
c. Number of Integrated Monitoring of Environmental Flows sites inundated in relation to volume of environmental water.
work, wetland studies from the Murrumbidgee River to the Gwydir–Gingham wetlands, numerous within-stream studies of algal production and fish recruitment, climate change modelling (including wetlands) done within the NSW Office of Water’s Science Branch, and climate change modelling done by NSW Office of Water’s hydrologists for the CSIRO’s Sustainable Yield Program. The current University of NSW and NSW Office of Water study builds on previous Integrated Monitoring of Environmental Flows funded studies of the responses of fish and invertebrates to flows and the Integrated Monitoring of Environmental Flows program funded fish studies performed in collaboration with the NSW Department of Industry and Investment. One initiative of Integrated Monitoring of Environmental Flows was to develop the first trial of the use of lidar (light detection and ranging) for creating wetland digital terrain models, performed in the Macquarie Marshes (see Figure 9 - page 13 and Figure 10 - page 12). This in turn led to a statewide project on the acquisition of lidar data for the development of wetland hydrodynamic models. The locations and technical specifications were determined in consultation with key stakeholders. Work included identifying the core management areas and where hydrodynamic modelling could provide advice on the best use of environmental water. Additionally, the NSW Office of Water and other agencies are supporting the Peter Cullen Postgraduate Scholarship, which supports student research at the University of NSW into the impact of human-built infrastructure on the Macquarie River floodplain.

Unregulated rivers water sharing plan

Monitoring activities
The impacts of low flows on the Upper Castlereagh River during drought are being investigated. These impacts are likely to be confounded should drier conditions result from climate change. A monitoring program was established within this plan area in 2009–10, consisting primarily of photo point monitoring. Monitoring sites have been established (see Figure 11 - page 13).

Links to other projects
Further information on monitoring of unregulated river water sharing plans can be found at www.water.nsw.gov.au

Groundwater water sharing plan

Monitoring activities
Groundwater levels have been monitored in each of the alluvial sections in the Macquarie, Talbragar, Castlereagh and Cudgegong Rivers. The spatial and temporal intensities of monitoring reflect the degree of groundwater pumping and the priority of likely impacts. In 2008–09, water users drew heavily on their entitlements owing to the dry conditions. All water levels declined on account of climatic conditions, groundwater pumping or both. However, there were no adverse impacts on other water users or on known environmental assets. The measured water level changes matched those predicted by the groundwater flow models for the conditions experienced.

Links to other projects
A groundwater flow model is being developed for the Upper Macquarie (Narromine to Wellington) to complement the Lower Macquarie model discussed earlier. The model will enable the impact of groundwater pumping on river flow and the riverine environment to be assessed. An 18-month project began in September 2009 to monitor the change in groundwater chemistry in the Lower Macquarie Groundwater Source downstream from Narromine. The project will sample monitoring bores and selected production bores monthly for salinity, pH and major ions. The data will be combined with the groundwater flow model to predict groundwater quality changes due to pumping. Several projects currently under way, including the National GDE
Atlas and catchment management authority funded projects, will allow broad identification of groundwater-dependent ecosystems by mid 2011. The National Groundwater Centre, led by the University of NSW with the assistance of the NSW Department of Industry & Investment is improving the Wellington Research Training Centre to provide large-scale field research sites that will focus on stream–aquifer interactions and the impact of agriculture on fractured-rock groundwater flows. These latter sites are proposed to operate for 10 years. It is proposed that several short courses per year will be delivered from here. The NSW ‘macro water sharing plan’ process is expected to develop plans for all groundwater sources in the Macquarie Valley by the end of 2010. Each groundwater plan will state long-term average annual extraction limits and rules that will allow only certain impacts on users and the environment. Groundwater sources that are highly connected to the rivers will include cease-to-pump criteria.

SOCIO-ECONOMIC MONITORING

In 2005, a ten year socio-economic monitoring project of the NSW irrigation industry commenced to:

■ monitor key social and economic changes at the farm and regional levels arising from water sharing plans
■ provide useful data for the NSW Office of Water’s review and evaluation of water sharing plans
■ provide useful data for the Natural Resource Commission’s review of water sharing plans
■ provide a benchmark for other economic and social monitoring exercises in natural resource management.

Key stakeholders were consulted extensively to develop the project’s methodology. Social and economic indicators were identified and used to develop a survey questionnaire for irrigators. The survey of irrigators, undertaken in 2006, collected baseline data for all water sharing plans that began in July 2004, including the regulated and unregulated water sharing plans in the Macquarie Valley. The NSW Irrigators’ Council, including its representatives throughout NSW, and the Primary Industries and Economic Development Standing Committee of the NSW Natural Resources Advisory Council continue to provide significant contributions to this project.

The results of the 2005-06 report are tabulated by catchment management authority area. The relevant catchment management authority for the Macquarie Valley is the Central West Catchment Management Authority. A sample of the 2005–06 results for the Central West Catchment Management Authority is presented below:

■ irrigators derived 50.5 per cent of their total income from farming activities (on average); generally, those irrigators with larger entitlements derived a higher proportion of their total income from farming activities
■ irrigators derived 31.2 per cent of total farm income from irrigated crops and pastures (on average); this was the lowest proportion reported by any catchment management authority.
■ 51.3 per cent of irrigators employ non-family members, and the percentage increases as entitlements increase
■ the total water used was 20,900ML, with a median volume of 30ML per irrigator
■ overall, irrigators used approximately 25 per cent of their total water entitlement.

The detailed report of the first survey of irrigators is available at www.water.nsw.gov.au

The second survey was completed in 2009. This survey collected baseline data for water sharing plans not covered in the 2005–06 survey.
In the socio-economic monitoring project, key stakeholders were consulted extensively to develop the project’s methodology.
monitoring plan for 2009-10

WHAT ECOLOGICAL MONITORING IS PLANNED FOR 2009–10?

Regulated rivers water sharing plan
The NSW Office of Water has commissioned the University of NSW to further develop invertebrate-flood response models, with a focus on optimising the use of active versus translucent environmental water allocations.

Unregulated rivers water sharing plan
Photo point monitoring sites are being established across the Upper Castlereagh River catchment upstream of Binnaway. Sites will be monitored on three to four occasions at low to very low flow levels (should they occur). Flows will be gauged to assess the spatial variability of flows across the catchment during periods of low to very low flows.

A predictive ecological model to determine the impact of water extraction on fish assemblages is being developed. Fish will be sampled in 2010 if there is enough water in the river.

Groundwater water sharing plan
Monitoring of groundwater levels in the various aquifers that underlie the Macquarie Valley will continue, either monthly on-site or by telemetry, depending on priority. All information will be available on the NSW Office of Water’s website.

Some minor additional piezometers are being installed in the Macquarie and Bell River catchments.

Entitlements for all groundwater sources will be tradeable.

Groundwater pumping will be available at the end of the water year on the basis of information collected by State Water Corporation on the NSW Office of Water behalf.

Should these studies show that the water sharing plan’s environmental objectives are unlikely to be met, further investigation to locate and monitor vulnerable riverine habitats will be undertaken.

WHAT SOCIO-ECONOMIC MONITORING IS PLANNED FOR 2009–10?

The NSW Office of Water has commissioned the Australian Bureau of Statistics to customise the 2006 Agricultural Census data to be consistent with the water sharing plans boundaries and related water sources. This agricultural data (expected to be available in 2010) will be collated with other available socio-economic data to monitor the performance of water sharing plans against their stated objectives.

In addition, a third survey of irrigators is proposed for the 2010-11 water year. This survey will cover all water sharing plans in NSW. The results of this survey will be compared against the benchmarks from the two previous surveys, providing additional information for monitoring the performance of water sharing plans.
WHAT IS PLANNED FOR FUTURE WATER SHARING PLANS?

Five additional water sharing plans covering the Macquarie Valley are currently being developed for:

- Macquarie-Bogan Unregulated Rivers and Alluvial Water Sources
- Castlereagh Unregulated Rivers and Alluvial Water Sources
- Murray-Darling Basin Fractured Rock Groundwater Sources
- Murray-Darling Basin Porous Rock Groundwater Sources

FUTURE PRIORITY NEEDS FOR ECOLOGICAL MONITORING AND EVALUATION IN THE MACQUARIE VALLEY

During the development of the water sharing plans for the Macquarie-Bogan Unregulated Rivers and Alluvial Water Sources, and Castlereagh Unregulated Rivers and Alluvial Water Sources, three potentially high-priority water sources were identified:

- the Macquarie above Burrendong Water Source
- the Bell River Water Source
- the Unregulated Lower Macquarie System Water Source.

Potentially high-priority water sources are those identified as being at high risk to instream environmental value by water extraction in accordance with the publication ‘Macro Water Sharing Plans - The approach for unregulated rivers. Report to assist community consultation, 2nd edition’, NOW 2009.

This report is available at www.water.nsw.gov.au.