



Department of
Primary Industries
Office of Water

ENVIRONMENTAL WORKS AND MEASURES FEASIBILITY PROGRAM IN NSW

Evaluation report



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More information

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Introduction

This report outlines the conduct and outcomes of the *NSW Environmental Works and Measures Feasibility Project*. The project comprised two parts:-

Part A – feasibility assessments on eight “state nominated “sub-projects, and

Part B – a state-led process to assist the development of community based environmental works and measures proposals.

The project commenced in late October 2011 and the final reports were submitted in June 2013.

The project achieved the identification of over 70 ideas that resulted in 10 community projects which have the potential to deliver SDL Offsets.

The project also delivered feasibility studies on the eight state nominated projects, which in most cases have the potential to deliver SDL offsets.

This report provides an overview of each of the state nominated projects as well as a summary and outcomes of the community based project identification process.

Background

The Murray-Darling Basin Authority’s (MDBA) *Guide to the Proposed Basin Plan* (the Guide) was released for public comment in October 2010.

The process of developing a Basin Plan that meets the needs of all stakeholders in the Basin has been complex with a range of expectations and values needing to be addressed. In NSW, the Commonwealth Government’s purchase of water entitlements and its effect on regional communities caused significant concern.

The Guide established a *Sustainable Diversion Limit* (SDL) for each water management area in the Murray-Darling Basin. These SDLs are expressed as an annual average volume of extraction that is considered to be the maximum volume that can be extracted in the long-term, while maintaining ecological sustainability of the water management area.

Generally, the achievement of the SDL requires less volume being extracted in the future than is currently the case. A more recent development in achieving sustainability within the Basin is the acknowledgement that the SDL may be increased if targeted environmental assets can be sustained using less environmental water.

In response to concerns from regional communities to the *Guide*, the Commonwealth Government established a House of Representatives Standing Committee on Regional Australia chaired by Independent, Tony Windsor MP, to investigate the effect of the proposed Basin Plan on regional communities.

Many submissions identified that water could be saved by changing inefficient water use practices and developing better, more efficient methods of delivering the desired environmental outcomes.

Consequently, the Commonwealth Government agreed to provide the NSW Government with funding to undertake;

- feasibility assessments on eight “shovel ready “state sub-projects (Part A).
- a state-led process to assist the development of community based environmental works and measures proposals (Part B).

Why NSW favours water recovery from works and measures.

NSW has long advocated that water savings should be derived through works and measures, infrastructure or operational changes rather than buyback of entitlements.

Upgrading or installing infrastructure enhances regional communities and helps to ensure the long-term viability of regional communities and industry and is a sustainable way of achieving the “triple bottom line” outcomes that ensure all social economic and environmental factors are addressed.

Under the Basin Plan, NSW is required to reduce the amount of water taken for both human and commercial purposes.

What are environmental Works and Measures?

The term “environmental works and measures” refers to infrastructure **works** or improved water delivery **measures**, that if implemented, would either reduce the volume of water taken from a local water source or improve local environmental outcomes by using less water to achieve the environmental targets.

Examples include:

- piping channels that deliver stock or domestic water, thereby reducing the volume of water that is lost to evaporation and seepage whilst still meeting consumptive needs – the water saved could then be re-allocated to the environment as a licensed entitlement;
- re-scheduling the delivery of irrigation water to reduce evaporation and seepage losses – the water saved could then be reassigned for environmental use; and
- constructing cuttings, levees and/or regulators to enable a priority wetland to be flooded using less water. Similarly the wetland may be better managed to provide a more environmentally sustainable “wetting and drying” regime that requires less water than currently used.

Schemes that involve the building of dams, on-route storages, and diversion of coastal rivers to the inland will not deliver SDL offsets. These schemes increase river regulation and generally have negative impacts on the environment.

Determination of SDL Offsets

The method and processes for determining SDL offsets was not available within the timeframes for the completion of these projects. Water savings assessments have been made for individual projects.

Projects with the potential for SDL offsets will be proposed for inclusion in the current works program being developed the SDL Adjustment Process.

What is bridging or reducing the gap?

Current situation under the draft Basin Plan



"Bridging the Gap"



"Reducing the Gap"



* Note: The above picture represents a concept; it is not intended to accurately represent the volumes of water extraction.

The outcomes- How have the NSW projects measured up

The following table summarises the progress and effectiveness of all projects against the project objectives

Project	Valley	Expected Savings for this project
Part A		
Euston Lake restoration and improved water efficiency	Murray	7 GL annually
Upper Murrumbidgee environmental flow enhancement	Murrumbidgee	N/A
Nimmie-Caira system enhanced environmental water delivery	Murrumbidgee	173 GL
Piping irrigation demands	Statewide	10 GL for the two pilot projects
Burrendong Dam Environmental flow enhancement	Macquarie	4 GL
Southern Macquarie marshes environmental flow enhancement	Macquarie	N/A
More efficient delivery of high priority stock and domestic supplies (3 case studies)	Murray Murrumbidgee Macquarie	547 ML (High Security) 1.9 GL
Modify weirs to enhance floodplain inundation	Murray	1.9GL
Part B		
Engage the community to find feasible projects that will bridge the gap for NSW SDLs	Statewide	430GL excluding CARMS

NSW Environmental Works and Measures Part A

State identified projects

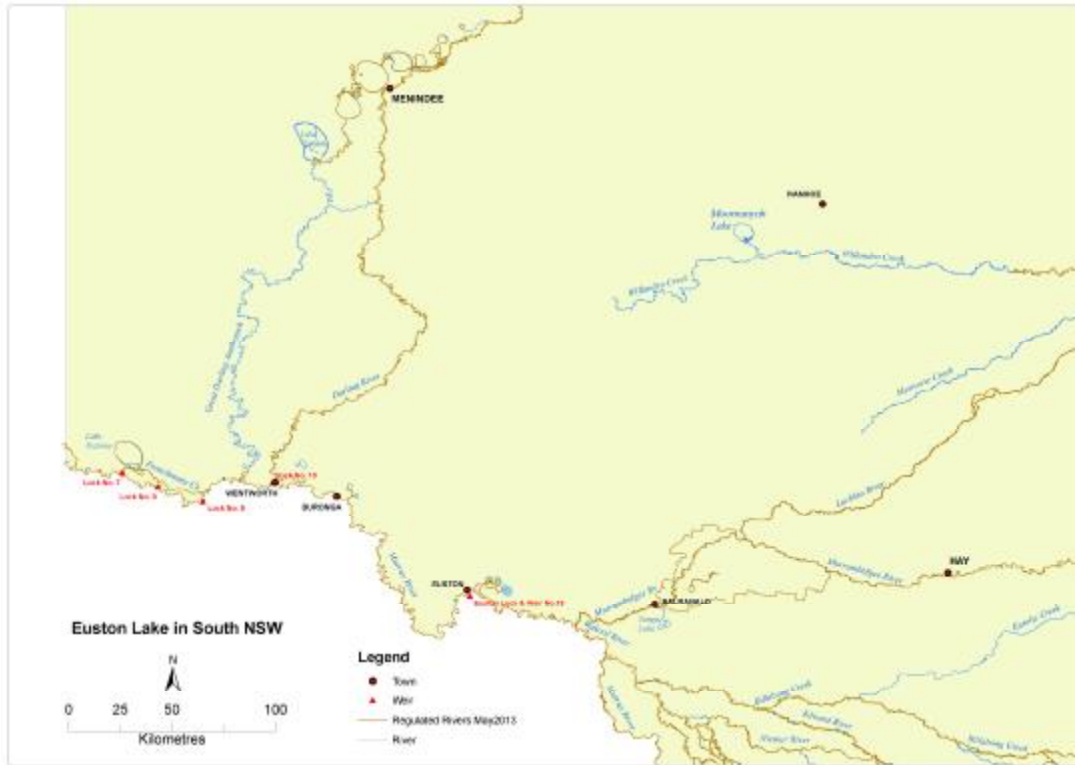
NSW Government agencies were asked to submit projects that had the potential to achieve SDL Offsets. The Commonwealth agreed to fund feasibility assessments of eight projects which would achieve environmental outcomes and to test whether the projects were able to contribute to SDL offsets under the Basin Plan assessment criteria.

Table 1 – State identified projects

Project	Proponent
Euston Lake restoration and improved water efficiency.	NSW Office of Water
Upper Murrumbidgee environmental flow enhancement.	NSW Office of Environment and Heritage
Nimmie-Caira system enhanced environmental water delivery.	NSW Office of Water
Piping Irrigation demands.	State Water Corporation
Burrendong Dam environmental flow enhancement.	State Water Corporation
Southern Macquarie Marshes environmental flow enhancement.	NSW Office of Environment and Heritage
More efficient use of high priority stock and domestic supplies	NSW Office of Water
Modify Weirs to enhance floodplain inundation.	NSW Office of Water

A. Euston Lake restoration and improved water efficiency

Project area



Project Overview

The Euston Lakes is an important wetland and waterway complex located in the far south-west of NSW, adjacent to the Murray River and near the township of Euston and the Victorian town of Robinvale. The Lakes complex includes creeks, lakes, and floodplain and wetland habitats and supports a range of threatened flora and fauna. The Lakes also provide water for irrigation and stock and domestic purposes and support a range of other uses including boating, fishing, tourism and camping.

The Euston Lakes have experienced significant change to their hydrological regimes since the construction of the Lock 15 (Euston) weir pool in 1937. This has contributed to a decline in the overall health of the Lakes system and led to considerable water losses from evaporation and seepage.

In response, the NSW Office of Water (NOW) is delivering a project to identify options to optimise the long term management of the Euston Lakes system and in doing so assess water efficiencies and environmental benefits of a more natural wetting and drying regime. The implementation of this regime will balance environmental and social needs and provide water savings that will contribute to Murray Darling Basin Plan Sustainable Diversion Limit (SDL) adjustments. SDL adjustments can encompass both supply and efficiency measures, and the business case was prepared on the basis that the water savings are an efficiency measure.

This Business Case assesses six possibilities for the rehabilitation of the Euston Lakes. These are based on two scenarios for different hydrological regimes in the Euston Lakes through local infrastructure works such as the installation of regulators, as well as manipulation of the Lock 15 (Euston) weir pool. Each scenario includes three options for the provision of an alternative water supply to existing users.

Both scenarios provide for two partial drying and refilling events every ten years and two full drying and refilling events every ten years. These will enhance water use efficiency and the ecological values of the local area and contribute to broader environmental, economic and social outcomes.

Scenario 1 has been modelled to deliver an estimated 5.33 GL in annual water savings while Scenario 2 delivers modelled annual water saving of around 7.76 GL.

An assessment of the two scenarios and three options has been made, including a benefit cost analysis. The benefit: cost ratios vary from 0.63 to 1.35.

An integrated water management plan has also been developed as part of this project with the objective of delivering a long term hydrological regime for Euston Lakes that protects and enhances its ecological condition and function while continuing to provide a water supply system for users. Six supporting objectives have been developed for the plan, focussing on the maintenance of habitats and the diversity of flora and faunal populations to support the maintenance and reproduction of bird and fish populations, and protect valuable ecological habitats such as fringing vegetation.

The community consultation on the optimisation of Euston Lakes undertaken as part of this project revealed a diverse range of views. These mostly supported earlier rounds of consultation and indicated that in general terms, the community is not yet convinced about the merits of the proposed project, with particular concern about long term operating costs. There is a very clear view from some in the community that the project is primarily delivering an environmental outcome and the benefits from a piped water supply are not especially large compared to maintaining the status quo.

The high level risk assessment undertaken for the project indicates that most risks relating to project implementation are able to be mitigated so they become a low level concern. The exceptions relate to those risks dealing with community engagement, community perception and buy in, which remain as medium level risks, even with mitigating actions in place.

The assessment of the current situation, possible outcomes, benefits and costs, and the strong community views means that the preferred option for the lakes system is to implement Option 1 of Scenario 2. Scenario 2 provides greater modelled water savings, while Option 1 provides a water supply system for all current water users (irrigation, stock and domestic).

There are strong community expectations that any modification to the operation of Euston Lakes would include a similar level of piped water supply to that currently available. Delivering on this expectation, results in a benefit cost ratio of 0.84. While this is not the highest benefit cost ratio of the modelled scenarios, the business case represents a combination of economic analysis plus social and environmental perspectives. Option 1 of Scenario 2 is considered the most likely to succeed. If other options are pursued, these are likely to expose the rehabilitation project to risks relating to lack of community support.

Conduct of the Project

This project was undertaken by Consultants, GHD and supported by the NSW Office of Water. GHD was commissioned to prepare a business case, concept design and Integrated Water Management Plan for the rehabilitation of the Euston Lakes. In

preparing these documents, GHD has built on various studies undertaken over the last decade in an effort to bring forward a consolidated and coherent case for investing in the rehabilitation of Euston Lakes.

Community Engagement

The project did not target community engagement, however undertook briefing sessions and one on one consultation with key community groups and landholders, together with the development of a briefing paper that was widely distributed throughout the community. A presentation was also made to the Balranald Shire Council on the progress of the project and its findings.

Governance

The project was managed by a steering committee comprising representatives from:-

- NSW Office of Water,
- Murray Darling Basin Authority
- NSW Lower Murray Darling CMA
- Victorian Mallee Catchment Management Authority
- NSW Office of Environment and Heritage
- Victorian Department of Environment and Primary Industries
- Australian Government Department of Sustainability Environment Water Population and Communities

Benefits and Outcomes

The project has the potential to deliver up to 7.76 GL of savings, however the more likely outcome based on a project acceptable to the local community is for savings of approximately 5.33 GL.

Determination of actual SDL offset will be determined through the SDL Adjustment process which is working towards a final SDL adjustment by July 2016.

Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:-

Key Activity

Meeting of the steering committee to agree on membership, terms of reference, consultancy requirements, on-going reporting and community engagement.

Review of existing information, work done to date, plans and broad understandings of water management scenarios.

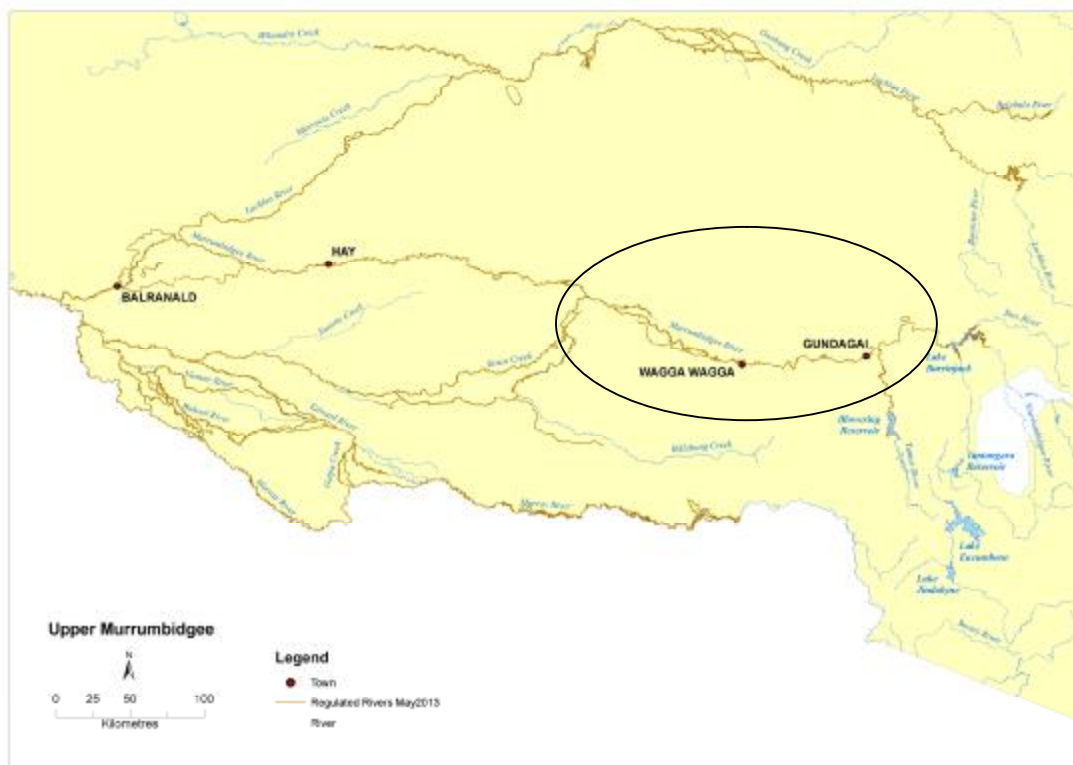
Project (consultancy and in house activities) to conduct community engagement / workshops / discussions throughout the life of the investigations.

Modelled water savings from preferred option/s and the potential for SDL offsets.

Project report identifying, scoping and costing land and water management options – including wetland management and cost benefit analysis

B. Upper Murrumbidgee environmental flow enhancement

Project area



The Upper Murrumbidgee Environmental Flow Enhancement project investigates the feasibility of relaxing an existing flow constraint in the Upper Murrumbidgee, 30km downstream of Gundagai. Effective delivery of environmental flows as managed watering events is highly dependent on existing system constraints (MDBA, 2012). Relaxing the flow constraint will allow improved environmental flows to be delivered to the Mid- Murrumbidgee wetlands between Wagga and Hay. Delivery of environmental flows is currently constrained to 32,000ML/day at Gundagai, as stated in the Water Sharing Plan (DIPNR, 2004). At flows larger than 32,000ML/day, the Mundarlo Bridge is overtopped and potential closures cause disruption to local traffic, requiring the use of an 80km diversion route to cross the Murrumbidgee River.

The feasibility of relaxing the flow constraint at Mundarlo Bridge has been investigated by assessing the benefits and impacts of a range of larger flows passing through the river system at Mundarlo. The flows scenarios investigated range from 32,000 ML/day to 48,500 ML/day. The upper flow limit of 48,500 ML/day was selected as it relates to 6.1m at the Gundagai gauge which is the minor flood level (as defined by the Bureau of Meteorology).

The mid- Murrumbidgee wetlands have Environmental Water Requirements (EWRs) which have been developed by considering requirements for wetland health and ecological sustainability. EWRs have been specified by the Murray Darling Basin Authority (MDBA) but also by the watering objectives in the annual watering plan (OEH, 2013). To understand the ecological benefits from flow constraint relaxation, an assessment was done to determine whether there was an improvement in how often the EWRs are met. This assessment only considers if the EWRs are “met” and does not consider what incremental ecological benefit may be achieved with increased flows beyond the current threshold. Complimentary to this assessment, the study also considered the benefits associated with increased opportunities for environmental watering events, similar to the one which occurred in September 2010.

The findings of the hydrology and ecology assessment demonstrated that there was a modest improvement in the attainment of Environmental Watering Requirements with a relaxation of the flow constraint. These increases are not likely to have a significant effect on the ecology of the wetlands on the Mid-Murrumbidgee floodplain. It is considered that the demand pattern used in the proposed Basin Plan SDL scenario may not optimise the additional operational flexibility that relaxing the channel capacity provides. Consequently, the improvement in meeting environmental watering targets and flow regime may be understated.

An opportunity assessment was undertaken to consider whether changing the constraint at Gundagai would increase the number of occasions when releases from Burrinjuck and Blowering Dams could be used to inundate mid-Murrumbidgee wetlands by 'piggy-backing' on natural high flow events in the catchment. The assessment concluded that raising the constraint to 40,000 ML/day increases the number of opportunities for delivering flows of 24,000 ML/day at Darlington Point by approximately 31 percent on average and increases the opportunities to deliver flows of 27,500 ML/day at Darlington Point by 24 percent on average. Raising the constraint to 48,500 ML/day increases the number of opportunities to deliver flows of 24,000 ML/day at Darlington Point by 38 percent on average and increases the opportunities to deliver flows of 27,500 ML/day at Darlington Point by 42 percent on average. Moreover, raising the constraint increases the number of years when dam releases can 'piggy back' on natural flow events to deliver water to approximately half of the wetlands on the Mid-Murrumbidgee floodplain. The wetlands that would be inundated by flows greater than 24,000 ML/day at Darlington Point are likely to support River Red Gum and Tall Spike Rush and would naturally be inundated at least once every 1-3 years. In some circumstances, raising the constraint will allow inundation of wetlands in more years than would otherwise be possible. It may therefore reduce the interval between wetting events, which will improve the survival and germination of River Red Gum and wetland vegetation such as Tall Spike Rush. It may also allow prolonged wetland inundation following large natural floods, which will increase the number of waterbird chicks that are successfully fledged.

The relaxation of the operational constraint at Mundarlo potentially allows for the environmental outcomes achieved under the Basin Plan SDL scenario to be realised with less water for the environment than has been allocated under this scenario. The difference in volume can potentially be returned to consumptive users in the form of an SDL offset or adjustment amount. The analysis indicates that offset volumes could be up to 16GL/Yr at Narrandera.

The findings from the environmental assessment indicated that optimised environmental benefits were achieved with the relaxation of the flow constraint to 48,500 ML/day. This preferred flow inundation profile was used to assess impacts along the river and discuss with landholders at the consultation sessions. There are significant incremental impacts for riparian landholders at the higher flow threshold as more riparian land becomes inundated. Potential impacts include loss of pumps, access issues due to inundation of low-lying roads and difficulty moving stock. A suite of mitigation options to address these impacts include improved warning and communication protocols, raising of local roads above inundation levels, increased capacity of under-road drainage.

Project consultation included initial meetings with Councils and key groups within the valley (Customer Service Groups, Aboriginal groups, NSW Irrigators Council). The second round of consultation included seven drop in sessions down the valley to discuss the benefits and impacts of the flow relaxation. The community has strong objections to any proposal which seeks to deliver higher flows down the system (where these flows have some impact on property/land). This view was expressed regardless of the extent of inundation or duration of river flows. There was some confusion amongst the community regarding the difference between natural flooding events and managed environmental flows. Key issues raised from the consultation include: impacts on bank erosion, impacts if flow releases coincide with local rain

events, rate of rise and fall, warning times. There was also a significant difference in the issues that are important along the river with a greater support from downstream communities for relaxing the flow constraint.

As part of the assessment, a range of design options were reviewed for Mundarlo Bridge to accommodate the flows under investigation. The options included raising or replacing the existing structure. As part of this exercise, a hydraulic model was constructed to determine localised impacts on landholders due to a different structure. The assessment concluded that there was minimal impact during the smaller flows (up to 48,500ML/day).

A concept bridge design has been developed at Mundarlo for a new bridge which would accommodate the 48,500 ML/day. This has been costed at \$8.7 million for design development and construction of a replacement bridge and associated roadworks. A local hydraulic assessment indicated that the new bridge would not present any increase in flood risk to adjacent properties. Constructed above the minor flood level, it would provide continued access in natural flooding events. The study concludes that relaxing the existing constraint at Mundarlo Bridge to 48,500ML/day will provide additional environmental benefits but may have a significant impact on some riparian landholders in the Murrumbidgee.

If further investigation is undertaken into relaxing the flow constraint it is recommended that a detailed assessment of property impacts be developed and a consultation plan based on property by property surveys. Due to the significant concerns about the study from the local community, appropriate investment would be needed to better understand the impacts before a decision can be made to progress the feasibility to the next stage.

Conduct of the Project

This project was undertaken by Consultants, SKM in association with the Risora Group and Barma Water Resources. The consultants examined a range of options for the removal of the Mundarlo Bridge Constraint, undertook a concept bridge design and participated in community consultation.

Community Engagement

Project consultation included initial meetings with Councils and key groups within the valley (Customer Service Groups, Aboriginal groups, NSW Irrigators Council).

The second round of consultation included seven drop in sessions down the valley to discuss the benefits and impacts of the flow relaxation.

Governance

The project was managed by a steering committee comprising representatives from:-

- Murrumbidgee Catchment Management Authority
- NSW Office of Water,
- Gundagai Shire Council
- NSW Office of Environment and Heritage

Benefits and Outcomes

The relaxation of the operational constraint at Mundarlo potentially allows for the environmental outcomes achieved under the Basin Plan SDL scenario to be realised with less water for the environment than has been allocated under this scenario. The difference in volume can potentially be returned to consumptive users in the form of an SDL offset or adjustment amount. The analysis indicates that offset volumes could be up to 16GL/Yr at Narrandera.

Determination of actual SDL offset will be determined through the SDL Adjustment process which is working towards a final SDL adjustment by July 2016.

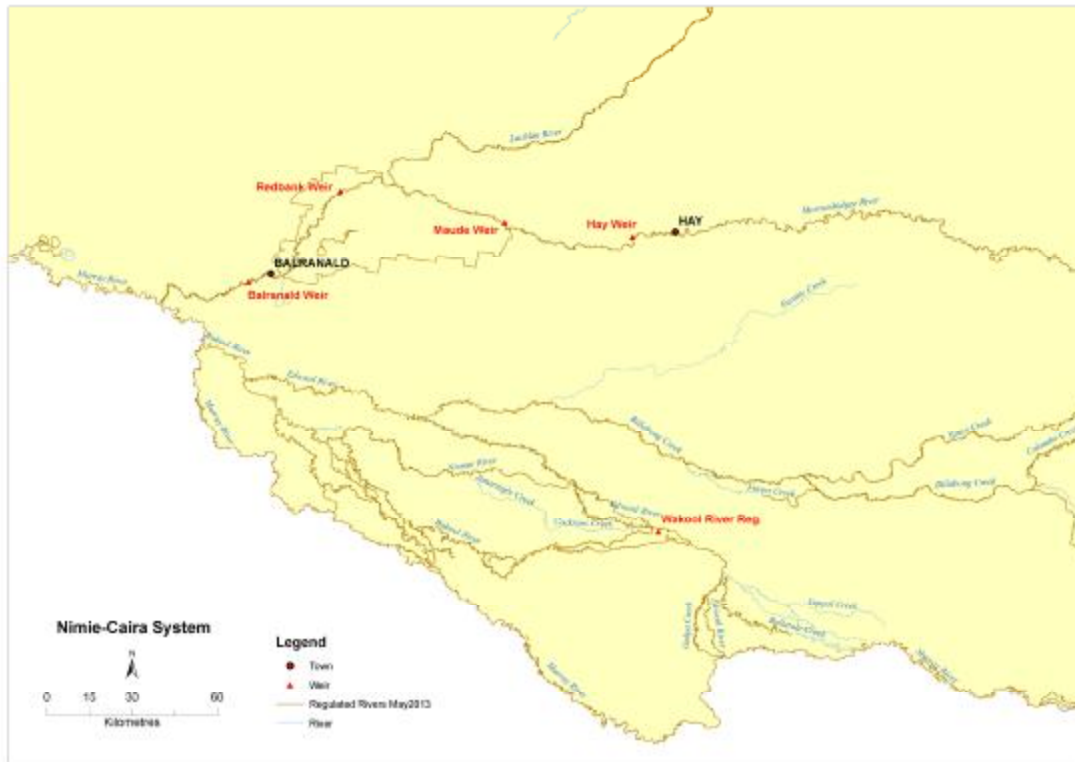
Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:-

Key Activity
Mundarlo Bridge upgrade/replacement investigation
Community consultation
Assessment of river and wetland benefits
Modelled water savings.

3. Nimmie-Caira system enhanced environmental water delivery

Project area



The Nimmie-Caira floodplain is part of a unique wetland area known as the Lowbidgee. Formed by the action of thousands of years of flooding, the Nimmie-Caira provides internationally important habitat and breeding areas for colonial water birds, supports populations of rare and endangered species of frogs and birds, and provides an important mid-Basin source of replenishment of river based populations of macro-invertebrates, fish and reptiles, far in excess of the levels of production possible in the surrounding semi-arid landscapes.

With its position adjacent to the red gum forests of the Redbank system, now reserved as part of Yanga National Park, and the environmentally significant Great Cumbung Swamp located directly to its north, the Nimmie-Caira provides an important and distinct set of environmental values in this diverse, large scale and internationally significant wetland system.

The Nimmie-Caira is part of the largest area of wetland remaining in the Murrumbidgee Valley, and has been identified as a hydrological indicator site in the Murray Darling Basin Plan by meeting four of the five MDBA criteria for key environmental assets.

The Nimmie-Caira System Enhance Environmental Water Delivery Project (“The Nimmie-Caira Project”) offers a unique combination of land and water purchase together with infrastructure reconfiguration, to provide both water entitlement for the environment and the means to efficiently deliver environmental flows to the Nimmie-Caira floodplain, southern areas of the Redbank system, the Fiddlers-Uara system as well as downstream to the Murray River.

Specifically, the Nimmie-Caira Project will provide 381,000 shares of supplementary water (Lowbidgee) access entitlement to the Commonwealth. The long term average

annual yield of this entitlement under current levels of development is 172.974 gigalitres (GL). Under these conditions, 40.374GL is currently estimated as benefitting local environmental assets, meaning that the ‘gap-bridging’ potential of the entitlement may be reduced from 172.974GL down to 132.6GL.

In addition, further SDL offsets may be realised by using the Nimmie-Caira infrastructure to deliver environmental flows to the Nimmie-Caira floodplain and other areas of the Lowbidgee, as well as provide environmental flows around the Murrumbidgee Choke at Chaston's Cutting. Through reconfiguration of the Nimmie-Caira water supply infrastructure and removal of blockages to flows in the creeks draining the lower reaches of the Lowbidgee Floodplain, up to 3,000ML/day can be delivered back to the Murrumbidgee River downstream of the choke. This will have the additional benefit of reinstating natural flows and floodplain connectivity to the Lowbidgee floodplain.

The Nimmie-Caira Project involves the purchase of 84,417 hectares of land on the Nimmie-Caira floodplain, owned by 11 farming businesses, together with landholders share of supplementary water (Lowbidgee) entitlement (381,000 shares), and associated infrastructure and improvements. The project will also fund the reconfiguration of water delivery infrastructure to more efficiently and effectively deliver environmental flows to the Nimmie-Caira floodplain and other parts of the Lowbidgee, as well as deliver flows through the system back to the Murrumbidgee River. The project will allow unconstrained use of the Nimmie-Caira infrastructure for the efficient delivery of environmental flows, unencumbered by the requirement to deliver water for agriculture.

The Nimmie-Caira contains significant indigenous cultural heritage values, and an objective of the project will be to protect these values into the future, where possible, with the involvement of local indigenous groups. The project will include funding to cover the cost of a comprehensive cultural heritage survey to ensure that these values and assets are better understood and recorded as a basis for ongoing management and conservation.

The land asset will be owned and managed by the NSW Government in the short term, with the objective of protecting the important environmental and cultural heritage values contained in the Nimmie-Caira. A range of land management models have been investigated as part of this study and several have been short listed for the NSW Government to consider. A budget to facilitate the transition from working agricultural farms to actively managed conservation areas has been included in the total project costs.

Conduct of the Project

The Nimmie-Caira Project was developed by the Risorsa Group in association with Barma Water Resources, Prohort Management, AK Environmental, IRP Environmental Consultants and MWH Australia). The team developed a feasibility study and business case, and a detailed plan for implementing the project.

Community Engagement

Prior to March 2012, the Office of Water undertook preliminary targeted consultation with key stakeholders (Balranald Council, Murrumbidgee Valley Water Users and State Water Corporation, NSW National Parks and Wildlife Service, the Murrumbidgee Catchment Management Authority, Regional Development Australia Murray and Nimmie-Caira landholders).

From March to June 2012, the consulting team consulted affected shire councils (Balranald, Hay and Wakool), the NSW National Parks and Wildlife Service, NSW State Water Corporation, Commonwealth Department of Sustainability, Environment, Water, Population and Community, Murray Darling Basin Authority, members of the local Aboriginal community and Nimmie-Caira landholders

Governance

The project is controlled and managed by the NSW Office of Water.

Benefits and Outcomes

The Nimmie-Caira project is a significant land and water and infrastructure proposal that is currently estimated as delivering 132.6GL of the remaining 183GL within-valley target to be recovered from the Murrumbidgee Valley under the Basin Plan. The project provides both exceptional value for money and excellent environmental outcomes both within the Lowbidgee area and downstream.

The project:-

- meets the primary objective of the SPPs in bridging the gap and improving water management
- achieves a substantial Long Term Annual Average Yield (LTAAY) due to the good reliability of Lowbidgee supplementary water.
- is far cheaper, quicker and more efficient than buying water entitlement from the open market.
- will protect and potentially enhance the significant environmental and indigenous cultural assets that are identified in the Lowbidgee floodplain area.
- has potential to address other Murrumbidgee river management issues

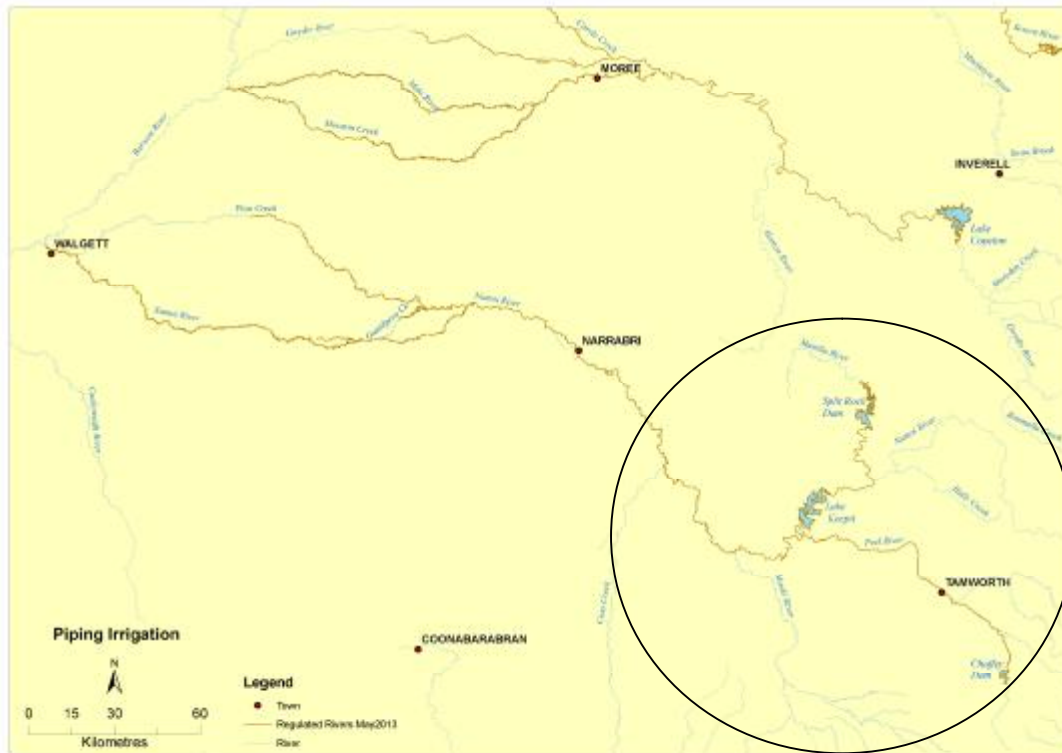
Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:-

Key Activity
Submit project management plan
Engage consultants
Present feasibility assessment report and business case
Present detailed implementation plan

4. Piping irrigation demands

Project area



State Water is NSW's rural bulk water delivery corporation, delivering more than 5,500 GL of water per year for consumptive use, and around 9,000 GL per year for the environment. State Water manages and operates around 20 dams, and more than 280 weirs and regulators to deliver water for irrigation, industry, town water supply, stock and domestic use, riparian and environmental flows. In the regulated systems, water is released to rivers from dams and delivered to irrigation corporations, town water authorities, farms, mines and electricity generators.

The delivery of water supply via river releases while having some environmental benefits, also has environmental costs, with substantial losses in some river systems. In many cases, river regulation has the effect of inverting the natural hydrological regime, reducing river flows during the wetter dam filling periods and increasing flows during the drier periods.

An opportunity exists to replace river delivery of water to users downstream of State Water dams with a piped scheme, thereby reducing water losses and potentially restoring a more natural flow regime downstream of the dams. Because of the ability of pipelines to supply water under pressure, other potential benefits include reduced pumping costs and greenhouse gas emissions, and increased production through more efficient irrigation application methods.

State Water engaged GHD to develop a pre-feasibility assessment process and supporting tools to assess three potential piped water supply schemes downstream of State Water dams. The main output from this study is a pre-feasibility assessment tool to assess proposed water supply schemes, together with three case studies to trial the use of the tool.

The report on the pre-feasibility assessment for irrigation supply pipelining summarises work completed on the project. It includes a summary of the conceptual assessment framework, a description of the latest version of the pre-feasibility assessment tool, and a summary of results for two case studies (the Peel River downstream of Chaffey Dam and Manilla River downstream of Split Rock Dam).

The two case studies presented prove the application of the assessment methodology in a real world application. The report also identifies other irrigation developments in close proximity to major dams.

Community Engagement

State Water undertook consultation with the customer service committee to understand the demands and change in market associated with a higher reliability of supply.

Governance

The project was managed by State Water with key inputs from the Namoi Customer Service Committee which comprises representatives from:

- Irrigators
- NSW Office of Water
- NSW Office of Environment and Heritage
- Commonwealth Water Holder

Benefits and Outcomes

The report has established a methodology whereby the feasibility of piping irrigation demands can be assessed. The project has also identified potential projects across the State that may benefit from this approach. The project undertook a screen of the potential irrigation piping projects and assessed via a model taking into account capita and operating costs, potential irrigation benefits as a result of providing higher water security and environmental water savings.

The screening model looked at the potential water savings associated with the projects and identified a cost benefit to these savings and also considered a sensitivity analysis.

The table below shows the potential savings and costs for each of the schemes identified by State Water Corporation. A more detailed assessment and maps are attached in Appendix A.

Scheme	Number of Customers with 50km	Water Savings ML/Yr	Capital Cost \$M	Water Savings Cost \$/ML
Split Rock	210	5,000	26.39	5,278
Chaffey	209	5,000	91.21	18,242
Wyangala	180	800	32.88	41,106
Windamere	151	6,000	82.27	13,712
Pindari	100	6,000	67.6	11,267
Burrendong	56	2,000	41.89	20,944
Keepit	47	1,600	50.69	31,684
Copeton	32	4,600	78.81	17,133
Burrinjuck	16	2,300	49.37	21,465
Carcoar	14	500	6.9	13,798

Achievement of Key Activities/Milestones

Key milestones of the project were developed, with a broad range of potential irrigation schemes identified around the State. GHD were hired to develop a model to assess the cost benefits of developing irrigation schemes to improved the value of water in the region and increase environmental water for the environment.

A total of ten potential pipeline schemes were identified and assessed.

The project met all the key milestones outlined in the project plan as summarised below:-

Key Activity

Literature review of Piped Irrigation Districts

Identification and mapping of irrigation districts in close proximity to dams that could be supplied via a pipe network. Maps of potential sites attached.

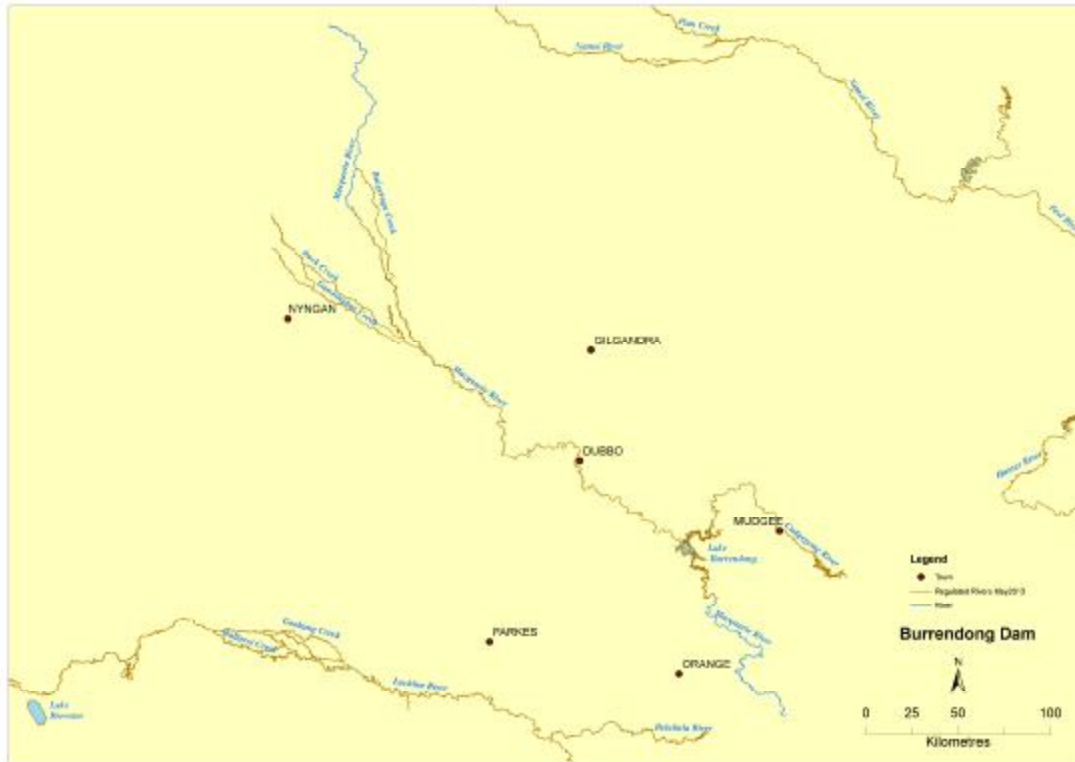
Development of a conceptual design of a pipe network to service irrigation demands to enable development of cost estimates

Identify water savings associated with piping water to irrigation schemes

Development of Irrigation model to assess criteria for feasibility of irrigation scheme

5. Burrendong Dam environmental flow enhancement

Project area



This study investigates the potential benefit from enhancing the outlet capacity at Burrendong dam, south-east of Wellington NSW. This may enable the release of higher pulse flows which could lead to environmental benefits, such as native fish spawning and recruitment, and potentially the more efficient delivery of environmental water, including to the Macquarie Marshes.

BWR was engaged by NSW State Water Corporation to assess the Environmental and Service Delivery Benefits of Increasing the Outlet Capacity of Burrendong dam. The study has primarily focused on the Macquarie river downstream of the dam to Marebone. The study is a scoping study involving modelling and desktop assessment, consistent with the expectations of State Water.

The following areas have been investigated as part of the project:

- Hydrologic Modelling of Valve Enlargement Options
- Effects of Valve Enlargement on Water Users
- Effects of Valve Enlargement on river Flows
- Effects of Valve Enlargement on the Environment
- Effects of Valve Enlargement on Geomorphology
- Social and Economic Impact Assessment of Valve Enlargement Options
- Assessment of Preferred Valve Enlargement Option

The study found that, despite periods of demand constraint, for the majority of time demands are much less than valve capacity. These periods of time increase with enlarged valve size.

Consequently, subject to water availability there is potential for the spare valve capacity to be utilised to provide refined environmental watering patterns to that adopted in the modelling scenarios assessed in this study and to make better use of an enlarged valve.

The frequency at which Environmental Water Requirement (EWR) Basin Plan targets for the Macquarie Marshes are met is only improved slightly as a result of valve enlargement. This occurs for event volumes of 250 and 400GL. Consequently, additional environmental outcomes and corresponding SDL supply contribution (adjustment) volumes under the environmental demand patterns assumed in the Benchmark (Basin Plan) Scenario are likely to be small (in the order of 4GL per annum) for valve enlargement supply measures.

A detailed cost benefit and a socio-economic study cannot be conducted due to the issues associated with optimising environmental water delivery patterns under an enlarged valve case. However preliminary scoping of costs and benefits indicate that an SDL adjustment/offset volume of approximately 6 GL would need to be generated in order for the valve enlargement to be cost benefit neutral.

Conduct of the Project

This project was undertaken by Consultants, Barma Water Resources (BWR Pty. Ltd.) with support from State Water Corporation.

Community Engagement

State Water undertook consultation with the customer service committee to understand the demands and potential benefits.

Governance

The project was managed by State Water with inputs from the Macquarie Environmental Working Group. The EWG comprises representatives from:

- Macquarie Irrigators
- NSW Office of Water
- NSW Office of Environment and Heritage
- Commonwealth Water Holder
- NSW Department Primary Industry

Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:-

Key Activity

Establish stakeholder working group

Undertake a review of previous studies

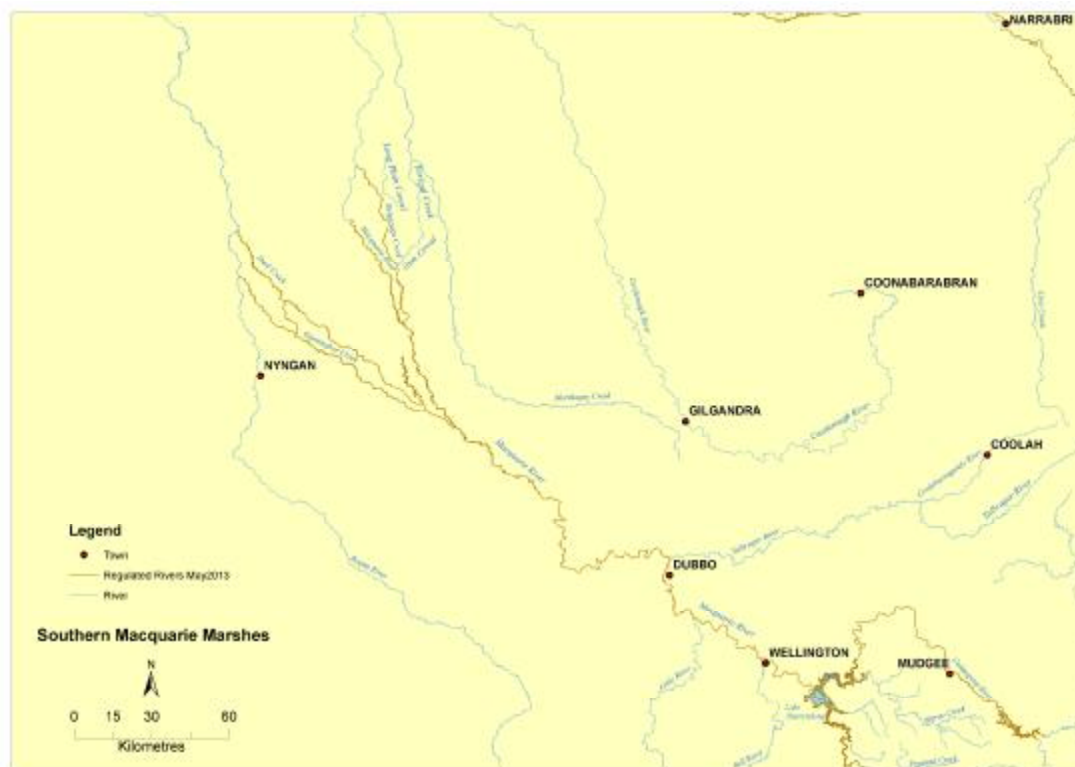
Review of the hydrology of the Macquarie River to determine the outlet capacity required to meet peak irrigation demands and environmental need of the river.

Undertake Cost-Benefit analysis

Identify savings

6. Southern Macquarie Marshes environmental flow enhancement

Project area



Barma Water Resources (BWR Pty. Ltd.) was engaged by the New South Wales Office of Environment and Heritage (OEH) to undertake a Geomorphic Restoration Scoping Study of the Southern Macquarie Marshes system.

A combination of variable climate, weather, hydrology, geomorphology (i.e. landforms and the processes that create and change them), land use and other human impacts determine the ecological character of the Macquarie Marshes. Within the wetlands, interconnected channels and floodplain levees and shallow flood basins are naturally affected by sedimentation and erosion, and determine the overall distribution of floodwater. However, erosion that is related to a more regulated hydrological regime has increasingly become an important consideration for ecosystem management in the Marshes.

Erosion is particularly harmful to wetland ecosystems where channels become so deep and wide that the surrounding floodplain is cut off from overbank flows (i.e. where wetlands become disconnected from the channel). Sedimentation has also been considered a problem, for example, where it leads to channels becoming infilled and choked with vegetation, causing undesirable flow diversions.

Both erosion and sedimentation are pronounced in the Southern Marshes, and issues stemming from these processes, as well as mitigation and rehabilitation strategies, are the focus of this project. Given the Southern Marshes function as a buffer to the Northern Marshes, addressing erosion and sedimentation affects here is critical to the ongoing health and relative stability of the whole Macquarie Marshes system.

The primary aim of this project was to investigate the river and wetland health outcomes likely to occur by undertaking a suite of physical works designed to restore

stream cross-section and stream hydrology. This was achieved through extensive data collection, consultation and works assessment tasks including hydrodynamic modelling and concept designs. Based on observations of erosion, sedimentation, changes in flow and other

related concerns and issues derived from the community consultation process, scientific knowledge, historical data and geomorphic mapping, ten channels and key sites along them were identified as being of high priority for consideration of potential works and measures. These included the Oxley Break, The Breakaway and the Buckiinguy Return channels. Many of these sites were selected due to erosion concerns and the potential for increasing flow effects for low and medium-level environmental water deliveries.

Hydrodynamic modelling was used to test the effects of various works options focussing on the reaches above. This was an adapted version of the Marshes Hydrodynamic Model (HDM). Two modelling flow scenarios were used to test each geomorphic condition scenario. These were low flow and medium flow options, as high flows are generally outside of management control and would be difficult to design around for the proposed works options. Geomorphic Condition Scenarios assessed were the baseline condition, 'Without Intervention' and 'With Intervention' – reflecting the potential level of resources and effort put into control of erosion and sedimentation over the next 5-10 years.

The modelling assessment of potential changes in channel geomorphology and resultant flow redistribution within the Southern Macquarie Marshes indicated various outcomes for the works scenarios including changes in inundation (positive and negative) within wetlands like Monkey Swamp, Buckiinguy Swamp and Willie's Reed Paddock.

Concept Designs of various structure types was undertaken for the report to provide indicative designs for various works options.

Conduct of the Project

This project was undertaken by consultants, Barma Water Resources in conjunction with officers from the NSW Office of Environment and Heritage.

Community Engagement

Separate to the steering committee meetings, two public information sessions were held in the Macquarie Marshes.

In addition, a fact sheet was prepared for the project and a further fact sheet will be prepared shortly upon completion of this stage of the project.

Governance

A steering committee, comprising OEH (2), private land managers (3) and public land managers (1) was formed to guide the project and provide feedback on various activities. NSW OEH Regional Operations was the project manager for the project.

Benefits and Outcomes

The outcomes of the project include several products with benefits to the Macquarie Marshes system:

- A suite of geomorphological information: base knowledge useful for a range of purposes. This included mapping products and scientific data on bank stability.
- an assessment of various works options: for further consideration in prioritising project-related efforts in the future
- justification for intervention in some circumstances: to assist in obtaining funding for detailed design and implementation in the future
- further specific commencement of community liaison activities around these types of works. Given that works can be highly sensitive, this project has allowed for some challenging discussions about the merits of intervention in geomorphologic stability.

No SDL adjustments were relevant to this outcomes of this project, as the outcomes would potentially ensure the maintenance of outcomes from the existing environmental water available

through stabilising assets which are a significant component of the target of environmental flows into the Marshes.

Achievement of Key Activities/Milestones

The project met the key milestones outlined in the project plan as summarised below:-

Key Activity

Investigation of river and wetland health outcomes likely to occur by undertaking a suite of works designed to restore stream cross-section and stream hydrology;

Defined the potential for this project to deliver offsets in the sustainable diversion limit.

Engaged with local land managers (both private and public land) to capture information on erosion and sedimentation issues that are a priority to stakeholders, and to investigate concerns and issues with any works recommended;

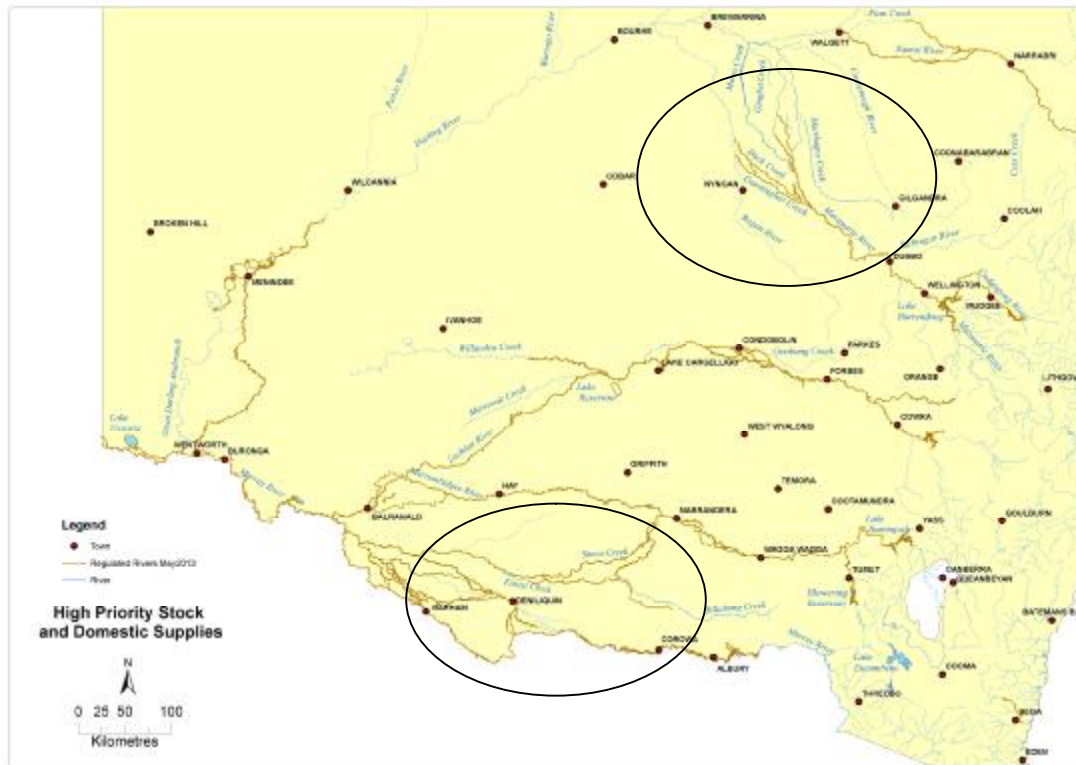
Concept design for a suite of works

Using the adapted Marshes HDM, investigated and defined some of the impacts of proposed works on water spread and inundation, particularly downstream and lateral inundation effects

Presented a concept-level implementation plan and budget required to allow for the progression of priority works identified in the scoping project.

7. More efficient delivery of high priority stock and domestic supplies

Project area



The Office of Water (OoW) engaged RPS to develop this desktop pre-feasibility assessment to identify potential water efficiency savings available through the piped delivery of stock and domestic water supplies in three high-priority locations in the Murray, Murrumbidgee and the Macquarie Valleys

This project aimed to conduct a preliminary desktop study and pre-feasibility assessment of non-optimised alternate stock & domestic water supply systems and make conclusions and recommendations for further investigation, as appropriate, for the three project locations.

Murray Valley – Coobool Creek

The Coobool Creek system is located between Wakool and Murray Rivers, roughly 25 km North West of Swan Hill and forms part of the larger Merran Creek System. The Merran Creek System encompasses a large network of creeks and lagoons which supply irrigation and stock & domestic water throughout the Little Merran Creek Water Trust District. There are 12 creeks and waterways, classified as both regulated and unregulated, which cover a combined total of 130 km. The Coobool Creek is the most complex part of the Merran Creek system with a combined entitlement of 5,735 ML which consists of; 5,118 ML general security, 557 ML supplementary, and 60 ML stock and domestic.

Pipelines to deliver stock and domestic water supplies (totaling 4.3 ML/year) have been proposed. Water would be sourced from the main stream of Coobool Creek and the Wakool River, as appropriate, as groundwater is not suitable for stock and domestic purposes. The hydrological modeling found that the implementation of these S&D pipelines (only) resulted in a saving of 38 ML/year. If the implementation of these pipelines is combined with the construction of some new regulators and

other minor works, some side channels can be removed from the inundated network enabling the recovery of additional water savings, totaling 407 ML/year.

These water savings come at a cost of \$0.56m. The value of the (high-security) water saved ranges from \$614,570 to \$1,286,120, depending on the assigned unit value of the water, resulting in a cost-benefit ratio ranging from 1.06 to 2.22.

Murrumbidgee Valley – Forest Creek

The Forest Creek system is located in the south western Riverine Plain in southern New South Wales and comprises Forest Creek, Eight Mile Creek and Forest Anabranche. The Forest Creek system forms part of the larger Yanco/Billabong Creek system. Forest Creek is an anabranche of Billabong Creek, approximately 200 kms in length, leaving Billabong Creek approximately 10 kms east of Conargo and entering Billabong Creek 8.5 kms upstream of Moulamein. The regulated Forest Creek system above Warriston Weir is the focus of this pre-feasibility study.

The regulated section of the Forest Creek is considered to be a highly inefficient water delivery system, with approximately 35 GL/year of water used to deliver the licensed entitlement. There is currently a combined entitlement of approximately 22,416 ML for the regulated section of the Forest Creek.

A pipeline has been proposed to deliver 24 ML/year of stock and domestic water supplies from the Hartwood Weir pool to the licensed users along Forest Creek. Groundwater has been found to be unsuitable for the purpose. With a reduction in S&D water use due to efficient delivery, the high-security water savings available are 102 ML/year.

These water savings come at a cost of \$1.27m. The value of the (high-security) water saved ranges from \$159,800 to \$297,040, depending on the assigned unit value of the water, resulting in a cost-benefit ratio ranging from 0.13 to 0.23.

The potential issues of Basic Landholder Rights to stock and domestic water may potentially undermine any water savings achieved as part of the proposal and there is a perception of some resistance to change by many landholders. However, there is potential to save up to 12.5 GL of general security water savings with a full-scale reconfiguration of the regulated section of Forest Creek.

Macquarie Valley – Gum Cowal-Terrigal

The Macquarie River catchment covers 75,000 km², extending from the Blue Mountains to the Darling Riverine Plains. The Macquarie River and its streams and anabranches, specifically the Macquarie River, Marebone Break, Bulgeraga Creek, Buckingham Creek, Monkeygar Creek, Old Macquarie River, Bora Channel, the Gingham, Mullins Swamp, Gum Cowal – Terrigal Creek to its confluence with Marthaguy Creek, Long Plain Cowal and Dusty Swamp, flow into the Macquarie Marshes. The Macquarie Marshes are the catchment's largest wetland system, located in the northern (downstream) end of the catchment. Downstream of these wetlands, the Macquarie River re-forms and connects to the Barwon River.

The Gum Cowal-Terrigal Creek system receives unregulated stock and domestic replenishment flows up to 10,000 ML per annum under the *Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source* (WSP, 2004). However, stock and domestic replenishment flows in the system have only averaged 1,650 ML/year since 1996.

There is opportunity to improve the efficiency of stock and domestic water delivery in the unregulated Gum Cowal-Terrigal Creek system from the Macquarie River at Marebone Weir through to its downstream junction with the Macquarie River.

A pipeline scheme to deliver stock and domestic water supplies to users in the system has been proposed by the NSW DPI Office of Water for pre-feasibility assessment. This pipeline may be

sourced with water from the Marebone Weir pool or groundwater from the Great Artesian Basin (GAB).

Conduct of the Project

This project was undertaken by Consultants, RPS P/L in conjunction with NSW Office of Water Modelling resources.

Community Engagement

As the project was a pre-feasibility investigation that undertook desktop modelling, analysis and design there was no formal community engagement implemented as part of the project. It is expected that if the project progresses to the feasibility stage based on the outcomes of the pre-feasibility investigations that a formal community engagement strategy and process will be developed.

Governance

The project was managed by a steering committee comprising representatives from:-

- NSW Office of Water,
- NSW State Water Corporation

Benefits and Outcomes

The project has identified a potential to save an estimated 547ML of Stock and Domestic and 1.98GL of unregulated water through the implementation of infrastructure works to provide alternate means for the delivery of stock and domestic water.

The benefits of the project are that it has targeted areas with smaller allocations of stock and domestic in system that are not on the main supply channels to determine if there are any efficiency gains that could be achieved by reducing the amount of water required to be delivered based on efficiency of a pipeline scheme or other infrastructure works. The results of the project shows that savings are achievable for stock and domestic water, although further savings may be achieved if the scope of the project is expanded and builds on previous investigations undertaken or working with other water efficiency projects that look at some of these complex systems as a whole.

The outcomes may also contribute to programs that are investigating the water efficiency savings through the piping of stock and domestic water which may not be considering the potential system efficiency gains that could be achieved to complement the savings through efficient delivery of stock and domestic water.

Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:

Key Activity

Meeting to the steering committee to agree on membership, terms of reference, modelling requirements, consultancy requirements and on-going reporting

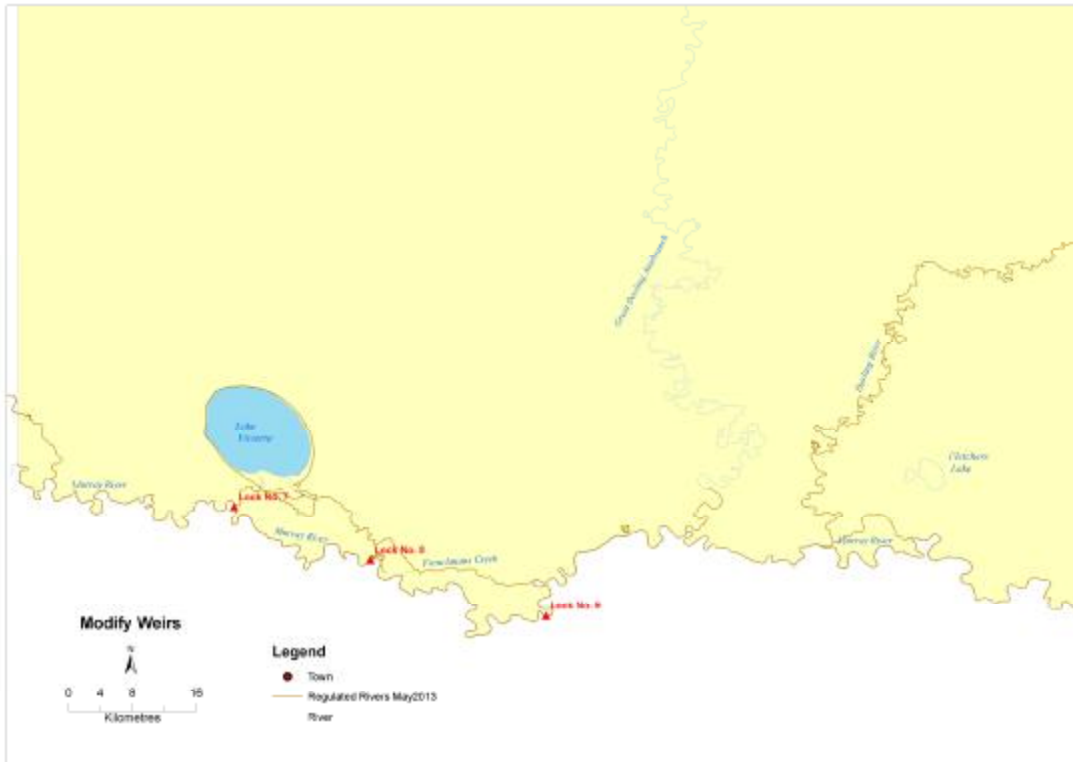
Project report summarising existing information, work done to date, plans and broad understandings of water management scenarios.

Project report/s on modelled water savings from preferred option/s.

Convene meeting to review progress and workshop specific project directions.

8. Modify weirs to enhance floodplain inundation

Project area



This Business Case builds on the foundations set by two separate, but complementary projects undertaken in the Locks 8 and 9 vicinity of the lower River Murray and identifies priorities for capital investment.

The two projects are well-aligned, strongly linked and comprise the *Locks 8 and 9 Weir Pool Manipulation Optimisation Plan – Analysis Report* (Ecological Associates Pty Ltd, 2013) and the *DRAFT Engineering Feasibility Study: Assessment & Costings of Structures & Fishway(s) in the Carrs, Cappitts & Bunberoo Creeks system* (NSW Public Works and Fishway Consulting Services, 2013).

The project area is from Lock 8 upstream to Lock 10; incorporating the Lock 8 weir pool and the Lock 9 weir pool (Figure 1).

The Business Case is an initiative of the NSW Government Office of Water and focuses on two priority areas: preparation of an Integrated Water Management Plan and an associated Investment Plan.

The project area spans two Catchment Management Authorities and contains components of one third of *The Living Murray* icon sites which are contiguous and provides linkage and connectivity with the two projects.

Weirs and the created upstream 'weir pools' confer stability on the river system (i.e. reduces variability of water levels and flow) and impacts on connectivity with the floodplain. Many native species of plants and animals rely on variability of conditions as cues for reproduction and dispersal and riverine-floodplain connectivity is essential to the productivity and ecological function of this ecological community. The weirs and other regulating structures are significant obstacles to fish movement along the lower River Murray channel.

The ecological limitations of weir pools are centred on the lack of variable flowing water habitat and lack of variation and inundation of the floodplain. Variation of the operating levels of these

weir pools has been proposed to improve ecosystem health and resilience, by restoring some aspects of seasonal variation and ephemeral wetting and drying of wetlands. Weir pool manipulations are expected to improve the productivity of the project area, increase the extent and health of riparian vegetation, promote increased populations of native fish and increased waterbird foraging habitat, particularly if used in conjunction with environmental and seasonal cues.

The proposed 0.65 m variation for Lock 9 and 1.1 m for Lock 8 will provide a cumulative stream bank influence of many hundreds of kilometres.

The DRAFT Engineering Feasibility Study on the Carrs, Cappitts and Bunberoo (CCB) Creeks system concluded that one of the biggest impacts on native fish populations within the lower River Murray is the loss of flowing water habitat and hydraulic diversity, caused by the construction of weirs.

At present, the two fixed crest concrete weirs at the upstream end of Carrs and Bunberoo Creeks, which were constructed in 1929, are at Lock 9 weir pool level and provide no upstream passage for fish and little downstream passage. The various road crossings also block passage for most of the time, except in very high flows, when they are submerged and road access is cut to Lock 9.

The CCB Creeks system has a head differential (difference in upstream and downstream water levels) of about 3 meters, because it has an inlet that is upstream of Lock 9 and an outlet downstream of Lock 9. This feature can be used to create the hydraulic grade to provide flowing water habitat and hydrodynamic diversity.

The CCB system is targeted as a key site on the River Murray as it has the possibility to address three fish habitat impacts through the introduction of flows through Carrs Weir No. 1 and No. 2 without having a large water requirement i.e. low transmission losses. Due to the large hydraulic gradients available due to the area lying between the weir pools of Lock 8 and Lock 9, the introduction of flows into the system not only offers connectivity and flow conditions, but also hydrodynamic diversity. Additional benefits also include improvements to the riparian zone ecology.

Where remnant flowing water habitat remains, these habitats support robust populations of diverse native fish species, in particular Murray cod; a species listed as vulnerable in the *Environment Protection and Biodiversity Conservation Act 1999*. A key feature of the CCB site is the interconnected mosaic of aquatic habitats so that areas are provided for larvae, juveniles and adult fish.

The future of river rehabilitation in the lower River Murray partly lies in enhancing habitats like the CCB Creeks system as spawning and nursery areas, so they act as source populations from a regional perspective. There are few anabranches along the Murray or Darling Rivers that have this potential and, what is also rare; this is combined with potentially large inlets that do not restrict flow (Mallen-Cooper, pers. comm. 2013).

Hydrodynamic modelling on the CCB Creeks system shows that this system has the potential to support robust and diverse native fish populations, if the weirs are refurbished to incorporate adjustable gates and fishways to these regulating structures. By putting this infrastructure in place, more is able to be achieved with

less water. The infrastructure will help restore a more natural flooding regime to the project area, similar in frequency and duration to that which occurred before river regulation.

The two reports identify that significant environmental outcomes can be achieved with small investment in new infrastructure for Locks 8 and 9 weir pool manipulation on its own; however, significant capital expenditure has been identified within the CCB Creeks system.

Order of cost estimates have been prepared for the upgrade of the two weirs, two block banks and five road crossings and a summary of estimated costs is provided.

The infrastructure costs at the CCB Creeks system and Weir Pool Manipulations is estimated to be \$17 million.

Potential for Water Savings

Raising weirs will increase the flooded area subject to evaporation and seepage losses, while lowering weirs reduces these losses.

Water losses and savings were calculated for the four modelling scenarios. Losses and savings are expressed as an incremental loss in relation to stable weir pool levels at the same constant flows (Table).

The Lock 9 weir manipulation cycles use less water less than the current stable weir levels. Water is saved by increasing the extent of the weir pool in winter and spring, when evaporation is low, and decreasing the weir pool in summer and autumn, when evaporation rates are high.

The Lock 8 weir manipulation cycles use more water than current stable weir levels. There is less potential to reduce the weir pool extent than at Lock 9, and only 100 ha is exposed at the minimum weir level compared to approximately 500 ha at Lock 9 There is also more potential to increase the weir pool extent in winter and spring.

Table A. Estimated incremental water use (GL) for Lock 8 and 9 weir pool scenarios

Flow (ML/d)	Current Constraints		Without Current Constraints	
	Lock 9	Lock 8	Lock 9	Lock 8
10,000	-3.7	1.8	-3.4	3.5
20,000	-5.2	1.7	-5.1	3.4

Based on the above modelled figures, If Locks 8 and 9 are both manipulated at the same time the net water savings can potentially be 1.9GL, however it is more conservative to assume zero net use while achieving potentially significant and extensive ecological objectives.

Other Benefits

Carrs Capitts Bunberoo system can generate considerable ecological benefits - specifically relating to fish habitat, ecology, migration and breeding events with little or no net water use. Modelled against current river operations and current commence to flow thresholds, there is little opportunity for operating the CCB system to achieve the desired ecological objectives. With the proposed works, optimum

flows can be regulated down the CCB system in order to maintain high value fish habitat without the need to surcharge Lock 9 pool or rely on unregulated events coming down the Murray.

Conduct of the Project

This project was undertaken by Consultants, Ecological Associates, NSW Public Works and the Murray Darling Wetlands Working Group and supported by the NSW Office of Water. Ecological Associates was commissioned to prepare a Weir Pool Optimisation Plan and Ecological Objectives for Locks 8&9. NSW Public Works were independently commissioned (by a separate program) for the development of the Carrs Cappitts and Bunberoo Engineering feasibility study and the Murray Wetlands Working Group were commissioned to develop the business case, drawing on these above documents. In preparing these documents, the consultants built on

various studies undertaken over the last decade in an effort to bring forward a consolidated and coherent case for investing in works for this reach of the river.

Community Engagement

No community engagement was undertaken for this project, however extensive engagement with relevant agencies was undertaken.

Governance

The project was managed by a steering committee comprising representatives from:

- NSW Office of Water (chair),
- Murray Darling Basin Authority
- NSW Lower Murray Darling CMA
- Victorian Mallee CMA
- NSW Office of Environment and Heritage
- SA Water
- Murray Wetlands Working Group
- Victorian Department of Environment and Primary Industries, and
- Australian Government Department of Sustainability Environment Water Population and Communities

Benefits and Outcomes

The project has the potential to deliver considerable ecological benefits for the area, and given its key location within existing high value areas (TLM sites) provides a strong case for future investment in the area for very little net water use. Determination of actual SDL offset will be determined through the SDL Adjustment process which is working towards a final SDL adjustment by July 2016.

Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:-

Key Activity

Meeting to the steering committee to agree on membership, terms of reference, consultancy requirements, on-going reporting and community engagement.

Review of existing information, work done to date, plans and broad understandings of water management scenarios.

Investigate and develop ecological objectives to Weir Pool manipulation of Locks 8&9

Hydrodynamic modelling and Modelled water savings from preferred option/s and the potential for SDL offsets.

Project business case identifying, scoping and costing land and water management options.

NSW Environmental Works and Measures Part B

Community ideas

NSW undertook an extensive but targeted consultation process to gather community ideas and additional projects, which had the potential to achieve SDL offsets for future evaluation and possible implementation.

The consultation process had three target groups:

1. Agency sponsored groups involved in environmental water management: the Environmental Water Advisory Groups (EWAG) and the Catchment Management Authorities. These groups are responsible for providing the NSW Government with advice as to the management of state held environmental water and management.
2. State Water as the organisation responsible for water delivery - managing flows from headwater, in-stream infrastructure and access to flows by entitlement holders. Consultation was undertaken via its Customer Service Committees, which represent its delivery customers such as the irrigation industry, stock and domestic users, local government and Office of Environment and Heritage (OEH).
3. Invited members of regional interest groups, such as local government, water user groups, local environmental interests and general public.

The project and proposals were discussed and submissions invited over a six week period. Approximately 200 people across the NSW basin were involved yielding 77 submissions.

Ten projects were shortlisted for further development against the following criteria.

Criteria	Rationale
<i>Complementary to the proposed SDLs in the draft Basin Plan by either reducing the volume of consumptive water used or using environmental water more efficiently</i>	<p>To reduce the socio-economic impact of the SDL by maintaining production with less water or achieving the environmental objectives with less water, so that the SDL can be increased or less consumption water needs to be retired from production.</p> <p>Projects need to demonstrate one of two things:</p> <ul style="list-style-type: none"> • that productivity is not reduced or is enhanced by the use of less water. This can only be achieved by the replacement of the existing methodology – i.e. the application, distribution or storage efficiency is improved, involving less evaporative losses, seepage or loss beyond the root zone (irrigation). • the environmental objectives intended to be satisfied by the operation of the Basin Plan can be equally or better achieved using less water. This is difficult to simply assess in a Basin context, as many of the environmental water objectives are achieved as the result of specified high flow rates within the natural river system. <p>A project was not considered if this criterion was not satisfied.</p>

Criteria	Rationale
<i>Consistent with the environmental objectives and targets in the draft Basin Plan;</i>	Proposals must either deliver similar or better environmental outcomes. Proposals that may achieve water savings, but compromise environmental sustainability, were not acceptable. In this instance other works or measures would be needed to offset the environmental 'disbenefit'.
<i>Sufficiently large that the benefits can be assessed using current technology and provide a catchment-wide benefit</i>	<p>Any proposal that is receiving funding must be able to demonstrate that there is a tangible long-term benefit in terms of impacts of the SDL or improved environmental water delivery.</p> <p>Savings in consumptive water can be realised as an on-farm savings, where the volume saved is assessed as the volume of entitlement transferred to the Commonwealth.</p> <p>This entitlement has all the attributes of the category of entitlement transferred. In the case of savings achieved by the reduction of evaporation and/or seepage within the operation of a flow system, the long term characteristics of these savings were to be determined by a behaviour modelling process. For example, the savings may only be realised during "average" regulated flow periods and hence any entitlements created to reflect these savings have to have these attributes, so as to minimise/eliminate third party impacts. These volumes and reliabilities can only be determined using the current generation of models, such as IQQM. Thus, the volume has to be significantly large so that calculated impacts are not within the error of calculation of the modelling process.</p>
<i>Individually robust so that: other proposals would not erode its benefits; or it is not dependent on other proposals proceeding;</i>	<p>A project must be robust enough so that any benefits accrued are permanent, i.e. cannot be eroded by other management changes that can possibly be foreseen. A project must also be self-contained such that it does not require some other complimentary action to take place. In some instances it is possible that project benefits will be enhanced by future works and management changes.</p> <p>It is an unacceptable risk to proceed with a proposal that is dependent on the implementation of a complementary proposal. Similarly, a proposal that provides a benefit that may be eroded if other subsequent actions occur is also an unacceptable risk.</p>

Criteria	Rationale
<i>Cost-effective: generally no more than three times the cost of purchasing entitlement to achieve the same volume of water;</i>	<p>There is a responsibility to the wider public to only provide funding for projects that compare reasonably with a cheaper alternative. The initial assessment for the short list is cursory. In the case of large projects, such as new storages costing hundreds of millions, it is unlikely that water savings or benefits would be cost effective.</p> <p>It is reasonable to pay a premium for projects that will enable long term economic production and social benefits, hence the 'three multiplier'.</p> <p>The final upper limit will be determined by the Commonwealth.</p>
<i>Achievable using existing proven technology.</i>	<p>While there are prospects of technology being available in the future that will achieve water savings, such as monomolecular film to reduce evaporation, this project aims to deliver benefits in the near future and is not a research or development source of funding.</p>

NSW has recommended the following projects under **Part B** to the Commonwealth for further investigation. They are summarised in the following table and further described following.

All savings have been determined as estimated long term annual average yield. LTAAY

Region	Proposal	Potential savings GL per year
Murray	Murray Irrigation on farm efficiency	67 (83 [general security])* MIL conversion for LTAAY
Murrumbidgee	Murrumbidgee Irrigation Area on-farm efficiency	**7.9 (12.3 [general security])*
Murray	Improved water delivery to small irrigation areas and irrigation trusts	5
Murray	Improved Riverine Environment along regulated streams (Edward Wakool Murray)	5
Murrumbidgee	Redbank North- Environmental Water Delivery	95
Murrumbidgee	Yanco Creek Management and Delivery Efficiency	10
Lachlan	Willandra Creek Offtake modifications	30
Northern Basin	`Northern Basin –on-farm storages efficiency project	100
Whole Basin	Removal of flow regulation from effluent streams across NSW	90
Darling	Talyawalka environmental flow offtake enhancement	20
Total		430 Excluding CARMS
Statewide	Computer Aided River Management (CARMS)	80-280

** The proponent has advised that in-principal funding was approved in December 2012.

The project is now moving through Stage 2 of Round 3 of the Commonwealth Farm Efficiency Project.

The project is retained in this report as a record of the assessment

Details of the NSW proposed community projects

1. Murray Irrigation on farm efficiency, and Murrumbidgee Irrigation Area on-farm efficiency

These first three projects (general security and stock and domestic in the MIL area) could proceed without substantial feasibility study of scope, benefits and costs. Both projects involve on-farm efficiency works within the Murray Irrigation Limited (MIL) and Murrumbidgee Irrigation areas of operation and are considered to be “shovel” ready. Both projects involve upgrading the on-farm water delivery infrastructure on private farms within the irrigation corporations.

These proposals suggest the use of methodology has been applied and the administration process has been used in the past in the Private Irrigation Infrastructure Operators Program in both corporations. Actual individual on-farm projects are still to be identified.

The projects involve total savings; estimated to be **95GL** of general security licence. The water savings commitments are realised and finalised by the transfer of entitlement to the Commonwealth Environmental Water Holder.

Subsequently the proponents have advised that the *Murrumbidgee Irrigation Area on farm efficiency project* have received in principle funding approval in December 2012 and are moving through stage 2 of Round 3 of the *Farm Efficiency funding* requirements

If this has become actual funding, then the this project would be removed from the NSW shortlist and the revised estimated saving for the Murray irrigation farm efficiency project would be 83 GL of general security licence to be transferred to the Commonwealth environmental water holder.

2. Improved water delivery to small irrigation areas and irrigation trusts in the Murray Valley

There are a number of small irrigation areas and trusts where an upgrade of infrastructure may result in more efficient delivery of water with reduced water loss, while maintaining production. Work is required to identify suitable enterprises where the water delivery infrastructure can be upgraded and also to determine the extent of the required works, costs and savings. Further work will be required to identify specific target projects, however a saving and transfer of entitlement of **5 GL** may be achievable.

3. Murray- Improved Riverine Environment along regulated streams

A number of watercourses in the mid Murray/Edward/Wakool systems carry substantially more flow than under natural conditions and these results in prolonged inundation, involving unwanted water losses. This project is similar in concept to the Euston Lakes Restoration and Improved Water Efficiency Project (an Environmental Works and Measures Part A project). The project would reduce unhealthy inundation and provide the means for controlled watering of wetlands connected to regulated stream. An investigation project seeking possible sites and suitable works is required to assess the scope of benefits and costs. Savings of **5GL** and ecological benefits may be achieved.

4. Redbank North- Environmental Water Delivery

Redbank North is an area of the Lowbidgee Flood Control and Irrigation District and it is feasible that that a project similar to the Nimmie Caira proposal (Environmental Works and Measures Part A) could be developed. The project would involve transfer of the existing supplementary entitlement to environmental use and restructuring the area for dry-land farming. There are potential savings of about **95 GL**, provided all of the landholders participate.

5. Yanco Creek Management and Delivery Efficiency

The Yanco Creek system is used to deliver water to a large number of water users along its length, but it is not a particularly efficient water carrier from either an environmental or water delivery perspective. The *Yanco Creek System Natural Resource Management Plan* identified

improved environmental management which would result in water savings, such as control of inflows to the wetlands that are connected to the regulated watercourses. Hence, like the Euston Lakes, they are wet for too long and are not allowed to dry out at the appropriate times. Potential savings of at least **10 GL** may be achieved with the existing concept. It may be possible to deliver greater savings and benefits with an expansion of this project.

6. Willandra Creek Offtake modifications in the Lachlan Valley

Willandra Creek is a natural effluent of the Lachlan River downstream of Lake Brewster. Under current conditions (existing development and management) more water flows into the creek than did under natural conditions. A project is required to determine what works are required to return to a more natural flow regime. Potentially **30 GL** could be saved.

7. Northern Basin – on-farm storages efficiency project

There are numerous on-farm storages with a capacity of about 1400 GL in the NSW Darling Basin. It is generally acknowledged that existing on-farm storage infrastructure can be modified to achieve considerable evaporation savings. A project is required to determine the extent and possible cost of the works and a process to engage the irrigation community. A saving of **100 GL** is potentially possible.

8. Basin wide - Removal of flow regulation from effluent streams across NSW

There are numerous effluent streams that are used as carriers of regulated flow. State Water has identified a number of these effluent streams where if the water supply regime was changed and alternate water source/supplies provided that significant volumes of regulated flow could be saved and the environments of the stream improved. A saving of up to **90 GL** may be achievable.

9. Talyawalka environmental flow offtake enhancement

The Talyawalka wetland system offtakes from the Darling River upstream of Wilcannia and is a targeted wetland system in the Basin Plan. Works may allow a more sustainable watering regime of the Talyawalka wetlands using less water than envisaged and a project is required to assess the possible environmental and volumetric benefits and costs of any proposed works. A saving of up to **20 GL** maybe achievable.

Additionally, the NSW Government considers the Computer Aided River Monitoring or CARMS project worthy of consideration and has been included in the shortlist but has not calculated its potential savings as part of the overall savings for NSW

CARMS is a series of operational tools to better process river data such as flows, extractions and releases and to forecast flows and weather related flow trends. The pilot project in the Murrumbidgee aims to improve the timing of water delivery and in doing so reduce the volume of operational loss.

There is potential across the Basin for water savings in the range of **80 GL to 280 GL**

Additionally NSW considered the mid Murray Flow Enhancement by Mitigation of Bullatale Creek Third Part Impacts worthy of further investigation. While there are no quantifiable SDL offsets, the project seeks to examine the mandatory third party impacts of delivery of high flows and how these can be addressed.

Conduct of the Project

This project was undertaken by the NSW Office; however Derek Everson was employed as a consultant to provide technical expertise particularly during the assessment of potential water savings.

Community Engagement

As there was a level of “consultation fatigue” in NSW regional communities as a result of the development of the Basin Plan, the program of community consultation for this project was targeted and low key.

Given the high level of concern felt by many members of the community about the implementation of the Basin Plan, it was considered open public meetings would be counterproductive.

Seventeen formal meetings were convened across the NSW Murray Darling Basin.

Approximately 90 community-based representatives and approximately 80 agency staff were consulted.

These meetings were supported by an Office of Water media strategy involving press releases, interviews, tweets and web-based information.

Governance

- **Project Steering Committee** was established that had high level executive experience to direct and advise the Project Management Committee and sign-off of key deliverables. This Steering committee included the NSW Water Commissioner and a senior executive from the Federal Department of Sustainability, Environment, Water, Population and Communities
- **Project Management Committee** made up of internal NSW Office of Water staff to oversee the development and implementation of the project. This also include the consultant and Department of Sustainability, Environment, Water, Population and Communities as an observer
- **Project Working Group:** interagency group to provide expert advice on the development and implementation of the project, particularly the community engagement activities. This group included NSW State Water, Office of Environment and Heritage NSW Office of Water Catchment Management Authority and NSW Department of Primary Industries.

Benefits and Outcomes

The project allowed the community to engage in suggesting ways that the SDL offsets could be met.

Seventy seven proposals were submitted that resulted in 10 proposals being submitted to the Commonwealth as recommendations for further investigation. These ten ideas have the potential to generate 430 gigalitres of water.

Achievement of Key Activities/Milestones

The project met all the key milestones outlined in the project plan as summarised below:

Key Activity

Develop a project management plan

Undertake stakeholder & community engagement.

Engage NSW Murray-Darling Basin communities to identify local environmental works and measures sub-projects.

Options review – Prioritise community-identified sub-projects to produce a short-list for pre-feasibility assessments and develop a short list of ideas to investigate further.

Evaluate the community-identified sub-projects by undertaking pre-feasibility assessments.

Final report submitted to the Commonwealth on completion of the project

Appendix A - Piping Irrigation Schemes Assessment Summary Report