16. SURFACE WATER QUALITY AND QUANTITY

16.1 PROCESSES

16.1.1 Cause

Surface water availability is a direct result of runoff and consequently depends on climatic conditions, land use, dam and weir construction and water extraction. Runoff generally increases with degraded pastures and cropping as the original timber and native perennial grasses are replaced with annuals and soil structure declines. Consequently, less soil moisture is utilised and runoff occurs once the soil is saturated or rainfall exceeds the soil's infiltration capacity. Runoff is also a function of ground cover. Degraded pastures with ground cover levels of less than 70% or annual crops, particularly grown under traditional cultivation methods leaves the soil bare, infiltration rates low and consequent high levels of runoff. Soil conservation earthworks and farm dams may reduce the runoff and streamflow.

A wide range of contaminants, including sediment, agricultural chemicals, intensive livestock industries, industrial waste, urban waste and run-off and salinisation, affects water quality. The accumulation of nutrients, particularly phosphorus, can lead to algal blooms and eutrophication of the water. Increased runoff from cleared catchments can lead to increased stream size and capacity in the steeper uplands. This results in increased sedimentation in the middle catchment, which can result in localised flooding and erosion, as well as blockage of the main channel and diversion of water flow. The presence of chemicals in waterways poses a risk to human and ecosystem health including fish kills, and remedial works are costly. A high salinity level in the water reduces the suitability of water to be used for human consumption and can also adversely affect aquatic ecosystems (57).

16.1.2 Upstream/Downstream Inter-Relationships

Large numbers of farm dams built in the catchment have a significant impact on hydrology and salt transport. Loss of streamflow may be most noticeable in small upland catchments where the area is heavily used for grazing. Dam numbers and sizes are increasing and this reduces the potential streamflow. Reduced streamflow can lead to increased salt concentration in the river system because it is not being diluted sufficiently. Salt load in the Macquarie River decreases with distance downstream due to water extraction for irrigation and absorption in the Macquarie Marshes but salt concentration and turbidity increases (89).

Extraction of water for irrigation and other uses is degrading aquatic ecosystems. Environmental flows are needed to improve the health of the riverine environment and to reduce the potential impacts of blue-green algae. Poor water quality impacts on town water supplies can result in a need for additional treatment. Increased salt load and sedimentation can result in damage to irrigation pumping systems. Increased levels of chemicals and decreased water temperatures from releases below reservoirs can be harmful for fish populations and reduce breeding events.

There is some conflict between irrigators, and graziers in the Marshes over water use and allocation.

16.2 PRESENT CONDITION

16.2.1 Extent and Distribution

Little River is an unregulated river in the Upper Macquarie Valley. There are 29 irrigation licences and 6 other licences on unregulated streams including Little River and the subcatchments. Several other licence applications have been lodged. These licences are available for use on approximately 475 hectares of irrigation land. (See Appendix 11a.) All surface water licences on unregulated streams are to be converted to volumetric licences by the middle of 2000. Most licences are in the lower catchment. Some landholders in the Suntop/Arthurville area believe that water is over-allocated.

There are also 30 irrigation and stock and domestic licences on the Macquarie River. A total of 1100 hectares is irrigated with surface water drawn from the regulated Macquarie River. Additional area is irrigated using groundwater from alluvial aquifers.

Blue-green algal levels on Burrendong Dam are low to moderate, which means blooms are not common. When storage levels were low in 1998, the first major blue-green algal bloom occurred in the Macquarie River. Turbidity and phosphorus levels in the Macquarie River increase in a downstream direction. Water quality decline reflects the cumulative impact of activities in the catchment. Nutrient levels found in the Macquarie are conducive to algal growth and blooms (90).

Instream salinity is a significant water quality issue and is discussed in Section 14 - Dryland Salinity. There are serious concerns about water quality in Yeoval. Due to rising watertables, septic systems are causing waterlogging and seepages, particularly in winter.

16.2.2 Severity

The Little River is rated as having a medium hydrologic stress level due to water extraction and a medium environmental stress level under the NSW Stressed Rivers Assessment.

In the MDBC Salinity Audit, three critical threshold levels for electrical conductivity in streams were identified. These were:

- 800 EC threshold - upper limit for desirable drinking water (World Health Organisation levels), potential yield reductions for crops under irrigation.
- 1500 EC threshold - irrigation is risky, direct adverse biological effects on the environment, water starts to taste salty at 1700 EC
- 5000 EC threshold - the value that divides fresh water from saline water, saline ecosystems are visible. The upper limit for irrigation and livestock watering is 2300 EC and mixing with herbicides is 4700 EC.

Electrical conductivity levels are considerably higher in Little River than in the Macquarie River at both Burrendong Dam and Dubbo (see Figure 19 and Appendix 11b for Water Quality data). In the Little River, the 800 EC threshold is regularly exceeded, increasing the risk of yield reductions in crops under irrigation. Figure 19 also shows the initial flushing effect in the stream from a runoff event then a massive spike as salts are washed from the soil surface and dams, in which salt has accumulated, overflow. This continues while shallow saline groundwater seeps into the stream. The graph also shows a corresponding rise in electrical conductivity levels in the Macquarie River at Dubbo. Once upper catchment water is retained in Burrendong Dam after the irrigation season has finished, instream salinity rises as there is almost no upper catchment water to dilute the influence of the Bell, Little and Talbragar Rivers.

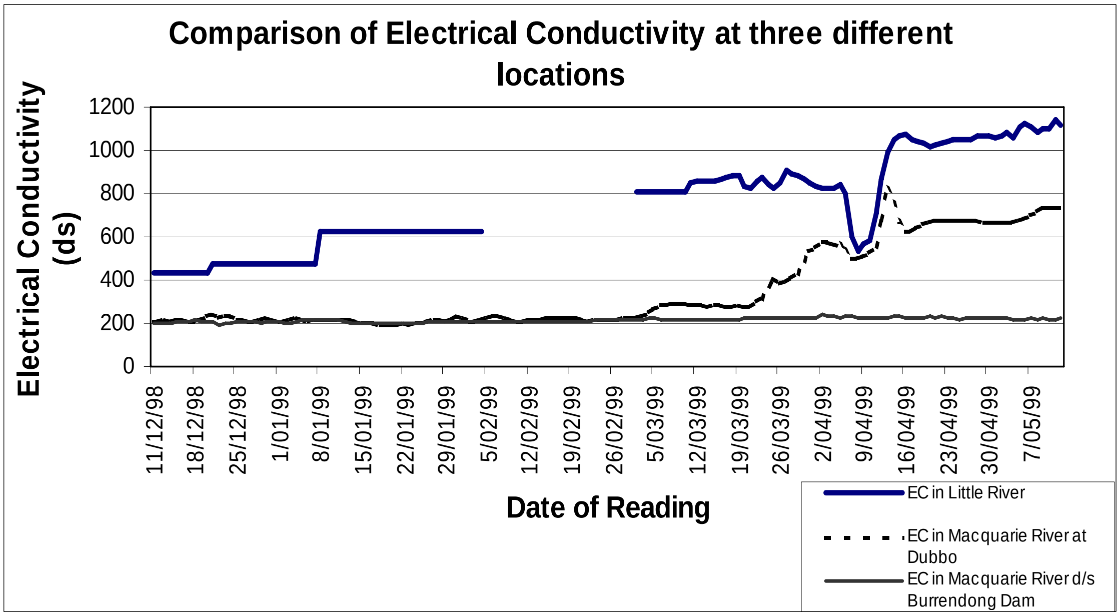

Figure 19. Electrical conductivity in Little River (Obley) and the Macquarie River at Dubbo and Burrendong Dam.

Guidelines for turbidity state that turbidity levels should be less than 5 Nephelometric Turbidity Units (NTU) for drinking water quality, and less than 50 NTU for environmental protection. Watercourses should also be maintained so that the seasonal mean turbidity does not change by more than ten percent (89). Figure 20 shows that Little River generally exceeds drinking water turbidity levels and frequently exceeds environmental protection levels.

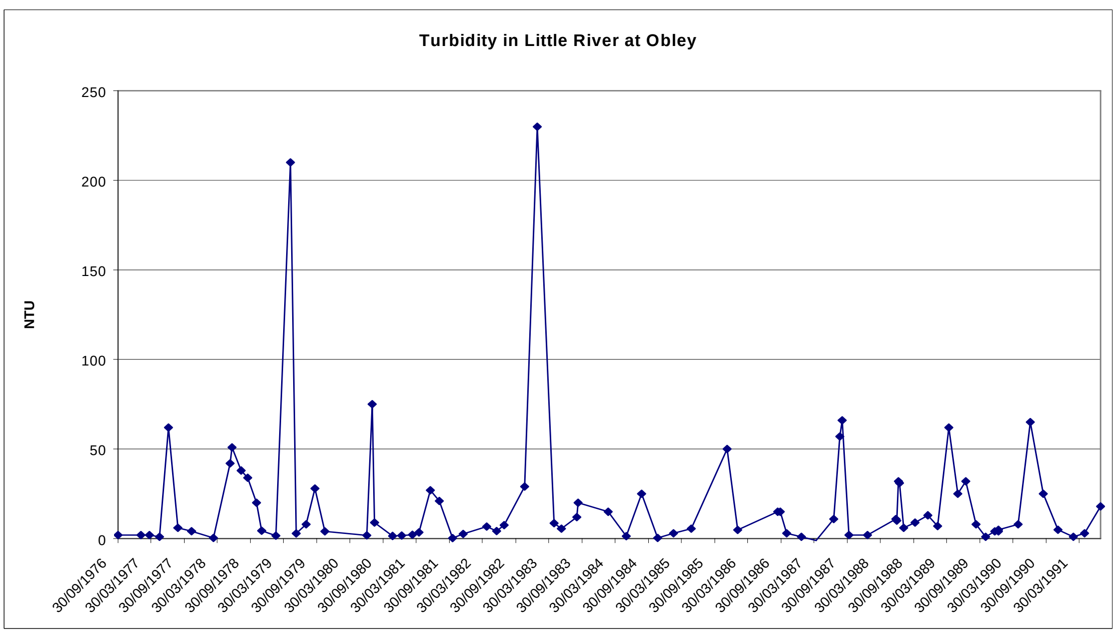

Figure 20. Turbidity levels in Little River.

16.2.3 Environmental Impacts

Environmental flow provisions were introduced in the Macquarie River in 1986 to maintain the health of the Macquarie Marshes. Other objectives of the environmental flows were to improve general river health, increase opportunities for native fish breeding and migration, improve the frequency of bird breeding events, increase the food and habitat availability, suppress algal blooms and to improve the health of in-stream ecology. The ongoing effects of these environmental flows will be monitored and from these a River Management Plan will be developed to ensure a balance between environmental, social and economic requirements (32).

The Macquarie Marshes Water Management Plan was introduced in 1996. The plan allows for ongoing planning and research, ensures wildlife water allocations in Burrendong storage, identifies areas for better management of cotton farming and other irrigation activities and restricts access to unregulated flow by capping off-allocation extractions to 50,000 ML/year (33, 34).

Land management in the Little River Catchment affects the Macquarie River in a number of ways. These include reducing the amount of water available to the Macquarie with farm dams and other diversions and increasing instream salinity by contributing water which is high in salt load. Rising salinity levels in the river systems affects the health of the aquatic ecosystems. A lack of healthy riparian zones and wetlands reduces the potential filtration benefits these zones have. The increased use of chemicals in the agricultural industry can result in fish kills if not applied appropriately. Releases of water from the bottom of storage reservoirs results in cold water pollution which can adversely affect aquatic ecosystems, particularly fish populations.

Water quality monitoring at Molong Rail Bridge, downstream of the Little and Macquarie River confluence, indicates high salt loads (approximately 132,000 tonnes) which has been attributed to dryland salinity problems in the upland areas of the catchment (89). Figure 21 shows how the salt load in Little River influences the Macquarie River.

During periods of high flow in the Macquarie, when water is being released from Burrendong Dam, inflows have little impact on the salt load of the Macquarie. However, the figure highlights the impact that Little River can have on salt load and salt concentration in the Macquarie River during low flow periods, when upstream water is being stored.

16.2.4 Social and Economic Impacts

The costs to Local Government for the treatment of town water supplies are significant, particularly for the removal of sedimentation and algae. Other costs associated with town water supplies are the repair and maintenance of treatment facilities. If water quality were to decline, these costs would significantly increase, particularly for the treatment of salinity in drinking water.

Similarly, costs to irrigators in the short term, for pumps and infrastructure repair or replacement, due to high sediment load in the water can be high and in the longer term, due to salt accumulation are likely to be massive.

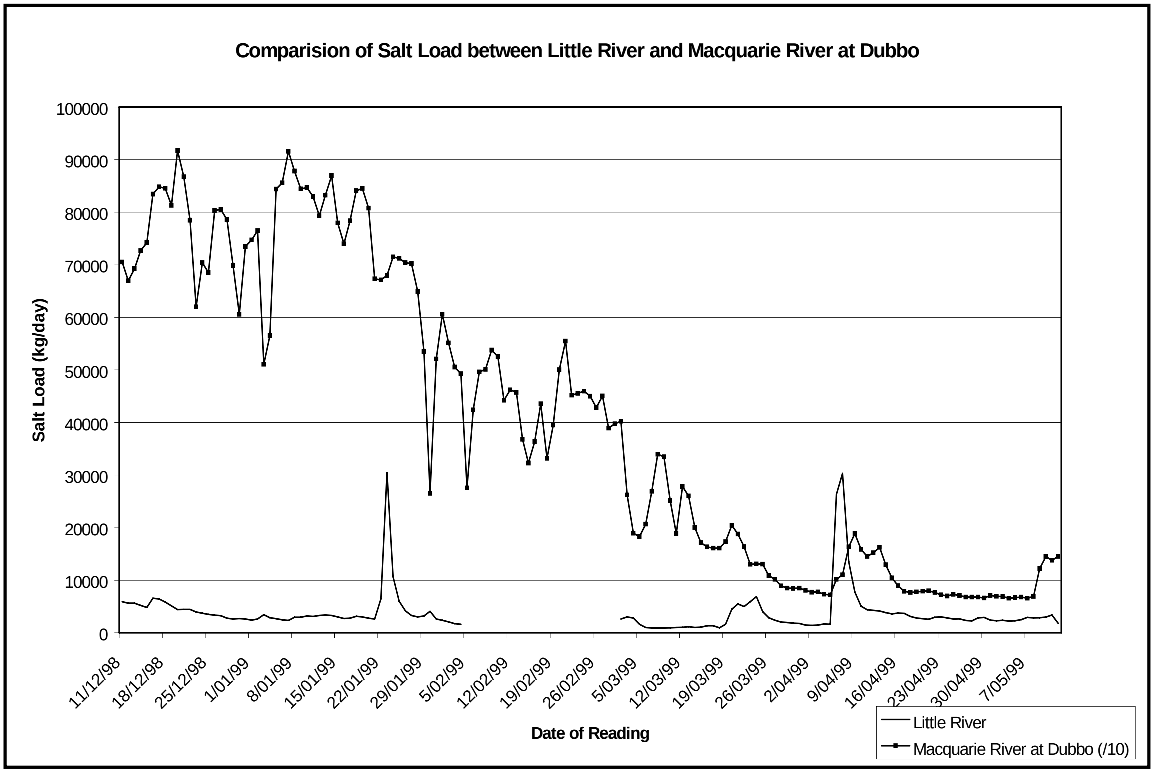

Figure 21. Salt loads in Little and Macquarie River.

16.3 THE FUTURE
16.3.1 Trends

It is expected that the deterioration of water quality in the tributary catchments in the Macquarie Valley is likely to be more severe and widespread than most other catchments in New South Wales. Water allocations for the Macquarie Marshes may be needed for flushing saline areas as methods of water quality control. Electrical conductivity increased with distance downstream along the Macquarie River corresponding with decreasing flows, and total salt load declines due to extraction (89).

16.3.2 Environmental impacts

If the current trend of salt load entering the Macquarie River from upstream continues, it is estimated that in 100 years the water quality will not be suitable to irrigate most crops. The Macquarie Marshes is likely to be placed under extreme stress in the future because of salt load accumulation. Degradation of the aquatic environment due to salinity may be accelerated. Irrigators are likely to want to build large on-farm storages to intercept freshes and avoid high salinity spikes. This would cause greater stress on regulated rivers. Dilution flows may be required on both regulated rivers and unregulated rivers. This would lead to lower reliability for all users and put pressure on environmental flow allocations.

16.3.3 Social and Economic Impacts

River salinity levels in the Macquarie River are predicted to exceed the World Health Organisation (WHO) safety limit for drinking water more frequently during the 21st Century.

Treatment costs of town water supplies would increase, particularly the treatment of turbidity, salt load and algal content. The potential long-term impacts of increased stream salinity are enormous. The irrigation industry may contract in size, have less cropping options or require engineering works or major changes to their management approach to be able to cope with higher salinity levels in the water and accumulated salts in the soils.

Increased water requirements may be needed for flushing, which is contrary to the current approach for increased water use efficiency. The socio-economic cost if the Macquarie Marshes are degraded will include losses in tourism, and even more significantly, ecosystem values.

16.4 CURRENT ACTIVITIES

16.4.1 Consultation

Macquarie Marshes Catchment Committee was formed in 1989. This committee is relevant to the Little River Catchment in that the committee is trying to ensure the wetlands remain productive, and are concerned about pollution from upstream sources. In 1997, the Macquarie Marshes Land and Water Management Plan was developed with input from landholders, government agencies, local Shire Councils, environmental groups, Aboriginal groups and the public.

16.4.2 Planning

The Department of Land and Water Conservation and the National Parks and Wildlife Service introduced the Macquarie Marshes Water Management Plan in 1996. The plan allows for ongoing planning and research, ensures wildlife water allocations in Burrendong storage, identifies areas for better management of cotton farming and other irrigation activities and restricts access to unregulated flow by capping off-allocation extractions to 50000 ML/year (33).

The Macquarie Valley Landcare Group (downstream of Narromine) has developed the Macquarie 2100 Plan which addresses a wide range of physical, social and economic issues, including the long term viability of the irrigation industry and associated communities.

A Nutrient Management Plan for the Macquarie Catchment has been developed by DLWC and the Central West Catchment Management Committee. The plan is a strategy for the promotion and adoption of land management practices and decision making which limits the entry of nutrients, particularly nitrogen and phosphorus into the waterways of the catchment (90). Both the NSW Government and MDBC have had an Algal Management Plan in place for some time.

As part of the Water Reform Process, the Macquarie River Management Committee will refine the Water Quality and River Flow Objectives for the Macquarie River. Interim Objectives are already in place, and environmental flows have been allocated for the Marshes.

An Unregulated River Management Committee in the Macquarie Valley has also been established. There is less urgency associated with these committees when compared to other regions such as the Namoi because not a lot of unregulated water is used for irrigation. However, water quality issues on the unregulated rivers require addressing urgently because of high salt loads especially in Little and Talbragar Rivers.

The MDBC and NSW State Government are both developing Salinity Strategies for release in mid 2000 and the MDBC is expected to set targets for each river system.

16.4.3 Research and Development

The Cooperative Research Centre (CRC) for Freshwater Ecology plays a valuable role in providing an understanding of inland waters by funding research, education and resource management programs. Major research programs undertaken by the CRC include ecological assessment, energy and nutrient dynamics, water regime and allocation and restoration and rehabilitation ecology. The effects of cold water pollution are being monitored below Burrendong Dam.

The National Eutrophication Management Program (NEMP) is a LWRRDC and MDBC program which aims to reduce the amounts of nutrients in waterways and to provide management options. The Catchment Management Support System (CMSS) is used to estimate the average annual nutrient load in the catchment, which can provide an initial basis for formulation of nutrient management plans.

16.4.4 Implementation

The NSW Water Reforms were introduced in 1997. A major part of the Water Reforms is the Murray-Darling Basin Cap and the Coalition of Australian Governments (COAG) Water Reform Agenda (36). The Murray-Darling Basin Ministerial Council set an upper limit on the amount of water that could be taken from the river system. The cap is defined in any valley as that amount of water that would have been extracted had development levels not grown beyond those which existed up to and including the 1993/94 season. The Cap is considered essential for restricting further damage to the river systems and environmental flows have been introduced to preserve and rehabilitate the river systems. However, there are repeated attempts by irrigators to have the Cap reviewed.

Environmental flow provisions were introduced to the Macquarie River in 1986 to maintain the health of the Macquarie Marshes.

The transfer of all area or pump capacity licences on unregulated streams in New South Wales to volumetric licenses will be implemented within the coming year. This will promote efficient water use and provide more investment security to existing water users. It will also bring unregulated water users into line with water users on regulated rivers.

16.4.5 Monitoring and Evaluation

Central and North West Regions Water Quality Monitoring Program (CNWRWQMP) has been monitoring and testing the Macquarie River since 1991 for trace metals, biological monitoring, pesticides monitoring and nutrients and general water quality monitoring. The most upstream site monitored by the CNWRWQMP is the Molong Road Bridge just above Dubbo (46). DLWC monitors a number of sites for water quality. However, the only site on Little River is at Obley. There is no monitoring site at the confluence of Little River and the Macquarie River. The New South Wales Water Reforms also provide for ongoing monitoring and reporting on the health of waterways within the State. The Cooperative Research Centre (CRC) for Freshwater Ecology also has ongoing monitoring programs in place, including monitoring the benefits of environmental flows.

16.4.6 Best Management Options (BMOs)

There are two categories of management options available - prevention and control. Land management practices need to be altered in order to prevent further reduction in water quality. Recommended actions to improve water quality and reduced the amount of nutrients reaching the waterways include:

- Retention of existing native riparian vegetation
- Restrict stock access to riparian areas
- Enhance and revegetate the riparian zone
- Maintain woody debris in rivers
- Engineering works (worst case scenario)
- Appropriate fertiliser management
- Apply split applications of fertilisers
- Increase soil organic matter to increase nutrient holding capacity
- Apply fertilisers close to target crop or pasture
- Use conservation farming techniques
- Prevent erosion
- Ensure waterways and filter strips remain grassed
- Maintain groundcover
- Apply chemicals at recommended rates and in appropriate climatic conditions. (90)

16.4.7 Identified or Perceived Barriers

There is potentially a conflict in policy and management between reduced water application to improve water use efficiency as recommended in the Water Reforms, and the need to flush salts through the profile as salinity levels in irrigation water increases.

16.4.8 Institutional

The COAG Water Reforms, the NSW Water Reform Process, the Murray Darling Basin "Cap", and the Water Harvesting/Dams policy are driving reform in surface water use. The NSW Water Reforms were introduced in 1997. These reforms aim to achieve better water use by improved sharing of water resources between the environment and water users. Initiatives associated with the reforms include the State Groundwater Policy, State Weirs Policy, Healthy Rivers Commission, a Review of Total Catchment Management (TCM), Water Advisory Council, Water Conservation Strategy and ongoing monitoring and reporting.

A major part of the Water Reforms is the continuation of the Murray-Darling Basin Cap, which was introduced in 1995. The Cap was introduced as a response to concern over the rate of growth in water extractions and the impact of this pressure on riverine health (36). The Murray-Darling Basin Ministerial Council set an upper limit on the amount of water that could be taken from the river system.

The Farm Dams Policy recognises the landholders' right to use rainwater runoff and allows the landholder to have farm dams of sufficient capacity to meet the general farm needs. The Policy also recognises that runoff water is used by other water users further down the catchment. The Farm Dams Policy allows landholders to capture and use up to 10% of the average yearly regional runoff from their property without needing a licence. This water can be used for any purpose. Any dams that are larger than the Maximum Harvestable Right Dam Capacity (MHRDC) have to be licensed (79).

16.4.9 Investment

The New South Wales Government is providing $33.5 million in incentive funding over five years, and $76.6 million on the implementation and support for regional community based committees. Water pricing is also being reviewed under the Water Reforms Policies to allow for a full cost recovery in rural water pricing.

Waterwise is a NSW Agriculture program funded by the Water Reform Package, which provides incentives for farmers to improve efficiency of water use. Other programs include Farming for the Future, Landcare, Rivercare, Conservation Farming Associations, Phosphorus Action, Trees on Farms, and One Billion Trees. Local Government initiatives include sewage treatment plant upgrades and nutrient control works as well as support for the Phosphorus Action Campaign.

The MDBC has made very significant investments into nutrient and salinity management, and has targeted the Mid Macquarie for future programs.

16.4.10 Cost Sharing

The Water Reform package has an incentives based program for change called Waterwise. Small subsidies are available for implementing on farm changes subject to farm planning. Costs of metering and loss of production through reductions in water allocations will be borne by producers under current policy. NHT and MDB 2001 also provide matching funds to landholders to help make necessary land management changes.

16.4.11 Financial and Benefit Cost Analysis

Ivey ATP undertook a study on the costs of salinity in Little River. They are currently involved in further studies across the Murray Darling Basin.

16.5 ANALYSIS

16.5.1 Identified or Perceived Gaps

There are no accepted ways of putting costs on the loss of ecosystems values, due to salinity. This is particularly relevant for potential degradation to the Macquarie Marshes.

The lack of water quality monitoring sites on the Little River and its tributaries severely limits the knowledge and understanding of the main sources of poor water quality. Further sites are needed at the junctions of the subcatchments eg. where the Buckinbah Creek meets Little River, so that investment to improve land management can be directed to the priority areas. In addition a site is needed on the Macquarie immediately downstream of where Little River enters so that accurate information is available on the impact of the Little River Catchment on streamflow and water quality in the Macquarie River.

16.5.2 Key Stakeholders and Contacts

Department of Land and Water Conservation
Sri Sritharan - River Operation Manager - Macquarie, Dubbo
Greg Raisin - Riverine Corridor Manager, Orange
Jane Rowlands - Total Catchment Management Coordinator, Orange
Debbie Love - Water Quality Resource Officer, Dubbo
Monika Muschal - Program Manager CNWRWQMP, Newcastle
Brian Gardoll - Water Administration, Dubbo

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