June 2002

Surface Water Management Strategy Review

Shepparton Irrigation Region

GOULBURN
BROKEN
CATCHMENT
MANAGEMENT
AUTHORITY

North Central
Catchment
Management Authority

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E Executive Summary

Approximately 7,300 irrigated dairying, horticultural and mixed farms supply some 22 food processing factories in the region.

Location and state of the region

The Shepparton Irrigation Region (SIR), located in the central northern area of Victoria, is one of regional Australia's most important food producing and food processing areas. The region, which covers some 519,240ha, contains numerous environmentally significant wetlands, has significant areas of native vegetation and has experienced a very heavy investment in regional infrastructure.

Approximately 7,300 irrigated dairying, horticultural and mixed farms supply some 22 food processing factories in the region. The industries employ approximately 13,000 people directly and a further 10,000 indirectly out of a total workforce of approximately 46,000 (ABS 1997). i.e. approximately 50% of the workforce in the SIR is dependent on the long-term viability of the irrigation-based industries and the related food processing industries (milk, horticulture, meat and grains).

The annual farm-gate production value from the SIR in the year 2000 has reached approximately $1 Billion. The processing of these products results in a total gross value to the Region of approximately $1.7 Billion. The current lack of regional surface drainage infrastructure is a major impediment to growth in agricultural production and output from the food production and processing industries.

Catchments

The region is primarily contained in the Goulburn Broken Catchment with a smaller area west of the Campaspe River located in the North Central Catchment.

Five irrigation areas form the region with the majority of water for irrigation being provided from Eildon Reservoir on the Goulburn River with other storages on the Broken and Campaspe Rivers supplementing the flows into the irrigation areas. The Murray Valley Irrigation Area bounded by the Murray River and the Broken Creek is also supplied from the Murray River at Yarrawonga Weir.

Why works are required?

The removal of the native open woodland and the development of irrigated agriculture in the SIR have altered the natural hydrologic balance. Rainfall, irrigation, plant growth, soil types and topography, are all factors, which impact on the hydrologic balance. The removal of most of the trees and the frequent application of irrigation water results in the soils of the region generally having a higher average moisture content. This in turn results in higher volumes of run-off being generated by rainfall events. This run-off overwhelms the natural drainage systems and temporarily inundates large areas of farmland and native vegetation.

Ponded rainfall is a significant source of recharge to the watertable and therefore exacerbates soil salinisation. From a farm perspective, it results in prolonged waterlogging on farms with an adverse impact on productivity, and is a major detriment to landholder investment in sustainable agriculture and best management practice.

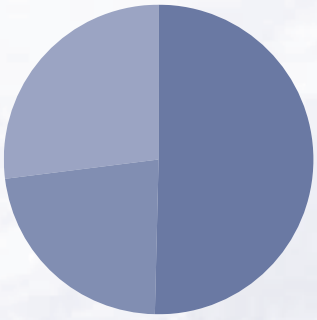
Some 286,040ha (60%) of the region was without effective surface drainage at the commencement of the implementation of the Surface Water Management Strategy in 1990. To alleviate these problems, significant surface drainage infrastructure works are required to enable the removal of excess rainfall run-off from irrigated lands, provide an outfall for ground-water pumps and create the opportunity to preserve or enhance wetlands and native vegetation.

The respective areas drained in the SIR as at July 2000 are shown in Figure E0-1 SIR Areas Drained. The area without drainage has now reduced to 241,510ha.

The expression "Surface Water Management" is used in preference to "Surface Drainage", because of the holistic objectives of managing surface water flows within the Strategy. The extent and degree of integration of the proposed works and measures go beyond the narrow objective implied by the expression "drainage".

The strategy will facilitate the construction of 1,760km of (CSDs) , 189km of Goulburn-Murray Water (G-MW) Primary Drains, 564km of Drainage Course Declaration (DCD) and 12km of drain upgrading.

Areas Drained in the SIR as at July 2000. ('000ha)



Total Area 519

Drained 1990 233

Drained 2000 278

The strategy will facilitate the construction of 1,760km of (CSDs) , 189km of Goulburn-Murray Water (G-MW) Primary Drains, 564km of Drainage Course Declaration (DCD) and 12km of drain upgrading.

Works required

Although the servicing of currently undrained land is the primary focus of the Strategy, other issues including monitoring, water quality, water use efficiency, modification to older drains (retrofitting) and farm aspects of surface water management apply to the whole of the SIR.

The strategy will facilitate the construction of 1,760km of (CSDs) , 189km of Goulburn-Murray Water (G-MW) Primary Drains, 564km of Drainage Course Declaration (DCD) and 12km of drain upgrading. In addition, 3,600ha will be serviced by water harvesting and significant upgrading works on the Broken Creek will be undertaken with some 41,900ha of wetlands and remnant vegetation being protected across the region.

Cost of works

The total estimated cost to finish implementing the Strategy at the year 2000 is $164.2 million of which $110 million is expected to be funded by both State and Federal Government. These government funded activities comprise $45.6 million for G-MW Primary Drain works and $64.4 million CSD works. All financial figures exclude GST.

Economics

The implementation of this strategy will lead to significant environmental, social and productivity benefits. Most of the financial benefits have been quantified using the Murray Darling Basin Commission's (MDBC) Drainage Evaluation Spreadsheet Model (DESM). This indicated that the unfinished part of the strategy as at December 2000, has a benefit-cost ratio of 1.23 and a Net Present Value of $40 million. As the actual costs of building Primary Drains and CSDs are relatively higher than those estimated in 1995, the benefit-cost ratio and the NPV have both marginally fallen relative to the 1995 estimates.

Significant benefits that have not been included in the analysis are the water quality/ nutrient reductions and the associated environmental and social benefits that the surface water management schemes facilitate. Those benefits are accounted for under the Water Quality Program of the Goulburn Broken Regional Catchment Strategy.

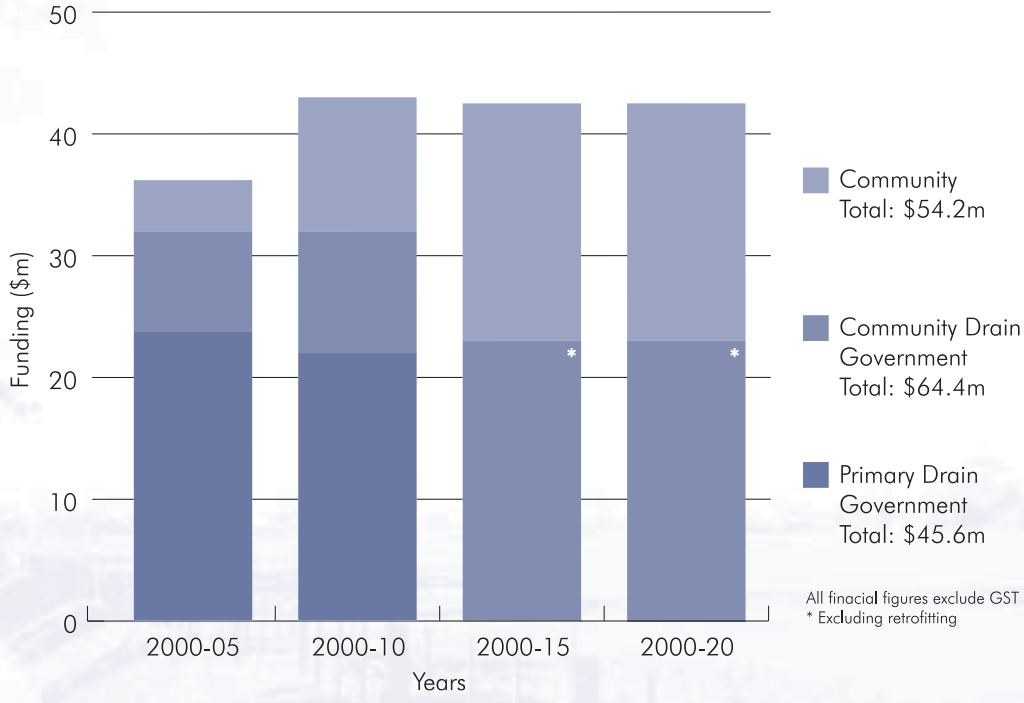
Funding needs

At current levels of funding, the Strategy capital works program will be completed by 2020. To achieve this target, the cash flow would need to be as shown in Table E0-1. Many of the CSDs cannot be constructed until their Primary drain outfalls are constructed. It is therefore important that Primary Drains are completed early in the program. Meeting this completion timeframe will therefore require government funding of at least $6.4 million per year (i.e. $32 million per five years) over the next 10 years with $4.6 million per year allocated to primary drains over the next ten years to ensure all Primary Drains are completed by 2010.

A total of $164.2 million is required over the next 20 years to ensure completion of all works under the Strategy.

At current levels of funding, the Strategy capital works program will be completed by 2020.

Table E0-1 - Proposed Funding



1 Shepparton Irrigation Region

The Food Bowl of Australia - A Great Place to Live - Under Threat and Essential to Preserve.

The annual farm-gate value of production from the SIR in 2000 has reached approximately $1 Billion. The processing of these products results in a gross value of production from agricultural production and processing of approximately $1.7 Billion.

The Shepparton Irrigation Region (SIR) covers some 519,240ha. Of this area 280,000ha is irrigated and 286,040ha was without effective surface drainage at the commencement of the implementation of the Surface Water Management Strategy in 1990. The area without drainage has now reduced to 241,050ha.

The respective areas drained in the SIR as at July 2000 are shown in Figure 1-1.

Economic heartland

The SIR is one of regional Australia's most important food producing and food processing areas, it contains numerous environmentally significant wetlands, has significant areas of native vegetation and has a very heavy investment in regional infrastructure.

Approximately 7,300 irrigated dairying, horticultural and mixed farms supply some 22 national and multinational food processing factories in the region. Farm production and food processing in the SIR employs approximately 13,000 people directly and a further 10,000 indirectly out of a total workforce of approximately 46,000 (Australian Bureau of Statistics 1997). i.e. approximately 50% of the workforce in the SIR is dependent on the long-term viability of the irrigation-based industries and the related food processing industries (milk, horticulture, meat and grains).

Regional Industries have invested approximately $1 Billion (Y2000$) in local manufacturing infrastructure over the last seven years on the understanding that the Regional Catchment Strategy for the SIR is implementing programs to protect their raw material (farm produce) base and water supply quality.

The annual farm-gate value of production from the SIR in 2000 has reached approximately $1 Billion. The processing of these products results in a gross value of production from agricultural production and processing of approximately $1.7 Billion. The lack of surface drainage infrastructure is a major impediment to this growth of both agriculture and its associated processing industries.

Extensive Environmental features

The SIR has extensive environmental assets of importance with significant wetlands and numerous sites of remnant vegetation.

Of the 10 sites listed in Victoria under the Ramsar Convention, four are within northern Victoria. The Barmah - Millewa Wetlands is immediately adjacent to the SIR, while Gunbower Forest, the Kerang Lakes and Hattah Kulkyne National Park are located downstream of the region. There are six other wetlands listed in the "Directory of Important Wetlands in Australia 2nd Edition Phillip Perret" while the Department of Natural Resources and Environment (NRE) staff have identified some 22 wetlands of Regional Significance in the SIR.

The heritage listed lower Goulburn River, together with the Broken River and Broken Creek are significant habitats for native fish. The latter streams are ranked second and third in Victoria after the Ovens River for Murray Cod breeding and are important also for Golden Perch.

The preservation of these sites, and their protection from the impacts of waterlogging due to flooding, high watertables, salinisation and degradation of water quality is important. Similarly steps must be taken to conserve and manage the biological diversity of the region.

Prior to settlement, the SIR was rich in native flora and fauna. As a consequence of clearing of the floodplains and other poorly drained land, there are now several threatened species including Buloke and White Cypress-pine (Murray Pine). Similarly a number of fauna species including the Brolga, Superb Parrot, Grey-crowned Babbler, White-Bellied Sea-Eagle, the Squirrel Glider, Barking Marsh Frog and the Giant Bullfrog are threatened due to habitat degradation. The same applies to Trout Cod, Murray Cod and the Murray River Crayfish. The latter species depend upon having clean rivers and streams for survival.

Archaeological heritage

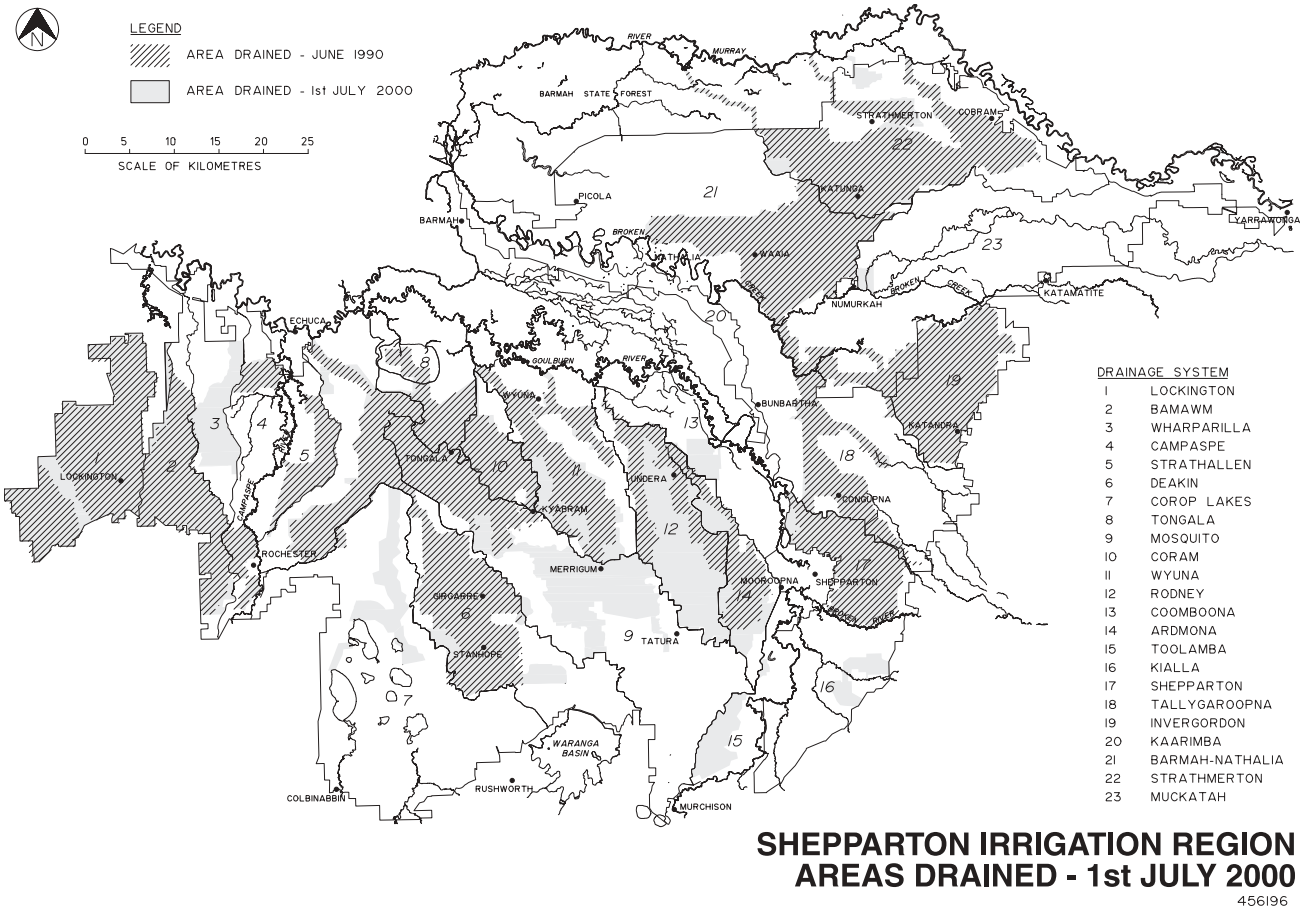
Field surveys for the implementation of projects to enhance surface water management have documented evidence of Aboriginal occupation of the Goulburn and Campaspe River Basins, particularly in areas where fresh water was readily available. A lack of adequate drainage following irrigation has lead to deterioration in some of these heritage sites. The implementation of a Surface Water Management Strategy will assist with the protection and enhancement of these archaeological sites.

Conclusion

The long-term sustainability of the SIR is vital to the economic well being of Victoria. Effective surface water management is essential to maintain the highly productive agricultural land, environmental significant wetlands, heritage sites, significant areas of native vegetation, regional biodiversity and regional infrastructure in the Shepparton Region.

Only about 50% of the SIR is protected from waterlogging with adequate surface water management systems. The Goulburn Broken Regional Catchment Strategy includes the SIR Land and Water Management Plan (SIRLWMP), part of which is the progressive implementation of a surface water management system throughout the SIR. One of the primary objectives of this system is to preserve the economic, environmental and social assets of the region.

Figure 1-1 SIR Areas Drained



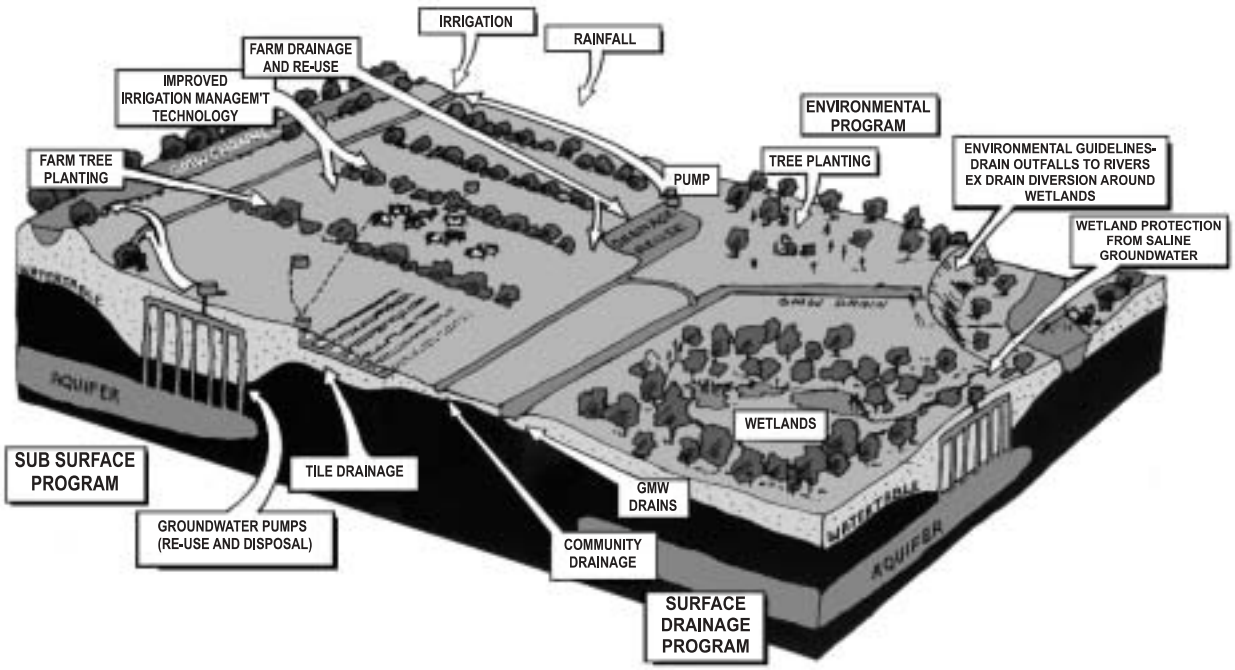
2 Why Does Surface Waterlogging Occur?

The removal of the native open woodland and the development of irrigated agriculture in the SIR have altered the natural hydrologic balance. Rainfall, irrigation, plant growth, soil types and topography are all factors that impact on the hydrologic balance. The removal of most of the trees and the frequent application of irrigation water results in the soils of the region generally having a higher average moisture content. This in turn results in higher volumes of run-off being generated by rainfall events. This run-off overwhelms the natural drainage systems and temporarily inundates large areas of farmland and native vegetation.

Ponded rainfall is a significant source of recharge to the watertable and therefore exacerbates soil salinisation. From a farm perspective, it results in prolonged waterlogging on farms with an adverse impact on productivity, and is a major detriment to landholder investment in sustainable agriculture and best management practice.

Surface water management systems (Figure 2-1) are designed to remove run-off from irrigated land and convey it, either to a natural stream, or to a re-use storage where it can be held, and then used for irrigation once the land starts to dry out. These systems result in reduced waterlogging, reduced salinisation, less road infrastructure deterioration and enhancement of wetland and native vegetation values.

Figure 2-1 An Example of a Surface Water Management System



3 What Should be Done?

The Goulburn Broken Catchment Management Authority (Goulburn Broken CMA) has developed a strategy to efficiently manage surface water in an economic, socially and environmentally acceptable manner. This document outlines that strategy.

The Surface Water Management Strategy has a major emphasis on "best management practice" and will be integrated with other catchment management programs to encourage best irrigation management practice and to ensure a holistic approach to surface water management.

Implementation of this Surface Water Management Strategy will address items such as waterlogging, salinisation and downstream water quality impacts, which are most likely to threaten agricultural production and environmental conservation.

The Strategy will:

- Enable the removal of excess rainfall run-off from irrigated lands;
- Provide an outfall for ground-water pumps;
- Facilitate management and reduction of nutrient inflows; and
- Create the opportunity to preserve and enhance wetlands and native vegetation.

These results will be achieved by removing excess run-off and reducing groundwater recharge in a controlled manner.

The initial Surface Drainage Strategy was included in the SIR Land and Water Management Plan developed by the regional community through the Goulburn Broken Salinity Pilot Program Advisory Council in 1989. In 1995 the Strategy was reviewed to reflect the increased use of community surface management schemes.

In April, 2000, a second review of the strategy commenced. This review, through an extensive process of community consultation, examined the implementation progress, changes in design and construction practices, and changes in the legislative, administrative and business environment.

In short, the 1995 review documented what drains needed to be constructed, whereas the 2000 review looked at how and why drains are constructed, as well as documenting what remains to be done.

4 Why do we Need a Surface Water Management Strategy?

A surface water management system includes the integrated application of all measures and actions that may be used to manage surface water so as to minimise any adverse impacts on the environment, heritage features, agriculture and the wider community. The strategy includes the development of regional drains as well as other farm and off-farm physical components and management practices associated with surface water management.

The SIR Surface Water Management Strategy consists of a number of components constructed such that rainfall generated run-off from irrigated land can be managed and removed in a controlled manner. A system includes physical components such as:

- Surface drains;
- Flood storage areas;
- Natural flow paths;
- Flow control structures (to facilitate water management and management of wetlands);
- Farm reuse systems; and
- Regional water reuse systems/diversion sumps.

The expression "surface water management system" is used in preference to "surface drainage", because of the holistic objectives of managing surface water flows within the Strategy. The extent and degree of integration of the proposed works and measures go beyond the narrow objective implied by the word "drainage".

In addition to physical components, education and the adoption of improved management practices also form a significant part of a surface water management system and play an important role in determining how effective the system is in achieving its objectives. Management practices cover the operation and maintenance of drains, as well as agricultural practices and the management of wetlands.

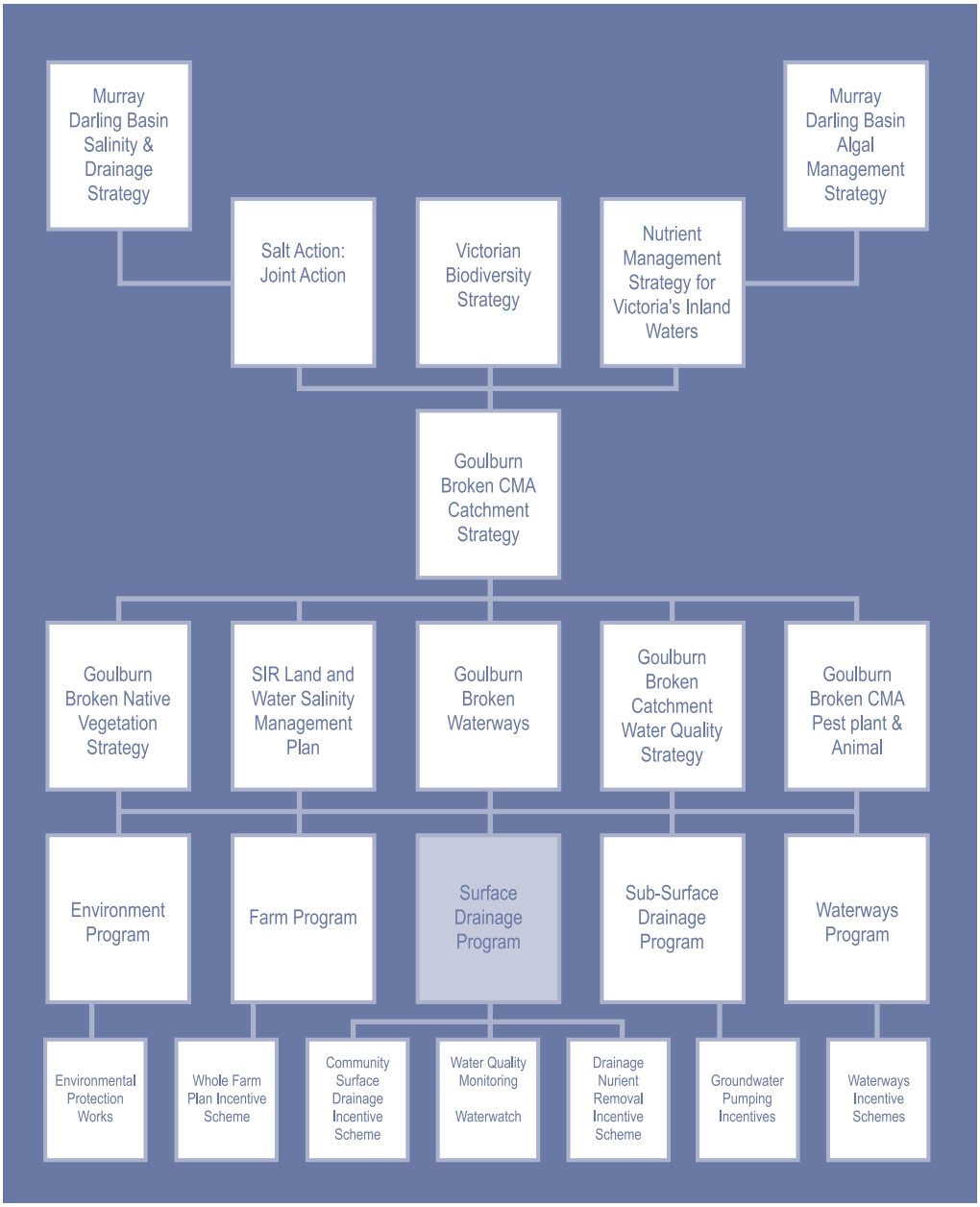
Monitoring is included to assist with the management and future development of the surface water management plan which may incorporate Environmental Management Plans. Research and development is also undertaken as part of the Strategy to investigate and develop new and improved methods and practices of surface water management.

School children planting aquatic plants at Mukatah.

5 Where Does SWM Stategy Fit in the Catchment Strategy?

The Surface Water Management Strategy for the SIR is one of a number of strategies, plans and action documents, which are components of the Goulburn Broken Regional Catchment Strategy. Figure 5-1 shows the relationships between these documents.

Figure 5-1 Strategic Plans Driving Natural Resource Management in the Shepparton Irrigation Region



6 Goals of the Surface Water Management Strategy

The primary goal of the Surface Water Management Strategy is to:

By the year 2020, improve the health of natural resources and reduce the risk to investment in the Shepparton Irrigation Region, by providing an appropriate surface water management service in areas where the total benefits, including economic, social and environmental benefits are well in excess of the costs of the works.

The Surface Water Management Strategy has been developed to achieve this primary goal through a program of works, the costs of which are well exceeded by the expected economic, environmental and social benefits.

The Goulburn Broken CMA has developed a number of sub-goals for the Surface Water Management Strategy, which reflect many of the beneficial functions of the surface water management system. These sub-goals are set out in detail in the SIR Surface Water Management Implementation Plan.

The Goulburn Broken CMA has developed a number of sub-goals for the Surface Water Management Strategy.

7 Philosophy/Principles

Community involvement in the 2000 review was through a series of workshops to discuss the strengths and weaknesses of the Strategy, as well as through representation of members of the SIRIC on the review Steering Committee.

Community driven:

The success of the strategy is dependent on successfully obtaining the understanding, support and involvement of the community. The Goulburn Broken CMA recognises this and is ensuring that the community has ownership of the Strategy through its involvement in its development.

In developing the 1990 strategy, community input was invited through press advertisements informing the community of the purpose, content and seeking general commitment to the Strategy.

The 1995 review of the strategy involved consultation with landholders with the aim of:

- Obtaining community input to the refinement of the strategy;
- Informing the community on the purpose and content of the strategy and seeking general commitment to the Strategy in accordance with State and Federal Government requirements; and
- Seeking community support at a sub-catchment level for the Strategy to enable prioritisation of the sub-catchments.

The level of community support in each drainage area was reassessed in 2000, prior to the current review of the strategy. Community involvement in the 2000 review was through a series of workshops to discuss the strengths and weaknesses of the Strategy, as well as through representation of members of the SIRIC on the review Steering Committee.

Provide every property with an appropriate drainage service:

The general design philosophy of the strategy is to provide every property in the SIR with an appropriate standard of drainage service. One of the most significant changes to occur in design philosophy over the last 10 years has been the reduction in design flows used to define the level of service for drainage. This reduction is from the run-off caused by a 75mm summer rainfall event which has an average recurrence interval (ARI) of approximately 1 in 10 years to the run-off from a 50mm summer rainfall event which has approximately a 1 in 2 year ARI. This change has resulted in a significant reduction in design flow and construction costs with only a small reduction in the benefits to be provided.

There has also been a move toward increasing run-off retention times within catchments that in turn assists with removal of nutrients and reduces downstream impacts. These increases in retention times have been achieved through greater utilisation of flow restricting structures and natural features within catchments such as retarding basins, existing and constructed wetlands and rock weirs.

Construct drains within their natural catchments:

An underlying philosophy for all the new works for the Surface Water Management Strategy is that drains are to be constructed within their natural catchments and the total catchment is to be considered. This was not always done in the past, although non-adherence to this principle did enable intense irrigation areas to be drained more economically and quickly. The philosophy of considering the total catchment may initially cost more, but it avoids any potential standard of service difficulties associated with meeting future requests for drainage in the upper catchment.

Maximise environmental benefits:

The strategy will maximise environmental benefits from an integrated surface water management system through the protection and enhancement of remnant wetlands by the:

- Reinstatement of appropriate wetting regimes;
- Reductions in accessions to groundwater;
- The reclamation of waterlogged land by reducing watertable levels: and
- Prevention of waterlogging and associated degradation of remnant dryland vegetation through provision of appropriate drainage.

The use of the environmental assessment procedures contained in the strategy will enable the identification and protection of habitat, in particular threatened species of native flora and fauna. The strategy will thus ensure the protection of remnant vegetation and facilitate maintenance and enhancement of wetlands. The detailed assessment procedures used as part of the Strategy implementation ensure that adequate consideration is given to environmental issues during the planning phase of integrated surface water management schemes.

Projections for the next ten years indicate that almost all the remnant vegetation and wetlands in the catchments will receive a benefit as Primary and CSDs are installed to serve most of the region. Details of past and projected wetland and remnant vegetation protection are shown in Table 7-1.

The strategy will ensure the protection of remnant vegetation and facilitate maintenance and enhancement of wetlands.

Table 7-1 - Expected Wetland and Remnant Vegetation Protection

Period	Remnant Vegetation to be Protected (ha)	Wetlands to be Protected (ha)	Trees to be Planted No.
1995 - 2000	3,313	3,646	-
2001 - 2005	19,200	3,750	75,000 covering 750ha
2006 - 2010	12,200	5,750	75,000 covering 750ha

Source: O'Connor, 2001.

The three principal water quality issues in the Goulburn Broken Catchment are irrigation salinity, dryland salinity and high nutrient levels.

Identifying and protection of Aboriginal heritage sites:

The principle adopted in implementing the strategy is that heritage sites are respected and identified.

Heritage assessments along the proposed alignments for works and over the surrounding areas are a crucial part of the overall SIR Surface Water Management Strategy. Implementation staff work with local Aboriginal communities to identify these sites and agree on the measures to ensure their preservation.

The strategy has been the major mechanism of identifying and documenting these sites in the SIR. Prior to implementing the strategy, the extent of aboriginal cultural and heritage sites was poorly documented.

Maximise social benefits:

The strategy will provide significant social benefits in addition to the environmental and economic benefits, which have been identified previously.

The works will reduce the risk for future investment in the catchment and improve optimism through the removal of local impediments to development. Provision of surface drainage will lead to increased investment in farm improvements such as laser grading and re-use systems, improved pastures and investments in farm assets. The provision of drainage in some other areas of the region has also led to significant changes in enterprise with the introduction of higher value agricultural crops.

The implementation of the strategy will also improve labour and resource efficiency allowing landowners more time for family and community activities.

The local aesthetics and living environment will be improved with the protection of vegetation from the impacts of salinisation and waterlogging. Farmland, which previously remained waterlogged with stagnant water and provided a breeding ground for mosquitoes, will be able to be drained by the implementation of the strategy.

As a by-product of the strategy implementation, the reduction in salinisation and waterlogging will reduce road infrastructure deterioration and therefore improve road standards and safety.

Minimise downstream impacts:

The implementation of the Surface Water Management Strategy will also include measures to minimise downstream impacts by utilising natural features for retention, water harvesting, nutrient retention through farm re-use, the controlled outfall of runoff from farms into drains, regional drainage reuse and the establishment of constructed wetlands for filtration and erosion control.

In the design of new drainage systems, consideration will be given to the range of flows and conditions under which the drain is required to operate to ensure that the works do not create or transfer flooding

problems to new locations. The sizing of the drain, and associated structures, will be based on the adopted design standard with the objective of the drain capacity 'mimicking' that of the natural depression for the design rainfall event. Achieving this objective is dependent upon the availability of sufficient retardation within the catchment. In more significant rainfall events the design objective is for the catchment outfall to perform as if no drain exists. Again, it is the intention of this objective to minimise flooding impacts on downstream communities.

Integral to the Surface Water Management Strategy are measures to control water quality in the discharges to natural watercourses. The three principal water quality issues in the Goulburn Broken Catchment are irrigation salinity, dryland salinity and high nutrient levels. The strategy aims to control all of these impacts.

Monitoring of strategy outputs and outcomes:

Reducing nutrient and salt loads will be managed through drain management plans, drainage reuse and flow management as detailed in previous sections. Targeted monitoring will form a key role in the collection of data for drain management.

Monitoring of water quality from the SIR is crucial to the management of existing surface water management systems and future development of the strategy. Data collected from throughout the region is used to assess the performance of the SIRLWMP and its water quality related programs.

Current monitoring programs will continue to be enhanced to effectively support implementation of the Surface Water Management Strategy. These programs will be developed to include enhanced analysis techniques, environmental health, biocides (pesticides and herbicides), pathogens, and biological monitoring techniques.

Cost Share based on beneficiary pays:

Philosophically, there are significant reasons for the irrigation community, local, State and Federal Governments and government agencies to invest in surface water management infrastructure. These include:-

- Reduced risk and increased confidence in private and government investment in farm and regional infrastructure.

- Increased focus on water use efficiency as water resources become more precious and water use efficiency is used as an irrigator and industry performance benchmark.

- Good water quality, nutrient management and biodiversity outcomes including the preservation and enhancement of environmental features are now key community and government expectations of a Surface Water Management Strategy.

Farmland, which previously remained waterlogged with stagnant water and provided a breeding ground for mosquitoes, will be able to be drained by the implementation of the strategy.

- Increased understanding and visible examples of benefits - landowners have become more aware of the multi-objective outcomes that can result from a well-implemented surface water management system.

- Increase in knowledge and importance of environmental issues - public awareness of world-wide environmental degradation issues, and the high profile of the Natural Heritage Trust, Landcare, Bushcare and Rivercare in Australia, create the political demand for strategies and processes for dealing with land and water degradation and loss of habitat and biodiversity.

- Increased vision and knowledge of successful outcomes - visible examples and high-profile publicity of successful drainage projects are readily observable in the catchment, creating demand for improved surface water management.

- Access to irrigation water entitlement - the limited availability and increased demand for additional water for irrigation resulting from water entitlements being separated from land and transferable, and the MDBC cap on diversions from rivers has lead to increased demand for drainage diversion water through regional drainage re-use.

- Better community and political attitude to drainage -The physical drainage works are just one of the tools in the catchment package needed to improve surface water management. The strong emphasis is now to describe all surface water as a resource that can be managed effectively and positively. The multiple environmental, productivity, social and financial outcomes expected of this Strategy promote the integrated management of the resource. In the past the term "drainage" promoted negative connotations relating to "dirty" or "waste" water, downstream impacts and reducing value of wetlands. This is not the case if the current whole of catchment approach to the total package of initiatives is considered.

8 Environmental Impacts

The SIR Surface Water Management Strategy has been developed to enhance the environment and is consistent with Commonwealth and MDBC policy and Strategy development including the National Water Quality Management Strategy, the MDBC Water Quality Policy and the MDBC Algal Management Strategy. The strategy will be implemented such that the standards and procedures developed by the environmental regulators are at least met and in many cases exceeded. The acts and regulations administered by these regulators and providing the foundation of any environmental actions under the Strategy include: -

- The Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)
- National Water Quality Management Strategy
- NSW Environmental Planning and Assessment Act 1979
- MDBC Algal Management Strategy
- Planning and Environment Act 1987
- MDBC Water Quality Policy
- Victorian State Environment Protection Policy Waters of Victoria
- Victorian Nutrient Management Strategy for Inland Waters
- Ramsar Convention
- Victoria's Biodiversity Strategy
- Public Land Classification
- Water (Irrigation Farm Dams) Act 2001

The strategy also recognises other legislation, policy and programs dealing with environmental aspects that need to be addressed during the development of integrated surface water management schemes. These include:

- Water Act 1989
- JAMBA and CAMBA
- Catchment and Land Protection Act 1994
- Directory of Important Wetlands in Australia
- Victoria Planning Provisions (VPP's)
- Regional Catchment Strategies
- Flora and Fauna Guarantee Act 1988
- Regional Vegetation Plans
- Heritage River Planning
- CMA Business Plans

The strategy recognises that the development, maintenance and operation of an integrated surface water management system involve a number of activities and aspects that could impact on the surrounding environment.

Without the implementation of an integrated surface water management system, activities associated with the provision of surface drainage such as the construction of new drains, maintenance of existing drains and the operation of the drainage system could have adverse environmental consequences. The strategy provides for the development, maintenance and operation of an integrated surface water management system involving a number of activities and aspects that will:

- Reduce water salinity and salt load downstream;
- Reduce nutrient concentration and load downstream;
- Reduce silt export;
- Reduce Loss of wetlands and biodiversity;
- Protect native vegetation;
- Protect heritage sites and values; and
- Protect the water resource to the region.

Implementation of the Surface Water Management Strategy will be managed throughout its design, construction and operation and maintenance activities to maximise the overall environmental benefits being achieved.

9 Responsibilities

The responsibility for the development and implementation of the Surface Water Management Strategy relies on the ongoing support of government, government departments and agencies and the community. The key stakeholders involved in the development and implementation of the SIR Surface Water Management Strategy include the Catchment Management Authorities (both Goulburn Broken and North Central) through the SIR Implementation Committee (IC) and its Surface Drainage Working Group, G-MW, NRE, local government, and the community.

The management organisation structure for the SIR Catchment Strategy is shown in Figure 9-1.

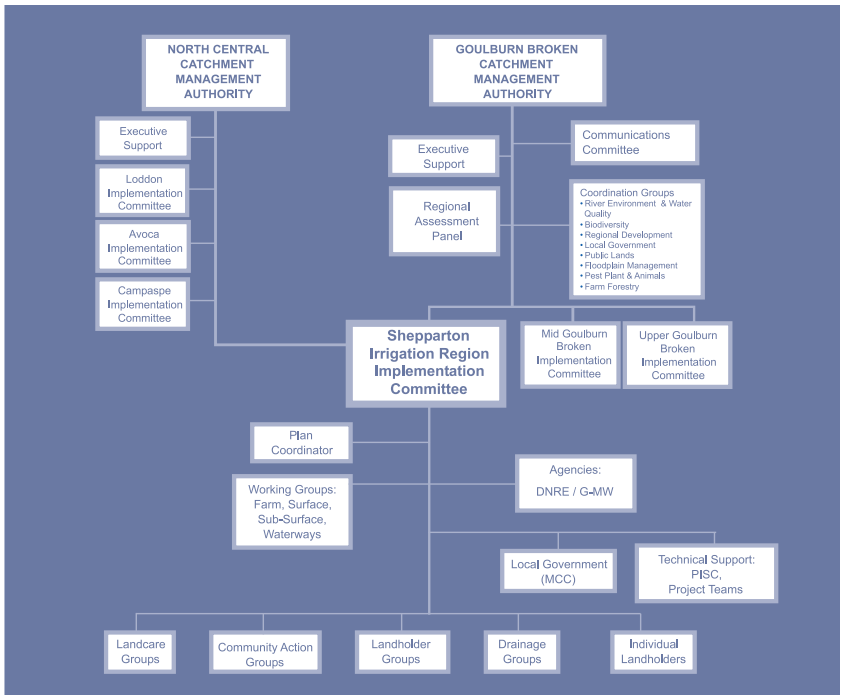
The involvement, and enthusiasm, of Community groups is necessary for successful implementation of community surface water management systems given that they are the primary beneficiaries and the systems cross their property boundaries. Community groups also fund an equal share with government for the construction of community surface water management schemes and fully fund the ongoing maintenance, operation and renewal costs of both primary and community surface water management systems.

G-MW has powers under the Water Act to construct, operate, maintain, and collect rates for drainage systems. G-MW has a responsibility to address drainage issues that arise as a result of the construction and operation of the irrigation channel system and the legislative power to construct and operate drainage systems.

G-MW is also a referral authority for development proposals and provides advice on the impact of development proposals on its irrigation and drainage infrastructure, and potential impacts on natural drainage lines.

NRE comprises a number of Divisions with a range of responsibilities. NRE manages the implementation of the SIR Catchment Strategy on behalf of the CMAs. NRE is also responsible for the environmental management of wetlands and flora and fauna and the management of State Forests and other public land.

Figure 9-1 Management Structure for Implementation of the SIR Catchment Strategy



Both State and Federal Governments provide funds for implementing programs identified within the Strategy, and furthering of research into surface water management.

On behalf of the MDBC, NRE administers the Victorian component of the MDBC Salinity and Drainage Strategy and is also a referral authority for development proposals.

The Environmental Protection Authority (EPA) is the State Government agency responsible for the protection of the environment in Victoria. The role of EPA in surface water management is currently being clarified. To date, EPA has undertaken an overseeing role and has shown a particular interest in point source discharges such as dairy effluent. In the future EPA may be involved as an auditor and in planning and monitoring.

Detailed roles of these and other authorities are provided in the SIR Surface Water Management Strategy Implementation Plan.

Local government is primarily responsible for the administration of planning controls. Planning controls limit the destruction of native vegetation and control the construction of earthworks that modify surface drainage patterns. As a result, the planning permit approval process plays a central role in ensuring all relevant issues are addressed in the design of new surface water management systems. Local government also contributes toward the cost of implementing and maintaining the Surface Water Management System.

While local, State and Federal Government agencies have administrative and legislative responsibilities for drainage, the regional communities play a vital role in providing the drive that is necessary for the successful implementation of all drainage projects.

There are also a number of influences on the strategy, which are external to the Region. The following organisations are key influences on the Strategy:

- Both State and Federal Governments provide funds for implementing programs identified within the Strategy, and furthering of research into surface water management. Programs such as the Working Nation Program, National Action Plan and the Natural Heritage Trust provide funds for works that not only benefit the local community, but also those within the state and basin-wide community through flow-on effects. Greater economic output of the region is reflected by the increase in yields and productivity resulting from surface water management programs.

- The MDBC promotes, co-ordinates and integrates planning and management for the sustainable use of land, water and environmental resources across the Murray Darling Basin. The MDBC oversees the management of water quality issues relating to drainage in the Murray River and provides advice on the allocation of funds under the Murray Darling 2001 component of the NHT Program.

- The Victorian Government is accountable to the MDBC for the Murray River impacts under the MDBC Agreement and programs.

10 Regional Surface Water Management Tools

In developing the Surface Water Management Strategy, a number of essential components or management tools of surface water management were integrated. These include:

10.1. Drainage Infrastructure

Drainage infrastructure is provided by a mix of Primary Drains, CSDs, Water Harvesting Systems and Drainage Course Declarations.

Primary Drains:

Previously known as arterial drains, Primary Drains are owned, operated and maintained by G-MW. Designed to a consistent standard, the full cost of construction of new Primary Drains is generally met from both State and Federal Government funds with contributions from local government and G-MW. Local government has contributed a substantial proportion of the cost of building road structures, and also pays 17% of the operation and maintenance costs of all drains built under the strategy.

While the proportion of government funding for the construction of Primary Drains differs from that of community drains, the level of government support has been based on the assumption that the entire surface water management system will be built, and that the community will contribute its share by building community drains soon after drainage outfall becomes available from the Primary Drain. Costs associated with the operation, maintenance and replacement of the primary drains are provided by G-MW customers within the drainage service.

The design and construction of Primary Drains requires extensive community and landowner consultation.

Primary Drains are designed in accordance with "Primary Surface Water Management Schemes, Guidelines for Design" which is periodically updated to include current best practice.

Community Surface Drains:

The total construction cost of CSD schemes has historically been lower than the cost of Primary Drains of equivalent capacity. However, the construction cost of new CSDs has been increasing as more design features, that help to improve the sustainability of each drain and reduce maintenance costs, have been adopted. The construction costs and the appearance of new CSDs are now closer to those of new Primary Drains of similar capacity.

The government currently funds 90% of the survey and design costs for CSDs. Government also funds 50% of the construction cost. The cost difference is funded by the landowners directly served by the drain, local government and G-MW. The community must also pay the annual operating and maintenance costs for the

The government currently funds 90% of the survey and design costs for CSDs. Government also funds 50% of the construction cost.

Community involvement in the initiation and implementation of Community Surface Water Management Systems is also critical to the success of the strategy.

drain and fund future replacement. Local government has contributed a substantial proportion of the cost of building or upgrading road structures to accommodate new surface drains.

Experience with community surface drainage groups has shown that there is a greater probability of successful implementation if community drains are less than 10km in length. Consequently the maximum practical length of community drains is around 20km or about 30 landowners. The support and co-operation of landowners and community interest are seen as key factors in the initiation and long term viability of community drains.

Community involvement in the initiation and implementation of Community Surface Water Management Systems is also critical to the success of the strategy. Community groups are responsible for the initiation of individual Community Surface Water Management Systems, and therefore are involved in the feasibility, design, and construction phases.

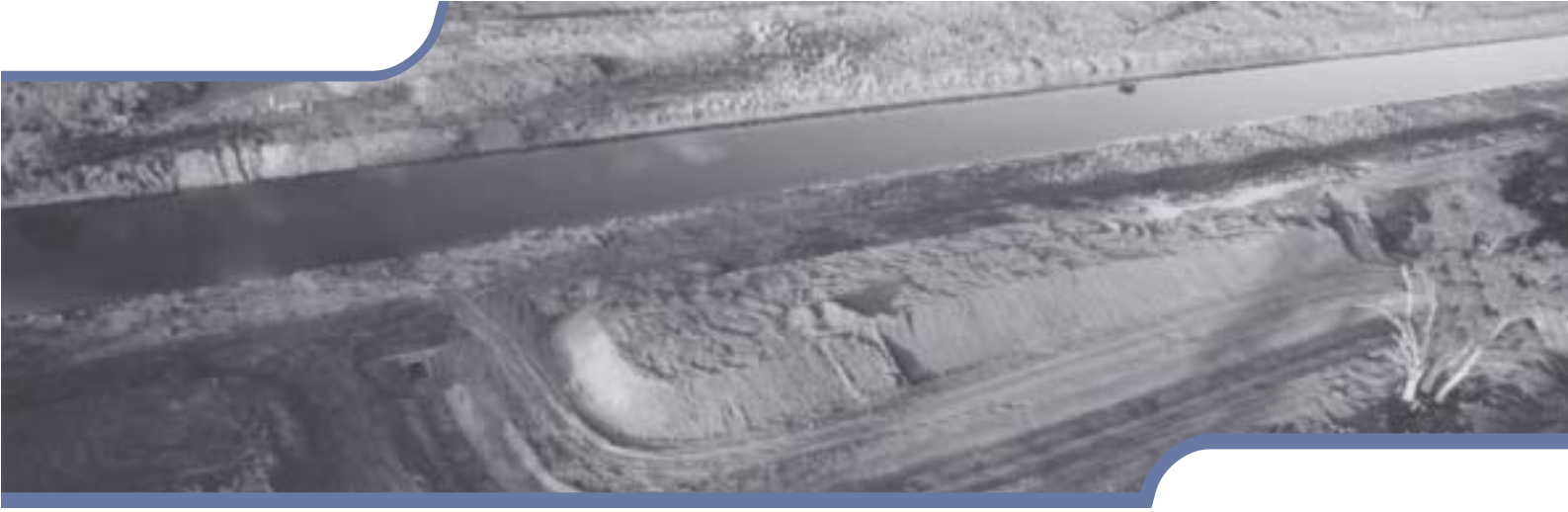
The process of implementing CSDs has many positive outcomes. One of the most positive is the increase in understanding of a range of surface water management issues amongst the community. This gains an appreciation of the trade off between level of service and construction cost, the need for a catchment-wide perspective and the problems associated with maintenance.

CSDs are designed in accordance with the "Community Surface Water Management Schemes, Guidelines for Design" which is endorsed by the Community Surface Drainage Coordinating Committee and updated regularly The guidelines allow each community group to have some flexibility to vary the design standards to suit the particular needs of their catchment.

Water Harvesting Systems:

In some sub-catchments, the concept of water harvesting has been included in the strategy. Similar to farm drainage reuse but on a larger scale, and dealing with mainly irrigation induced rainfall runoff, the level of protection that can be provided at a reasonable cost is very limited. This type of system is only proposed for areas with low irrigation intensities that are remote from suitable outfall, where suitable outfall is limited by potential environmental impacts, or where natural drainage can be provided for some rainfall events.

The introduction of an Irrigation Farm Dams amendment to the Water Act 1989 may have significant impact on these proposals. The legislation will require landowners constructing storages with volumes greater than 10ML per 100 ha of irrigated land on their property in the catchment to purchase a water entitlement for the additional volume.



Drainage Course Declarations:

The Strategy also includes the use of Drainage Course Declarations (DCDs) along natural drainage lines to facilitate drainage by clearing the waterway of non-natural obstructions. The removal of obstructions from Declared Drainage Courses are generally funded 50:50 between the landowner and government.

Pumping into G-MW channels:

While the practice of removing excess surface water from irrigated farmland by pumping into G-MW channels as an interim measure is included in the Surface Water Management Strategy, this practice is only allowed in special circumstances and where other forms of drainage are impractical.

10.2 Associated Works and Measures

Drain flow reduction:

To minimise the downstream impacts the Strategy contains three important drain flow reduction initiatives.

A. Drain management is seen as an important surface water management tool in the proactive control of drain flows and reducing nutrients outfalling to natural waterways. To limit adverse impacts on downstream water quality, Drain Management Plans will be prepared for each individual drain catchment for all drains in the SIR.

These plans will provide information on the operation of the drain including:

- Maintenance of the vegetated waterway and structures;
- Allowable discharge points;
- Known point source discharges involving formal agreements;
- Land status and approved usage;
- Asset type and condition;
- Drainage diversion agreements;
- Wetland Management Plans;
- Other environmental requirements; and
- Frequency and purpose of monitoring.

B. The implementation of nutrient harvesting by diversion of water from drains has been encouraged as part of the Goulburn Broken Water Quality Strategy as a means of achieving nutrient load reduction. As part of the SIRSWMS, Drain Diversion Plans / Strategies will be included as part of Drain Management Plans.

C. Farmers are encouraged to develop Whole Farm Plans to provide better farm layouts including improved irrigation management, laser grading, farm drains and irrigation tailwater re-use systems in the pursuit of improved irrigation efficiency. The SIRLWMP farm program complements the drain construction program and is an integral part of the Surface Water Management Strategy.

The removal of obstructions from Declared Drainage Courses are generally funded 50:50 between the landowner and government.

More irrigators now view water flowing in drains as a valuable resource.

Increased Water Prices:

Irrigators are showing an increasing awareness of the value of water and the need to improve water use efficiency and have become more aware of the environmental impacts of irrigation. This has been reinforced by the introduction of Transferable Water Entitlements, coupled with the sequence of drier than average years and the cap on diversions from streams in the Murray Darling Basin. More irrigators now view water flowing in drains as a valuable resource. The volume of water being reduced from drains and therefore demand for permits to divert water from drains has been increasing. This has resulted in an increasing demand for structures that facilitate diversion of drainage flows to farms to be incorporated in new drains.

10.3. Modifications to Existing Systems

New surface drains have progressively been constructed in the SIR over many decades. Community expectations of drainage systems with respect to the level of service (hydraulic performance), incorporation of servicing of wetlands and other environmental features have changed significantly over that time.

Although the servicing of currently undrained land is the primary focus of the Strategy, the Shepparton Surface Water Management Strategy includes a program to review the older drainage systems and to investigate the incorporation of features now required by the community.

This modification of existing drains (retrofitting) to incorporate current design to deliver a better mix of beneficial outcomes (i.e. nutrient management and environmental enhancement) than drains built in the region over preceding decades has been included where:

- It is required to provide outfall for new drains serving undrained areas; or
- Where it is required to provide or restore environmental features; and
- Can be justified when considering the financial, social and environmental benefits.

Drain retrofitting will require further investigation before a detailed program can be established. Further work is required to establish appropriate modification with respect to hydraulic features such as construction of rock weirs, and environmental features including constructed wetlands and drain revegetation. The estimated cost and program of drain retrofitting from 2004/2005 through to 2008/2009 and beyond will be determined following that review.

10.4. Procedures and Design Features

The SIR Surface Water Management Strategy defines a number of procedures and design features, which are part of the strategy implementation. Additional to features detailed in other sections of this document, these include Environmental and Archaeological Heritage Assessment, flow retardation structures, environmentally sensitive construction techniques, Drain Management Plans to facilitate nutrient management, and water quality monitoring. As the strategy is implemented, consultants and agency staff will undertake research and experiments to continue updating Current Best Practice.

10.5 Monitoring

Monitoring is essential in the provision of data for management of the Surface Water Management Strategy. Parameters monitored include water quantity, water quality, wetland health, vegetation health, land use change and economic benefits as well as biodiversity and social outcomes.

In addition to meeting legislative and other agreed reporting requirements, the data collected from the water monitoring programs allows practitioners to develop their knowledge and to improve design, construction and management techniques. In addition, the strategy recognises the importance of monitoring wetlands and remnant vegetation under the Environmental Quality Mandatory Monitoring Program (EQMMP) (Nolan ITU, 2000). The EQMMP is part of a Statewide environmental monitoring strategy to determine impacts of salinity management plans on wetlands and remnant vegetation.

The Surface Water Management Strategy recognises further development of monitoring of wetlands and remnant vegetation is required such that areas affected by the construction of surface drains can be assessed against those in the areas without drainage, to measure change, in particular, the degree of enhancement being achieved through the implementation of the strategy.

Monitoring is essential in the provision of data for management of the Surface Water Management Strategy.

11 Regional Surface Water Management Areas

For management and reporting purposes the strategy geographically divides the region into 23 Drainage Areas. These areas are generally based on natural drainage system catchments with outfall to major waterways. Where there were a number of small drain catchments with independent outfall to the same watercourse, these catchments are grouped to form a Drainage Area based on that watercourse. Some of the larger catchments have been segmented into more manageable size areas to facilitate implementation of the strategy.

The Drainage Areas adopted for the Strategy are depicted in Figure 1.1 and the size, area requiring drainage and the area of wetlands in each catchment is shown in Table 11-1. The wetland areas equate to about 3 % of the SIR or 6 % of the undrained portion of the SIR.

Table 11-1 -Area, Area Requiring Drainage & Area of Wetlands in all Catchments.

Catchments	Total Catchment Area (ha)	Area Requiring Drainage as at 2000 (ha)	Area of Wetland in the Catchment
Lockington	20,440	3,620	11
Bamawm	11,570	1,550	41
Wharparilla	9,470	3,290	210
Campaspe	11,180	7,400	99
Strathallen	9,240	4,360	61
Deakin	46,230	19,320	661
Corop Lakes	48,620	34,450	7,030
Tongala	14,930	2,160	526
Mosquito	45,990	24,200	1,620
Coram	7,100	1,660	51
Wyuna	22,750	12,910	435
Rodney	17,230	4,200	101
Coomboona	15,360	6,870	262
Ardmona	9,420	3,330	74
Toolamba	8,740	1,470	641
Kialla	17,110	4,930	248
Shepparton	9,800	540	176
Tallygaroopna	37,110	27,300	647
Invergordon	19,180	5,480	100
Kaarimba	8,900	5,830	199
Barmah/Nathalia	55,200	26,940	817
Strathmerton	33,630	6,510	118
Muckatah	40,040	33,190	1,010
Total	519,240	241,510	15,138

A number of drainage options comprising mixes of Primary and CSDS and natural flow paths using Drainage Course Declarations have been developed for each Drainage Area and the relative benefits, costs and priorities determined. The community has been consulted and one option has been recommended for adoption in each catchment.

Primary Drains are constructed to provide the outfall for community groups to construct their drainage schemes. The extent of the primary drain in any particular catchment has been determined taking into account the:

- Area and length of the catchment;
- The shape of the catchment;
- Configuration of the depression network within each catchment;
- Number of landowners ;
- The layout of the drainage lines and relative location of property boundaries;
- Catchment topography;
- Land use;
- Property size;
- Road and channel infrastructure;
- Tributary drains;
- Environmental issues;
- Economics of drain construction;
- Extent of water trading into or out of the catchment; and
- Social issues.

Extensive community consultation is undertaken to ensure that the best possible outcome is attained for both the design and construction of Primary Drain development.

Primary Drains are constructed to provide the outfall for community groups to construct their Surface Water Management Schemes.

12 Works
- What is to be Done on the Ground?

In the ten years to June 2000, the works constructed have provided a service to an additional 44,530ha of land within the SIR.

The initial Surface Drainage Strategy was included in the SIR Land and Water Management Plan developed by the regional community through the Goulburn Broken Salinity Pilot Program Advisory Council in 1989. At that time, of the 519,240 ha in the SIR, 336,900 ha were not serviced by surface drains.

A review of the Surface Drainage Strategy in 1995 found that of the 336,900 ha, 50,860 ha did not require a drainage service because the area was not irrigated, had direct access to a stream, or was serviced by new drains. This left approximately 286,040ha requiring improved drainage service at that time. Between 1995 and 2000 a further 44,530ha has been drained, leaving 241,510 ha to be addressed by this revised Strategy.

The 1995 review included extensive consultation involving the community, government agencies and community representatives overseeing natural resource management in the SIR. The review set out the areas served and proposed routes of new and remodelled Primary Drains, CSDs)and Drainage Course Declarations (DCDs) to service the 286,040 ha requiring an improved drainage.

In the ten years to June 2000, the works constructed have provided a service to an additional 44,530ha of land within the SIR. This represents 16% of the 286,040ha of land requiring a drainage service at the commencement of the strategy.

Although the servicing of undrained land is the primary focus of the Strategy, other issues including monitoring, water quality, water use efficiency, retrofitting and on-farm aspects of the surface water management apply to the whole 519,240 ha of the Shepparton Region.

The Surface Water Management Strategy works program to service the remaining 241,510ha of irrigated land requiring a drainage service comprises:

- 189km of new G-MW Primary Drain (60%).
- 12km of G-MW Primary Drain upgrading (26%).
- 1,785km of CSD (83%).
- 3,630ha of water harvesting (100%).
- 562km of DCD (92%).
- upgrading works on the Broken Creek (20%).
- 41,900ha of wetlands and remnant vegetation to be protected.

(The figures in brackets indicate the proportion of the works remaining in 2000 compared to the 1989 strategy requirements):

A significant outcome of the works completed to date has been the direct and indirect protection of 3,313ha of remnant vegetation, and 3,646ha of wetland from unseasonal inundation.

The total estimated cost to finish implementing the Strategy at 2000 is $164.2

million of which $110 million is expected to be State and Federal Government funded. These government funded activities comprise $45.6 million for G-MW Primary Drain works and $64.4 million for community works. All financial figures are quoted excluding GST.

To ensure the on-going environmental benefits resulting from these works are realised and maximised, supporting follow-up works, strategies and agreements are undertaken and implemented.

The total estimated cost to finish implementing the Strategy at 2000 is $164.2 million of which $110 million is expected to be State and Federal Government funded.

Table 12-1 - Summary of Works Remaining in 2000

DRAINAGE AREA	AREA OF CATCHMENT (ha)	AREA REQUIRING DRAINAGE (ha)	AREA DRAINED 2000 (ha)	NEW PRIMARY DRAINS (km)	COMMUNITY DRAINS (km)	DRAINAGE COURSE DECLARATION (km)	DRAIN REMODELLING (km)	TOTAL COST (1999 $)	ENVIRONMENTAL FEATURES (ASSESSMENTS) (ha)
1 Lockington	20,440	5,400	1,780	0.0	46.8	120.0	0.0	$ 3,816,622	931
2 Bamawm	11,570	1,740	190	0.0	13.2	0.0	0.0	$ 894,960	225
3 Wharparilla	9,470	9,470	6,180	0.0	35.7	0.0	0.0	$ 2,420,460	710
4 Campaspe	11,180	7,400	0.0	2.3	58.6	20.0	0.0	$ 4,700,988	789
5 Strathallan	9,240	4,360	0.0	0.0	28.0	0.0	0.0	$ 1,898,400	567
ROCHESTER DRAINAGE AREA	**61,900**	**28,370**	**8,150**	**2.3**	**182.3**	**140.0**	**0.0**	**$ 13,731,429**	**3,222**
6 Deakin	46,230	21,210	1,890	23.0	157.6	15.0	7.0	$ 15,498,987	2,359
7 Corop Lakes	48,620	38,850	4,400	15.0	121.8	143.0	0.0	$ 13,206,815	7,150
8 Tongala	14,930	2,160	0.0	0.0	14.1	0.0	0.0	$ 955,980	7,206
9 Mosquito	45,990	34,120	9,920	27.5	230.6	56.0	0.0	$ 21,503,988	1,523
10 Coram	7,100	1,660	0.0	0.0	19.1	0.0	0.0	$ 1,294,980	83
11 Wyuna	22,750	14,340	1,430	0.0	133.8	0.0	0.0	$ 9,072,318	2,202
12 Rodney	17,230	10,680	6,480	0.0	61.3	0.0	0.0	$ 4,152,750	380
13 Coomboona	15,360	8,900	2,030	0.0	53.9	0.0	0.0	$ 3,654,420	782
14 Ardmona	9,420	5,730	2,400	0.0	25.7	0.0	0.0	$ 1,745,172	249
15 Toolamba	8,740	4,410	2,940	0.0	25.6	0.0	0.0	$ 1,735,680	2,691
CENTRAL GOULBURN DRAINAGE AREA	**236,370**	**142,060**	**31,490**	**65.5**	**843.4**	**214.0**	**7.0**	**$ 72,821,090**	**24,625**
16 Kialla	17,110	5,970	1,040	0.0	48.1	14.0	0.0	$ 3,485,745	2,240
SHEPPARTON SOUTH DRAINAGE AREA	**17,110**	**5,970**	**1,040**	**0.0**	**48.1**	**14.0**	**0.0**	**$ 3,485,745**	**2,240**
17 Shepparton	9,800	540	0.0	0.0	2.4	0.0	0.0	$ 162,720	354
18 Tallygaroopna	37,110	27,500	200.0	13.5	224.0	53.0	5.0	$ 18,786,840	2,230
19 Invergordon	19,180	5,480	0.0	0.0	24.4	0.0	0.0	$ 1,654,320	1,180
20 Kaarimba	8,900	5,830	0.0	0.0	51.0	0.0	0.0	$ 4,183,800	1,452
SHEPPARTON NORTH DRAINAGE AREA	**74,990**	**39350**	**200**	**14**	**302**	**53**	**5**	**$ 24,787,680**	**5,216**
21 Barmah/Nathalia	55,200	27,340	400	37.5	185.1	0.0	0.0	$ 20,249,780	3,291
22 Strathmerton	33,630	8,310	1,800	0.0	76.5	0.0	0.0	$ 5,186,700	1,925
23 Muckatah	40,040	34,640	1,450	70.3	147.4	141.0	0.0	$ 23,944,616	1,458
MURRAY VALLEY DRAINAGE AREA	**128,870**	**70,290**	**3,650**	**107.8**	**409**	**141**	**0**	**$ 49,381,096**	**6,674**
TOTALS	***519,240***	***286,040***	***44,530***	***189***	***1,785***	***562***	***12***	***$ 164,207,042***	***41,977***

13 Economics

The implementation of this strategy will lead to significant environmental, social and productivity benefits. These benefits have been quantified using the MDBC's Drainage Evaluation Spreadsheet Model (DESM) developed by Jacob and Hallows. The model evaluates the economic performance of the projects over a 50-year period using discounted cash flow methodology with a 5% discount rate.

The modelling indicated that the unfinished part of the strategy as at December 2000, has a benefit-cost ratio of 1.23 and a Net Present Value of $40 million. The benefit-cost ratio and the NPV have both fallen relative to the 1995 estimates. This is primarily due to the actual costs of building Primary and CSDs being relatively higher than those estimated in 1995.

Drainage scheme benefits taken into account include the agricultural benefits resulting from changed surface waterlogging and watertable conditions, salinity, and flooding. Also included are the road benefits from improved drainage, benefits to be derived from the reuse of drainage water and the benefits/disbenefits resulting from changed downstream salinity levels. Cost data includes the capital, operating, maintenance and renewals costs of the drainage schemes under evaluation.

The net benefits were determined on a "Without Project" versus a "With Project" basis and took into account variations in water use intensity and farming enterprise as a result of implementing drainage, as well as the rate of implementation.

The 1995 strategy made no allowance for conversion of newly drained land to support higher value production. Experience has since shown that some conversion of both mixed and dairy land to horticulture, and annual pasture to perennial pasture, are occurring with significant regional economic impacts. Over the 50-year evaluation period of the Strategy, it can be assumed that a net benefit at least equal to the salinity, waterlogging and flooding benefits, will be captured by land-use change as landholders learn to appreciate the potential productivity of the improved salinity and drainage conditions. This change in land-use will also be stimulated by intense institutional pressure for more efficient, high value use of irrigation water under conditions of increasing constraints on the supply of water for irrigation. In calculating the economic benefits of irrigation in the SIR, it has been assumed that land use change will lead to a doubling of the salinity, waterlogging and flooding benefits.

The break-even land-use change benefit is equal to 36% of salinity, waterlogging and flooding benefits. As this major land-use change is difficult to predict and requires specialised entrepreneurial skills to implement, the assumption is made to demonstrate the impact of such changes. The economic viability of some drainage schemes will depend on significant land-use change occurring over the life of the strategy. The change will be driven by economic imperative by farmers and supported by agency and industry input.

Table 13-1 outlines the discounted costs, benefits, Net Present Values (NPV) and Benefit Cost Ratios (BCR) for each of the 23 sub-catchments within the SIR's Surface Water Management Strategy. The data is in 1999 dollars and is based on the area to be served in 1995 and the works required to serve that area.

Table 13-1 also lists the catchments in ranked NPV and BCR order and shows the 1995 rankings.

Relative to the 1995 strategy report, both the program NPV and BCR have fallen in real terms from $85.44 million in the 1995 analysis (in 1999 $$'s) to $59.13 million in 2000. Similarly the overall BCR has dropped from 1.7 in the 1995 analysis to 1.24 in this analysis, similarly reflecting the increased costs for limited increase in benefits. These reductions reflect the change in costing, based on recent construction and implementation experience and incorporation of additional environmental features. For example:

A. The recognition that many of the very large, undrained catchments will require a greater proportion of Primary Drain relative to CSDs to enable effective and sustainable management of the total schemes and their outfalls, compared to the proportions anticipated in 1995.

B. The additional features built into the drain designs so that they are now a part of an integrated surface water management system, not just a conduit for drainage water have considerably increased the costs.

Significant benefits that have not been included in the analysis are the water quality/ nutrient reductions and the associated environmental and social benefits that the surface water management schemes facilitate. Those benefits are accounted for under the Water Quality Program of the Goulburn Broken RCS.

The updated economic evaluation concluded that the implementation of the Surface Water Management Strategy for the SIR is a cost-effective investment.

Table 13-1
Ranking of Drainage areas by NPV and Benefit Cost - $ millions (1999)

Sorted by NPV						Sorted by BCR			
Drainage area	Total Benefits $m	Total Costs $m	NPV 5% $m	2000 Order	1995 Order	Drainage area	BCR	2000 Order	1995 Order
Deakin	24.14	13.16	10.98	1	1	Invergordon	4.93	1	2
Strathmerton	9.39	4.42	4.97	2	4	Bamawm	2.94	2	3
Invergordon	5.57	1.13	4.44	3	6	Shepparton	2.77	3	1
Wharparilla	6.77	3.68	3.09	4	8	Coram	2.55	4	4
Tallygaroopna	17.15	14.75	2.4	5	11	Strathmerton	2.12	5	5
Campaspe	5.91	3.56	2.35	6	12	Wharparilla	1.84	6	6
Rodney	10.97	8.66	2.31	7	9	Deakin	1.83	7	8
Mosquito	35.19	33.13	2.06	8	3	Strathallen	1.68	8	7
Bamawm	2.59	0.88	1.71	9	14	Campaspe	1.66	9	10
Corop Lakes	18.81	17.31	1.5	10	5	Tongala	1.52	10	9
Coram	2.37	0.93	1.44	11	16	Ardmona	1.32	11	11
Barmah/Nathalia	18.49	17.09	1.4	12	10	Rodney	1.27	12	14
Ardmona	4.57	3.47	1.1	13	13	Tallygaroopna	1.2	13	22
Wyuna	11.1	10.11	0.99	14	7	Coomboona	1.16	4	13
Strathallen	2.13	1.27	0.86	15	18	Wyuna	1.1	15	12
Coomboona	3.55	3.06	0.49	16	17	Corop Lakes	1.09	16	18
Tongala	1.12	0.74	0.38	17	21	Barmah/Nathalia	1.08	17	20
Shepparton	0.55	0.2	0.35	18	22	Mosquito	1.06	18	21
Kialla	3.51	3.35	0.16	19	19	Kialla	1.05	19	16
Lockington	5.39	5.4	-0.01	20	15	Lockington	1	20	17
Muckatah	23.64	24.47	-0.83	21	2	Muckatah	0.97	21	19
Toolamba	2.8	3.66	-0.86	22	23	Toolamba	0.77	22	23
Kaarimba	2.42	3.29	-0.87	23	20	Kaarimba	0.73	23	15
Total	218.13	177.72	40.41 NPV			Overall	1.23 BCR		

14 Works Prioritisation

14.1. Primary Drains and other Public infrastructure

In order to establish priorities for Primary drainage works and other public infrastructure associated with drainage across the catchments within the SIR, the strategy includes a revised prioritisation method.

During 2000 a review of the method previously used to prioritise works was undertaken. As part of this review a range of different parameters and weightings for the Surface Water Management Strategy Review were assessed. The system adopted was a variation on the SPAC system used in 1995. The revised system, however is simpler, involves a smaller number of parameters and places heavier weighting on environmental goals, at the expense of financial goals. These changes reflect the change in community expectations and values over the last five years.

Coincidentally, these proportions, which were independently developed, are the same as those adopted for developing the Loddon-Murray Surface Water Management Strategy.

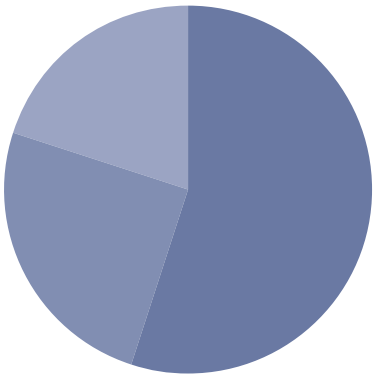
To assess the relative priority for implementing Primary Drains in each catchment these weighting were applied to each drainage area by using the following formula:

Rating Index = 0.55 *npv/NPV + 0.25 * e/E + 0.20 * c/C

where npv = NPV ($/ha) of an individual drainage area
NPV = Total NPV ($/ha) for all schemes
e = Environmental rating for individual scheme
E = Sum on environmental rating for all schemes
c = Community response rating for individual scheme
C = Sum of the community response ratings for all schemes

The priorities based on the rating Index for the catchments, which were identified as still requiring Primary Drains to be constructed in 2000, are presented in Table 14-1.

The parameters used and the weightings adopted are as follows:



Economic Factor 55%
Environmental Factor 25%
Community Response Factor 20%

Table 14-1 - 2000 Prioritisation by Rating Index for Public Works (Primary Drains)

Drainage Area	Area to be Drained ha	NPV $million	npv/ha	Environmental Rating	Community Response Factor	Rating Index
Weighting Parameter			0.55	0.25	0.2	*100
Deakin	21,210	11.0	518	7	3	10.3
Mosquito	34,120	2.1	60	9	3	6.9
Campaspe	7,400	2.4	318	1	3	6.3
Corop Lakes	38,850	1.5	39	10	2	6.0
Barmah/Nathalia	27,340	1.4	51	6	3	5.7
Muckatah	34,640	-0.8	-24	6	3	5.0
Tallygaroopna	27,500	2.4	87	1	3	4.2
Kialla [(2)]	5,970	0.2	27	1	0	0.6
Lockington [(2)]	5,540	0.0	-2	0	0	0.0
TOTALS	202,570	20.0	1074	41	20	

NOTES

[1)] Catchments with only Community Surface Drain works remaining are not listed.

[2)] Only Drainage Course Declarations to be completed.

14.2 Community Drains

The priority and order of construction for CSDs will be dependent on landowners facilitating drains in their respective catchments and the funds they are able to privately access for that purpose, however, subject to continued government support, a 2020 completion is considered to be realistic.

15 Ten Year Works Program

The revised 10-year program to implement the Primary Drain and Associated works program is outlined in Table 15-1.

The construction of CSDs will occur in a relatively random manner as outfall become available, landowners secure funds and then agree with their neighbours, and others on their drain, to proceed with planning and construction.

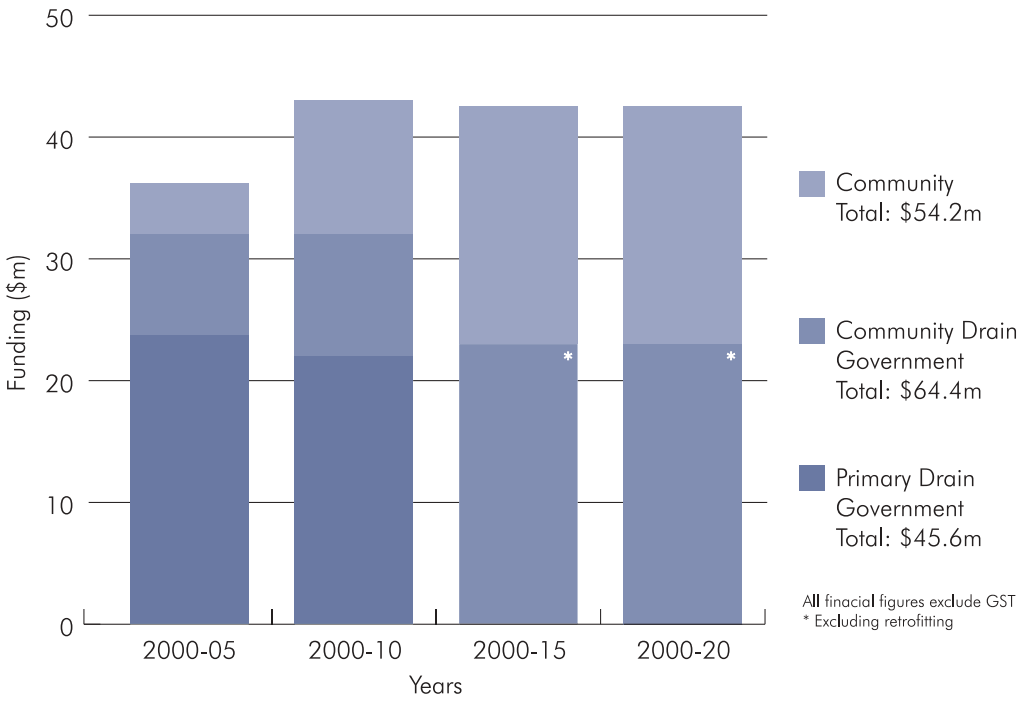
Table 15-1 Proposed Works Program

	Year									
Catchment	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
Lockington DCD										
Lockington Remodel										
Campaspe Primary Drains										
Campaspe DCD										
Deakin Primary Drains										
Deakin DCD										
Deakin Remodel										
Corop Lakes Primary Drains										
Corop Lakes DCD										
Mosquito Primary Drains										
Mosquito DCD										
Wyuna Primary Drains										
Wyuna Remodel										
Rodney Remodel										
Ardmona Primary Drains										
Kialla DCD										
Tallygaroopna Primary Drains										
Tallygaroopna DCD										
Tallygaroopna Remodel										
Barmah/Nathalia Primary Drains										
Muckatah Primary Drains										
Broken Creek Weirs										
Drain Retrofitting										
Drain Monitoring										
Drain Diversion Strategy										
Diversion (Metering/Management)										
Expected Expenditure ($'000)	**$4,619**	**$5,572**	**$5,414**	**$6,038**	**$5,295**	**$5,257**	**$4,474**	**$3,976**	**$3,502**	**$2,585**

16 Funding

At current levels of funding, the strategy capital works program will be completed in 2020. To achieve this target the cash flow would need to be as shown in Table 16-1. Many of the CSDs cannot be constructed until their Primary Drain outfalls are constructed. Meeting this completion time frame will therefore require Government funding of at least $32 million per five year period over the next 10 years and a total of $110 million being available over the next 20 years to ensure completion of all works under the strategy. This will ensure all Primary Drains are completed by 2010.

Table 16-1 - Proposed Funding



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